The Book and Paper Group
ANNUAL

VOLUME THIRTY-NINE 2020

The American Institute for Conservation of Historic and Artistic Works

AIC BPG Book and Paper Group

american institute for conservation

Preserving Cultural Heritage

The Book and Paper Group
of the
American Institute for Conservation of Historic and Artistic Works

2020

Chair
SARAH REIDELL

Program Chair
ELIZA SPAULDING

Assistant Program Chair
ANDREA KNOWLTON

Secretary/Treasurer
SAIRA HAQQI

2020 – 2021 Publications Committee
BRENNA CAMPBELL (CHAIR), MELISSA TEDONE SARAH REIDELL (EMERITUS)
HENRY HEBERT (EMERITUS), JUSTIN P. JOHNSON, KATHERINE KELLY, DIANE KNAUF,
KIMBERLY KWAN, MICHELLE SMITH, MARIA OLIVIA DAVALOS STANTON

THE BOOK AND PAPER GROUP

ANNUAL

VOLUME 39 2020

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

Abstracts presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

Summaries of discussion groups at the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

The Book and Paper Group Annual

Managing Editor
JUSTIN P. JOHNSON
University of Washington Libraries
Seattle, WA

Assistant Editor
KIMBERLY KWAN
Northwestern University Libraries
Evanston, IL

Editorial Office: bpgannual@gmail.com

American Institute for Conservation of Historic and Artistic Works
727 15th Street NW, Suite 500
Washington, DC 20005
info@conservation-us.org www.conservation-us.org

JAN BURANDT

PAPER—It Is More Than That: A Syntax for Thorough Descriptions

INTRODUCTION

The Menil Drawing Institute building opened in the fall of 2018 after many years of planning. It sits intentionally near the center of the more than 30-acre campus of the Menil Collection. The entire building is dedicated exclusively to drawings. The paper conservation studio is located in its Northeast corner; there is a curatorial suite, visiting scholar's offices and courtyard, generous storage for drawings, and offices for a dedicated registrar and art handler. It includes exhibition space, and at the heart is the Janie C. Lee Drawing Study Room.

Every detail of the chapel-like room was thought through very deliberately, and during the planning, care was taken to design for diffuse raking light. Complete control of the lighting is possible, with capability of going from total darkness to a wide range of both artificial light and UV-filtered daylight from skylights at the sides and the center of the room. It offers an exquisite setting for studying the subtleties of drawings.

Drawings tell a graphic story that is—in a visual sense—deeply dependent on the substrate on which they lie. There is an intimate relationship between drawings and paper. Artists engaging with paper must choose from an astonishing array of substrates. The design of the study room promotes focused engagement with the artworks and appreciation of nuances of paper.

LANGUAGE AS TEACHER

The study room is a haven for scholars, a classroom for students and a forum for museum members. A casual viewer might look at an artwork and see graphite on paper. A conservator could look at that same artwork and see graphite on the felt side of a moderately-textured, medium-weight, cream, handmade antique laid paper with red fibrous inclusions, deckle edges and a crescent watermark at the lower right corner.

Conservators study paper history and paper-making practices. They appreciate the extensive variety of papers in their care and how the differences in sheets impact resulting artworks. People often refer to paper as being flat, but that simply is not true.

Paper is three-dimensional. To fully appreciate its beauty or understand its behavior, this fundamental truth must be instilled into one's core of knowledge. There is nothing that illustrates that more dramatically than a light and shade or chiaroscuro watermark (fig. 1).

There are many physical qualities that contribute to the overall character each unique sheet of paper brings to a completed drawing. These characteristics, formulated together in a nuanced syntax for paper descriptions, bring to the forefront information that may otherwise only be found deep within an examination report, or perhaps not noted at all. An extended description of paper is meant to reside between a sparse public-facing medium and an analytical report. It incorporates details that are apparent from visual examination alone.

Recognizing and recording more qualities of paper during an examination encourages deeper looking and understanding. Aspects of paper that are regularly observed are organized in a standardized grammatical framework that can be referenced during examinations. If the many visual qualities paper possesses are put into words, it serves as a teaching moment, and students are likely to look more intently at subtleties of paper that might otherwise go unrecognized.[1]

HISTORY

In 1996, *The Print Council of America Paper Sample Book: A Practical Guide to the Description of Paper* (fig. 2) was published in a limited edition of 500 copies (Lunning and Perkinson 1996). Containing 26 samples from a variety of papers, this guide provides a benchmark for standardized characterization of three qualities of paper, with simplified language for descriptors. Color, weight, and texture are described in these samples. It is a treasured resource in many conservation laboratories and print study rooms. This publication has often been used to aide in the descriptions of works of art on paper, and it is routinely referenced in notes to readers in scholarly publications on prints and drawings. It is the resource at the core of this project.[2]

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

Fig. 1. A sheet of Fabriano paper with light-and-shade watermark, in transmitted light (Baker 2010, 107).

ELEMENTS OF CHARACTERIZATION

Sidedness of Paper

The method of producing paper often results in sheets with distinctively different surface qualities on opposing sides. The felt and wire sides of a piece of handmade paper can be quite different in appearance. Artists often make deliberate choices depending on their preferences. In the case of 18th-century French artist Jean Jacque Lequeu, this aspect of paper was a notable contributor to his compositions. He often included multiple lines of tiny script that followed laid lines perfectly. The importance of this relationship becomes obvious when viewing drawings where the text is horizontal with distantly spaced chain lines, and his script wavered without the precision of laid lines to follow.

Surface Texture

The Print Council of America Paper Sample Book provides a useful guide to characterize the degree of texture in paper.

The behavior of mediums is greatly influenced by this quality of paper. Very smooth surfaces allow for even washes of wet mediums and straight unbroken lines of dry mediums. In contrast, rough surfaces often collect dry mediums at the high points of the paper and leave voids in the deeper profile. Wet medium applied in a dry brush manner may

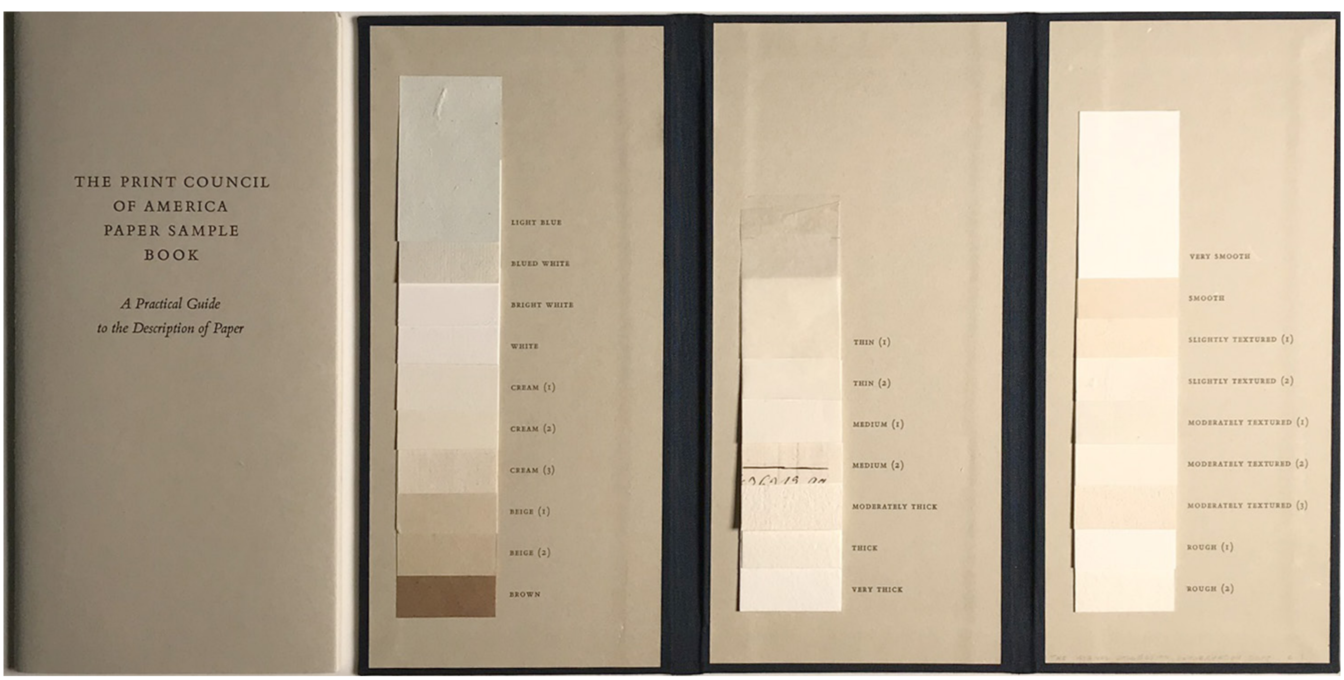


Fig. 2. *The Print Council of America Paper Sample Book: A Practical Guide to the Description of Paper*. Paper samples demonstrate variances in color, weight, and texture of paper (Lunning and Perkinson 1996).

behave similarly, resulting in skips in the medium. A very wet application can result in washes gravitating to the crevices of the paper surface, leaving less medium at the high points. Resulting differences in appearance can be striking and recognizable at a distance.

Weight

The weight or thickness of a paper can be measured precisely, but *The Print Council of America Paper Sample Book* serves as a generalized standard that is particularly useful when it is not possible to measure a drawing. An example of paper weight influencing drawings can be seen in a series of Jackson Pollock drawings that were made on thin, stacked papers. The ink applied to the top drawing flowed readily through the sheet, depositing ink on the underlying paper. Those marks began the making of the next drawing (O'Connor and Thaw 1978, 283).

Color

Lunning and Perkinson (1996) again provide a benchmark for describing color. Ideally, color would also be measured with a spectrophotometer, in which case data would appear in the body of an examination report. It can be tricky referring to color, as many times the current color of a paper does not reflect the original color. When the original color is known and a transition has occurred, both colors can be described. There are many reasons a sheet may change color, and the purpose here is not to fully describe, as in the body of a report, but rather to clarify the artist's intent. This is most important when the change that has occurred is a radical one, such as a blue paper becoming brown in appearance. When evidence exists to document the original color, it is truer to the artist to describe the color of the sheet when artwork was created than the color resulting from damage.

Preparation

There are many ways the surface of paper can be altered or prepared. Burnishing compresses paper fibers and can impart a sheen to paper surfaces. Many different coatings are used to prepare papers for drawing, particularly in the case of metalpoint drawings, which generally require a hardened surface. There are many methods and types of preparation, treatment, or coating of paper, and descriptions can be as detailed or cursory as one wants.

Hand or Machine Made

Differentiating between handmade and machine-made papers can be useful when it is not otherwise obvious. The purpose of this syntax was not to force an artificially complex description of paper but to create a placeholder for language to be incorporated into as needed. There are times when specifying machine or handmade seems redundant, in which case it could simply be omitted from the description.

Sheet Formation

The manner of formation is one of the few qualities of paper often referenced in public-facing mediums, usually simply laid or wove. Extended medium descriptions may specify in more detail the difference between antique or modern laid or wove papers, and characterization of dandy roll patterns (Baker 2010, 94–105) (fig. 3).

The specifics of formation are critically important when comparing the work of individual artists. Identifying similarities between poorly formed wove sheets, or papers with peculiar spacing of laid and chain lines, can help establish connections between drawings in distant collections.

Origin

When a specific papermaker or mill is known, that is valuable information to include in a description. Perhaps only a country of origin is known. Often it remains a mystery, with other characteristics serving as clues. If a particular product line is known, that information could also be included.

Type

Arguments can be made against naming paper by type. Definitions of paper form and function may vary from place to place or time to time. If paper type were the only point of reference, the characterization could certainly be considered inadequate.

However, as incorporated into this larger descriptive framework, it cannot hurt—and may help clarify meaning

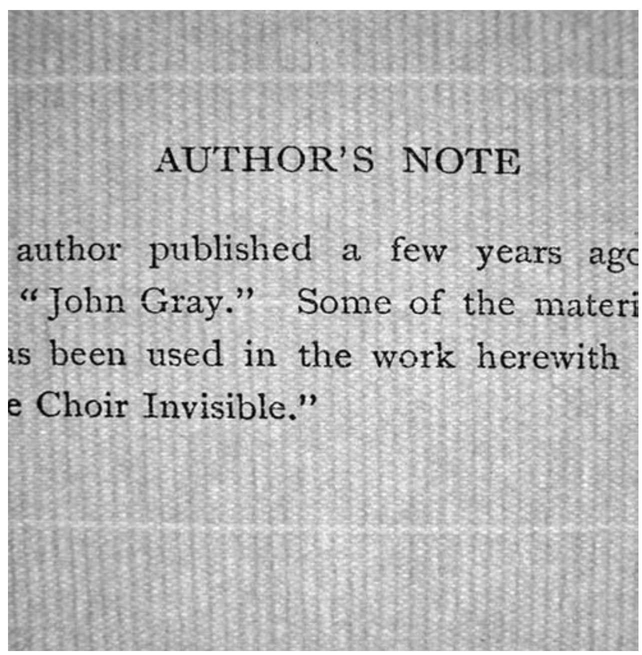


Fig. 3. Laid pattern produced by a dandy roll, with underlying wove pattern from fourdrinier wire (Baker 2010, 104).

for future scholars. The fact that an incarcerated artist drew on a Manila envelope in prison speaks to a probable shortage of materials, and it produces an instantly recognizable picture in one's mind to state that type directly. Similarly, describing a sheet as being on ruled notebook paper paints a clear picture. The Art & Architecture Thesaurus (Getty 2004) lists a number of papers by function and form, but the list is not complete by any means. The Menil Collection paper laboratory is building a glossary based on the collection that can be a reference in-house. Terms describing type can be meaningless or misleading if not defined by text and example.

Substrate

In a public-facing medium, the only word likely to make an appearance would be the substrate itself—usually paper.[3]

Paper conservators are increasingly confronted with a wide variety of substrates with limited resemblance to paper—such as drawings on leaves, or polyester film. Unconventional drawing substrates may be related only loosely to this syntax for paper description.

Details of Formation

In the course of paper formation, inclusions may be incorporated into the sheet by design or accident. Colored fibrous inclusions lend a special quality. Woody or iron inclusions can result in characteristic damages to paper. Mechanical distortion to the sheet in the form of a papermaker's tears or backmarks may be present (Farnsworth 2018, 17). Optical brighteners detected in examination are included here.

Edges of Sheet

The character of the edges of a drawing sheet are worthy of note, whether there is a simple description of a deckle or torn edge, or hand-cut edge. When the nature of the paper is to have a machine-cut edge, it would not necessarily be specified, such as with a modern graph paper. At times, the edge speaks more to the creation of the paper, and at other times the drawing itself. This Mondrian sketch is on the back of an envelope torn open in such a way it seems to speak to the urgent need to produce this composition in a hurry (fig. 4).

Marks

A chop mark, blindstamp, or watermark is always worth describing. Any estate stamps applied with ink would be included with a medium description. If a drawing were pricked for transfer, that would also fall into this category. When describing the location of marks, a standardized reference is used.

SYNTAX

The familiar features presented earlier are arranged in the following order to maintain a standardized syntax. With each aspect having an assigned location, in the unlikely event that every characteristic is known, they each will easily fall into place. When aspects are unknown or irrelevant, they will be left out.

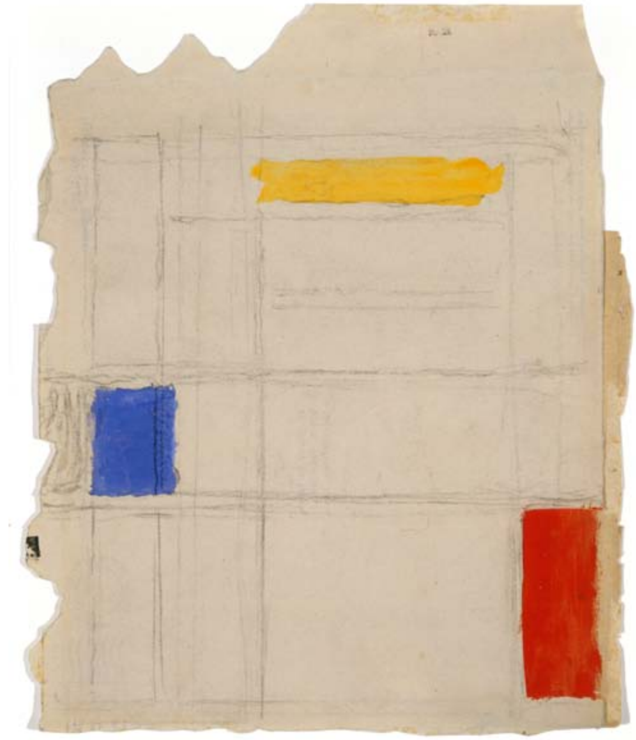


Fig. 4. Piet Mondrian, *Study for a Composition*, ca. 1940–1941. Charcoal and gouache on paper, 11 × 9 in. (27.9 × 22.9 cm). The Menil Collection, Houston.

> [Drawing medium] on [side of paper] of [surface texture], [weight], [intensity of original color], [transition if relevant] to [current color], [preparation], [hand or machine made] [formation], [paper mill or country of origin] [product line] [type] [substrate] with [specific feature], [details of edges] and [marks] at [location]

The text in the preceding extract is entered into the autotext feature of a software program. After being quickly inserted into working documents to give cues, it is deleted when the description is complete.

Examples

Examples include brown ink on the wire side of slightly textured, medium-weight, cream, antique laid paper with hand-cut edges, and partial watermark of top of a crown at lower right edge, as well as graphite pencil on the printed side of smooth, medium-weight, cream, wove, Eugene Dietzgen Co. Graph paper with holes punched along left edge.

PHILOSOPHY OF USE

When approaching new drawings or revisiting ones that have been in the collection, this strategy of defining the papers is applied as possible. Conditions of examinations dictate how much information is available. A drawing cannot be fully examined until it is removed from its frame; in reality, that is not always possible. Overmatted drawings with fully painted surfaces reveal very little about the underlying substrate. What is learned from a visual examination is included in the extended medium descriptions for the drawings.

All of these paper characteristics have appeared in descriptions in historic records; however, without a standardized framework, there was no consistency. The syntax was finalized after consultation with Menil publication editors, who have a growing interest in artwork characterization that is more fully descriptive than our streamlined public-facing form. The purpose of this thorough description of paper is for conservation reference first and foremost. Undoubtedly, there would be changes should these extended mediums ever be incorporated into publications. The extreme care given to the reproduction of the images of drawings results in publications where the character of the drawings is so beautifully illustrated that a description of any sort seems almost unnecessary.

ADDITIONAL RESOURCES

Medium Description

Descriptive Terminology for Works of Art on Paper: Guidelines for the Accurate and Consistent Description of the Materials and Techniques of Drawings, Prints, and Collages (Ash et al. 2014) was published online and therefore is an incredibly democratic resource for the standardization of medium descriptions. This is the starting point for any consideration of the topic. The Menil Collection paper laboratory copy is in a three-ring binder, interleaved with blank pages. Conversations and debates between curators, editors, and conservators sometimes result in stylistic variations to the guidelines. In those cases, the interleaved pages are marked up to reflect Menil adaptations, with references to the participants in the conversations.

Paper-Based Photograph Characterization

Occasionally, paper based photographic materials are prominent as components of drawings. In those instances, a different characterization framework specific to photographs is referenced (Burandt and McGlinchey Sexton 2019). A comprehensive list of physical attributes of photographs and a grammatical structure to create a formula for consistent description of photographs with a high level of detail is provided. These descriptions, through text alone, produce a clear picture of the materiality of the photographs, and invite the reader to visualize the subtle nuances that make each image unique.

CONCLUSION

Standardization of terminology is a satisfying form of organization. It assures that any collaborator in a conservation studio setting can produce a relatively consistent description of complex and subtle materials. Providing a clear framework for examination is helpful for interns learning to look at works of art. The level of detail included is a reminder to slow down and appreciate all of the subtle detail, and look for clues to deeper understanding of the artwork. Using these standardized guidelines together during examination of drawings invites a thorough and consistent exploration of paper. The resulting description allows readers to build a richly nuanced vision of paper and medium through text alone. With a pandemic putting distance between people and collections, these sorts of deeply descriptive characterizations may be more meaningful than ever.

> *In the end we will conserve only what we love;*
> *we will love only what we understand;*
> *and we will understand only what we are taught.*

Baba Dioum, 1968

In fond memory of Liz Lunning.

ACKNOWLEDGMENTS

Appreciation to Menil colleagues, especially Carrie Ermler, Sarah Robinson, Joseph Newland, Nancy O’Connor, Edouard Kopp, and Brad Epley.

NOTES

1. Menil membership programs offer many opportunities for the conservation department to interact directly with enthusiastic museum members. Conservation talks are usually very well attended. Connecting with the public, and helping the public connect with the art, is a rich experience.
2. Elizabeth Lunning was a former paper conservator at the Menil Collection.
3. Public facing mediums for prints at the Menil Collection describe process only and do not mention the substrate unless it is something other than paper.

REFERENCES

Ash, Nancy, Scott Homolka, Stephanie Lussier, Rebecca Pollak, Eliza Spaulding, and Renée Wolcott. 2014. *Descriptive Terminology for Works of Art on Paper: Guidelines for the Accurate and Consistent Description of the Materials and Techniques of Drawings, Prints, and Collages*. Philadelphia: Philadelphia Museum of Art. http://www.philamuseum.org/doc_downloads/conservation/DescriptiveTerminologyforArtonPaper.pdf.

Baker, Cathleen A. 2010. *From the Hand to the Machine: Nineteenth-Century American Paper and Mediums: Technologies, Materials, and Conservation*. Ann Arbor, MI: Legacy Press.

Burandt, Jan, and Jennifer McGlinchey Sexton. 2019. "It's All That: Standardization of the Material Characterization of Photographs in the Age of the Extended Medium Field." *Topics in Photographic Preservation* 18: 124–33.

Farnsworth, Donald. 2018. *Sidedness: Wire and Felt Side of Handmade Paper*. Oakland, CA: Magnolia Press. http://www.magnoliaeditions.com/wp-content/uploads/2019/01/Sidedness-of-Paper-V3-Web-12-31-18.pdf.

Getty. 2020. Art & Architecture Thesaurus Online Hierarchy Display. http://www.getty.edu/vow/AATHierarchy?find=paper&logic=AND&note=&page=1&subjectid=300014109.

Lunning, Elizabeth, and Roy Perkinson. 1996. *The Print Council of America Paper Sample Book: A Practical Guide to the Description of Paper*. Boston: Print Council of America.

O'Connor, Francis Valentine, and Eugene Victor Thaw. 1978. *Jackson Pollock: A Catalogue Raisonné of Paintings, Drawings and Other Works*. New Haven, CT: Yale University Press.

FURTHER READING

Albro, Sylvia Rodgers. 2016. *Fabriano: City of Medieval and Renaissance papermaking*. New Castle, DE: Oak Knoll Press.

Banik, Gerhard, and Irene Breückle. 2018. *Paper and Water: A Guide for Conservators*. Munich: Siegl.

Barrett, Timothy D. 2018. *European Hand Papermaking: Traditions, Tools, and Techniques*. Ann Arbor, MI: Legacy Press.

Ginsberg, Tatiana, ed. 2019. *Papermaker's Tears: Essays on the Art and Craft of Paper*. Ann Arbor, MI: Legacy Press.

JAN BURANDT
Conservator of Works of Art on Paper
The Menil Collection
Houston, TX
jburandt@menil.org

MARY H. FRENCH

Hair Today and (Not) Gone Tomorrow: The Conservation of a 19th-Century Hair Album

INTRODUCTION

In 2019, the Davenport House Museum brought a nineteenth-century album to the Northeast Document Conservation Center (NEDCC) for assessment, conservation, and digitization. The Sarah Davenport album contained an unusual surprise: locks of human hair that Sarah had collected from her family and tied into the book using silk ribbons (fig. 1). Due to the presence of this hair, which was slightly brittle and often detached from the support leaves, as well as the need to preserve the artifactual value of the volume, this project required drawing upon elements of textile, objects, and book conservation to find a solution that would neither harm the hair nor render the book meaningless from a curatorial and historical perspective.

Victorian Hairwork

Victorians used human hair from friends and family to create wreaths and jewelry, items commonly referred to as hairwork. In a time before photography, a piece of hair was the only tangible way to remember a person who had died, and hair wreaths and jewelry were often created as an act of mourning (Sheumaker 2007, ix–x). The jewelry served as a way to keep the memory of loved ones near the wearers as they went on with their daily lives. These items were considered a socially acceptable fashion accessory during the official mourning period when regular jewelry might be viewed as disrespectful or distasteful.

Hair wreaths also served a memorial function, at least initially, and were often fashioned into a horseshoe shape with the open end facing upward to signify an ascent into heaven (Everhart Museum 2020). Over time, Victorians began to create hair wreaths as sentimental items to gift to friends. Similarly, hair albums were often assembled using locks of hair from living friends and family and functioned as a type of album amicorum or friendship album (Sheumaker 2007, 26). Locks of hair in these albums were styled according to the abilities of the album creator, ranging from simple bunches to elaborate braided and looped creations.

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

The Davenport House Museum

The Davenport House, located in Savannah, Georgia, was built by local master builder Isaiah Davenport in the 1820s as a home for himself, his wife Sarah, and their children, and it is one of the oldest brick structures in the city. Sarah Rosamond Clark Davenport married Isaiah Davenport in 1809 at the age of 21. The couple bore 10 children over the course of 17 years, 7 of whom lived to adulthood. Unfortunately, the Davenports' first 3 children, Susannah, Sarah Rush, and Thurston, passed away in their infant and toddler years of bilious fever, teething/bowel complaints, and dysentery, respectively. After only 18 years of marriage, Isaiah passed away from yellow fever in 1827 at the age of 43. Faced with financial difficulties, Sarah sold off several properties and turned the family home into a boarding house in an attempt to keep the property and provide for herself, her mother, and her children (Davenport House Museum 2010).

As family circumstances changed, the house was eventually sold, and over the course of the next century, it fell into disrepair. In 1955, just hours before the historic house was scheduled to be demolished to pave the way for a funeral home parking lot, it was purchased by the newly formed Historic Savannah Foundation. Over the next seven years, the house was restored and was opened to the public as the historic Davenport House Museum in the early 1960s (Davenport House Museum 2015).

Sarah Davenport's Album

Sarah Davenport's album is an important part of the museum's collection, as it contains tangible physical representations of the entire Davenport family. Sarah was gifted the album in 1829 by an anonymous friend, ostensibly as a friendship album. It contains handwritten poems and anecdotes on memory, mortality, faith, youth, beauty, and love, and locks of hair from her parents, husband, children, their

Fig. 1. The Sarah Davenport album prior to treatment.

spouses, and her grandchildren. Sarah arranged the locks of hair by birth order and family unit into a family tree of sorts, a common grouping method in Victorian hair albums (Sheumaker 2007, 121).

Sarah's book has more focus on mourning than is usual for hair albums, possibly because the album was given to her in the same year that her mother died. By 1829, Sarah had already experienced significant loss, including the death of her husband; three of her children; and her maternal grandmother, mother, and father. The album contains locks of hair from these family members who predecease the creation of the album, in some cases by decades, so it is clear that Sarah had been collecting hair long before she ever thought to assemble it in one place.

CONSERVATION ISSUES

The album consists of a full leather binding with blind and gold tooling on the boards and spine. There were several structural issues with the binding, including a detached front board and broken sewing in the first two sections. The remainder of the text block's sewing was intact, and the back board was still attached. The damage at the front was caused by the addition of thick locks of hair throughout the first three sections, which distorted the text block and strained the sewing and front board attachment (fig. 2). The album did not have any compensation stubs to account for the extra bulk of the hair, so the binding broke in the areas experiencing the most mechanical strain. This type of damage is very common in scrapbooks created from books never meant to accommodate the addition of extra materials by the reader.

The text block consisted of sections of machine-made paper sewn through the fold onto two recessed cords. There were manuscript entries throughout the text block, and locks of hair were attached with silk ribbons laced through slits in the support leaves. The silk ribbons were brittle and fractured; as a result, many of the locks of hair were detached from the text block. Historic hair tends to get more brittle as it ages, and these 200-year-old locks were no exception. Some were broken at their attachment point where the thread or ribbon tied around the hair had created a single compression point that bore the brunt of the mechanical strain. Several support leaves were torn or had losses at the attachment slits, again a result of the hair straining at a single point. Some hair locks had even separated over time into two pieces.

DEVISING A TREATMENT PLAN

The Sarah Davenport album is an unusual object featuring a variety of materials including human hair, silk ribbons, paper, and leather. The question of how to treat this album, both in terms of its individual components and as a whole object, was by no means

Fig. 2. Text block distortion caused by the hair locks' extra bulk.

simple. When multiple pieces of hair are introduced into a bound structure with moving parts, the result is a particularly complex object with many competing conservation priorities. Formulating a treatment plan that maintained the functionality and historic appearance of the album while also addressing the conservation needs of the hair required drawing from multiple conservation disciplines to overcome this unique challenge.

Treatment Goals and Ethical Considerations

The goals of treatment were to stabilize the hair to prevent further loss; mend the broken silk ribbons; identify the correct location and positioning of the loose hair locks; reattach them to the support leaves; and restore functionality to the binding by mending the torn support leaves, strengthening the sewing, and reattaching the front board.

Deciding how to treat the hair was complicated and by far the most difficult part of the conservation process. When considering potential treatment options, the conservator needed to determine whether it was safe to remount the hair and also whether doing so was appropriate for both the album and the client's needs.

As it ages, hair becomes more brittle and fragile, making it vulnerable to mechanical wear. The least interventive and safest option for the hair was to rehouse the loose hair locks in acid-free tissue in archival storage boxes. However, the album had a significant amount of artifactual value stemming from Sarah's careful arrangements of the hair, and it would lose most of its meaning if the hair locks were removed and stored separately. Both the conservator and the curator strongly felt that the album and hair needed to remain together in a format as close as possible to Sarah's original creation.

Leaving the hair loose was not possible since many of the hair locks had already gone missing over time: if the locks were to remain with the album, they needed to be secured in some way since reattachment would help prevent further loss. Although the hair was slightly brittle, it was fairly flexible and could be handled safely. This meant that the hair could be remounted provided that it was done gently and in a way that minimized pressure points or other mechanical stress.

However, the hair was not strong enough to simply reattach by tying ribbons through the slits in the support leaves, and many of the support leaves had torn because of the original attachment method anyway. This method would place too much strain on both the hair and the paper at a single point of attachment. Furthermore, the original silk ribbons were so fragile that they would disintegrate if tied in a knot. A thorough literature search was conducted, but there seemed to be no direct precedent to guide the conservation process.

Considering that hair is a material rarely handled by book conservators, outside expertise was needed. Camille Myers Breeze and Morgan Blei Carbone of Museum Textile Services were consulted to ask how textile conservators stabilize fragile textiles. Their technique involves stitching the original materials between a backing layer of Stabiltex/Tetex polyester woven textile and an upper layer of nylon thermoset net using an ultrafine polyester thread so that the fragile materials are supported on both sides. Since wigs are made by stitching hair onto a mesh textile, it was felt that there was a strong historic precedent for securing loose hair in this manner, and the conservator decided to develop a method based on textile conservation techniques.

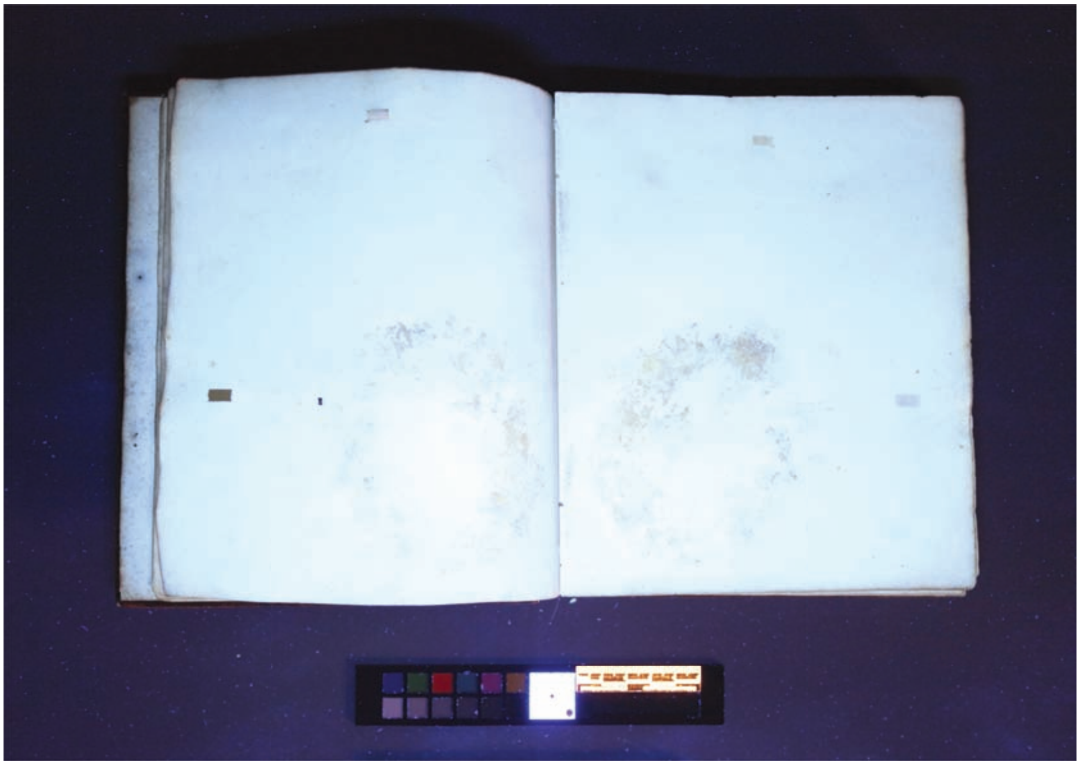


Fig. 3. Discoloration of the text block caused by the unidentified white powder as seen under long-wavelength UV light.

CONSERVATION TREATMENT

Documentation

Prior to beginning treatment, the album condition was documented with a written report and representative photographs. The leaves were collated and paginated in graphite pencil. Leaves containing locks of hair were photocollated to record the precise initial locations of the hair. These leaves were also imaged under long-wavelength UV light. This was initially done to check for the potential presence of insecticides since mercury (II) chloride when applied to paper can fluoresce peach or cream under UV light (Purewal 2012, 115). A handheld UV light unexpectedly revealed hidden staining on the support leaves in the exact shape of the hair and these images were useful for remounting the hair locks in their precise original locations once they had been stabilized.

Surface Cleaning

During examination, it was discovered that some support leaves in the album were covered in an unidentified white powder that was potentially toxic. The use of insecticides such as mercury, arsenic, and lead on natural history specimens was widespread in museum collections during the 19th and 20th centuries (Hawks 2001). Because this album contained hair and showed very little insect activity, the powder was almost certainly a hazardous insecticide (Purewal 2001, 77). The powder was located only on blank support leaves between the leaves containing hair, was causing damage to the paper (fig. 3), and served no artifactual purpose, so for safety reasons it was decided to remove as much of it as possible.

The powder was removed by using a HEPA-filtered vacuum in a fume hood. Where necessary, a microspatula was used to loosen the powder. The support leaves were then surface cleaned with vulcanized rubber sponges. Although vacuuming and surface cleaning reduced the risk of exposure to potentially hazardous materials, it did not eliminate it, and so the conservator and photographer wore N95 masks, nitrile gloves, and laboratory coats while handling the album throughout the decontamination, conservation, and imaging processes. Additionally, the book was stored separately from other projects to avoid any potential cross contamination. Samples of the white powder were collected and retained, and it is hoped that these will be analyzed in the future to identify the unknown substance.

Spine Cleaning and Partial Disbinding

Next, the leather on the boards and spine were lifted to improve access to the spine for cleaning and prepare for the eventual reback (fig. 4). The back board and spine piece were still attached to the binding, so these areas were masked off

Fig. 4. Lifting leather on the boards in preparation for board reattachment.

with Melinex to prevent moisture migration and then the spine was cleaned with a 4% methyl cellulose poultice.

Paper Mending

The sewing was broken toward the front of the text block leaving the first two sections loose and almost entirely detached, and so these sections were removed to facilitate mending. Most of the spine folds of the bifolia in these two sections were split or partially split, and the leaves had many small tears and losses. The majority of this damage was concentrated along the fore edges of the sections, which protruded beyond the edges of the front board and were therefore unprotected. The slits in the support leaves through which the hair locks had been tied were also torn and sometimes lost. Tears were mended, losses were filled, and spine folds were guarded with a lightweight Japanese kozo tissue and Aytex-P wheat starch paste. The Japanese tissue was lightly toned with Liquitex acrylic pigment where needed to help the repair blend into the text block.

Stabilizing the Hair

Materials Selection

As mentioned previously, textile conservators often stabilize fragile textiles by stitching them between a backing textile and a sheer overlay. Common backing textiles include polyester Tetex/Stabiltex or silk crepeline. Nylon net is most often used as the sheer overlay since it has a very open structure, is almost invisible, and does not fray when cut (AIC Wiki 2020). Gutermann Skala 360 polyester thread was selected for sewing because of its long-term stability and because the thread was so fine that it closely resembled human hair and would blend into the background well.

There are two types of nylon net: bobbinet-constructed nylon net, which is softer and has a better drape, and thermoset (also known as heat-set) nylon net, which is slightly stiffer and may also be more abrasive depending on the supplier. Bobbinet net is very expensive; difficult to source; and often only available in white, off-white, or black, although it can be dyed to better match the object's coloring. Nylon thermoset net, on the other hand, is widely available, very inexpensive, and comes in an almost unlimited color palette. However, the thermoset net must be chosen carefully, since the softness of nylon thermoset nets varies widely between manufacturers and more abrasive sheer overlay textiles pose a threat to fragile historical materials (Fulkerson LaVallee 2005).

Although the excellent drape of bobbinet-constructed net is normally an asset for textile stabilization, it was felt that nylon thermoset net would be a better choice for stabilizing the hair because it is slightly more rigid and therefore the hair would be less likely to experience mechanical wear due to flexing. A 100% nylon apparel-grade CPSIA-compliant thermoset tulle from Fabric.com was selected for this project due to its softness and sheerness.

Nylon can be a controversial choice of textile—there is evidence that it degrades when exposed to light (AIC Wiki 2020). In this case, the netting would be covered by hair in the closed pages of a book, which would then be stored in a custom drop-spine cloth-covered box. Light exposure to the volume in the long term would be minimal, so it was decided to proceed with the nylon textile since it offered the most support while minimizing visual impact.

Refining the Technique

Before working with the historic locks of hair, the textile stabilization technique needed to be developed with practice models. It was impractical to source modern human hair, so hair silk was used to experiment with the technique instead because it looks and feels similar to human hair. During testing, it was discovered that the nylon thermoset net was very visually distracting when laid on top of the hair silk. It was also discovered that the Stabiltex/Tetex polyester backing layer was very prone to fraying. Although the edges could be heat sealed after trimming, this would involve getting a heated tool very close to the hair. The nylon thermoset net, however, did not fray when trimmed. The decision was made to use the nylon thermoset net as a backing layer and to omit the sheer overlay. Instead, the hair would be held to the backing textile using a network of broad stitches woven through multiple layers of the hair to form an invisible yet secure three-dimensional "net" structure capable of gently supporting the hair.

Preparing a Sewing Frame

The netting needed to be held at an even tension so that the hair would not pucker after stitching. An embroidery hoop would have stretched the net too much, causing uneven tension when the net was released. Instead, a window mat with a 3 × 3 in. aperture was cut out of four-ply acid-free and lignin-free black mat board. The shade of both the nylon thermoset net and Gutermann Skala polyester thread were selected carefully to provide the best possible color match with the individual locks of hair. A 5 × 5 in. square of the net was attached to the flat, nonbeveled side of the mat board using painter's tape (fig. 5). The tape held the textile flat with minimal tension so that it would not contract unevenly when released. The painter's tape could be removed easily so that both mat and tape could be reused multiple times, minimizing waste materials.

Once the netting was attached, the mat board was turned over so that the hair could nestle inside the beveled recess of the window mat. The mat board rested on top of several brass rectangular weights—one at each corner of the board—so that

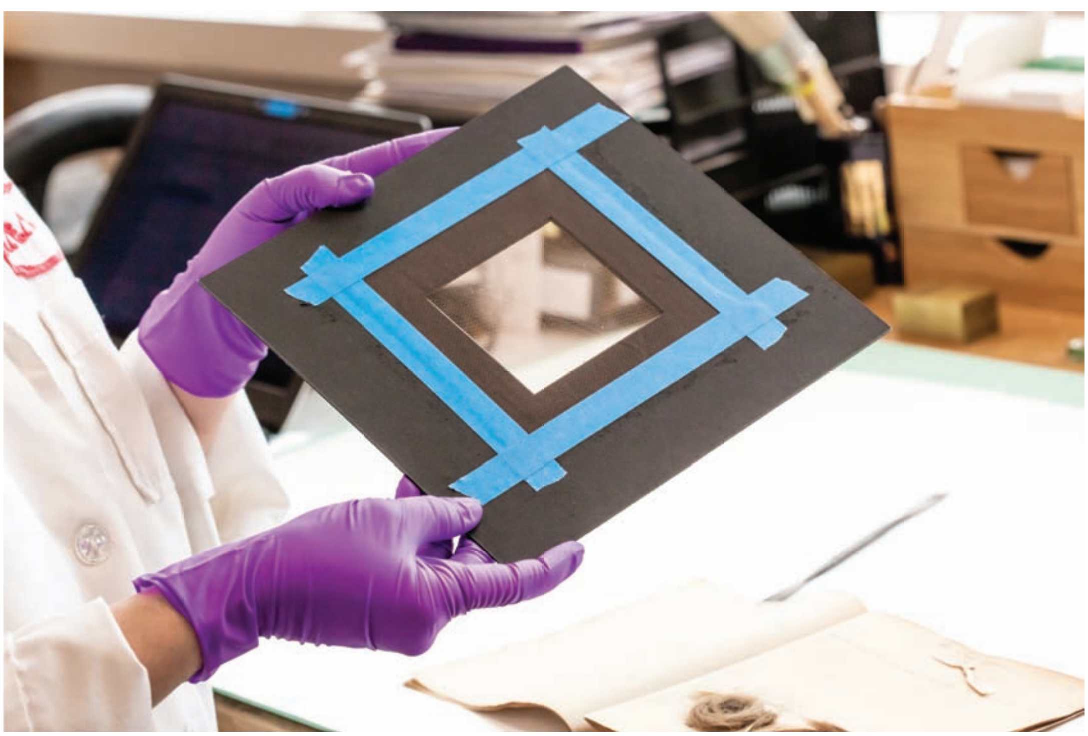


Fig. 5. Nylon thermoset net fixed to the mat board sewing frame with painter's tape.

Fig. 6. Tweezers were used to tuck in stray hairs and arrange the lock into the most natural shape.

both sides of the net could be accessed during sewing. A needle was threaded with Gutermann Skala 360 polyester thread.[1] Because the thread was so fine, it tended to slide out of the eye of the needle, so the thread was tied around the eye using a square knot to secure it. After sewing, this knot was loosened by unpicking it gently with an awl. The tail end of the thread was secured by tying it with a square knot to the nylon net.

Styling the Hair

Once the net and thread were in place, a lock of hair was transferred to the net using a large microspatula. The hair was placed over the thread where it was knotted to the net so that the knot was covered. The hair was then gently arranged so that the curl of the lock fell in the most natural position. Any stray strands of hair that were sticking out from the lock were tucked back into place with fine, round flat-tip stainless steel tweezers so that they would be included in the stitching process (fig. 6).

Sewing Technique

Next, the hair was sewn to the nylon net using long stitches woven through several layers of hair at varying depths (fig. 7). To avoid compression points where the hair could possibly break over time, the sewing tension of the thread was kept loose and the stitches were long to spread any strain over a larger surface area. This method secured the hair to the net while leaving very little of the stitch visible on the surface of the lock. Because the thread had a very similar texture, appearance, and sheen as the hair, the small lengths of thread that showed through the hair were almost invisible.

Once sewing was complete, the mat board was flipped over and the remaining thread was tied in a square knot to the tail of thread from the initial knot on the back of the net. Small glass blocks were used to support the hair while the mat was inverted (fig. 8). This was particularly helpful when a fragile silk ribbon was attached to the lock. Both loose ends of thread were then woven through the nylon net before trimming the ends.

After sewing, the net was trimmed as closely as possible to the hair. During trimming, the hair was held gently with fine, round, flat-tip stainless steel tweezers to keep it away from the scalpel blade (fig. 9). Holding the hair back from the blade also allowed the conservator to see where the sewing threads were so that the threads were not accidentally severed during the net trimming process. The inner circle of the net was trimmed first, followed by the net around the outer edge of the lock. The net was trimmed in this order to help maintain net tension for as long as possible (fig. 10).

Determining the Original Hair Locations

Once the hair locks had been stabilized, their original locations needed to be determined before they were remounted into the volume. Since some locks had moved locations over time, usually to the conjugate leaf of their bifolium, precise

Fig. 7. Weaving the sewing needle through layers of hair.

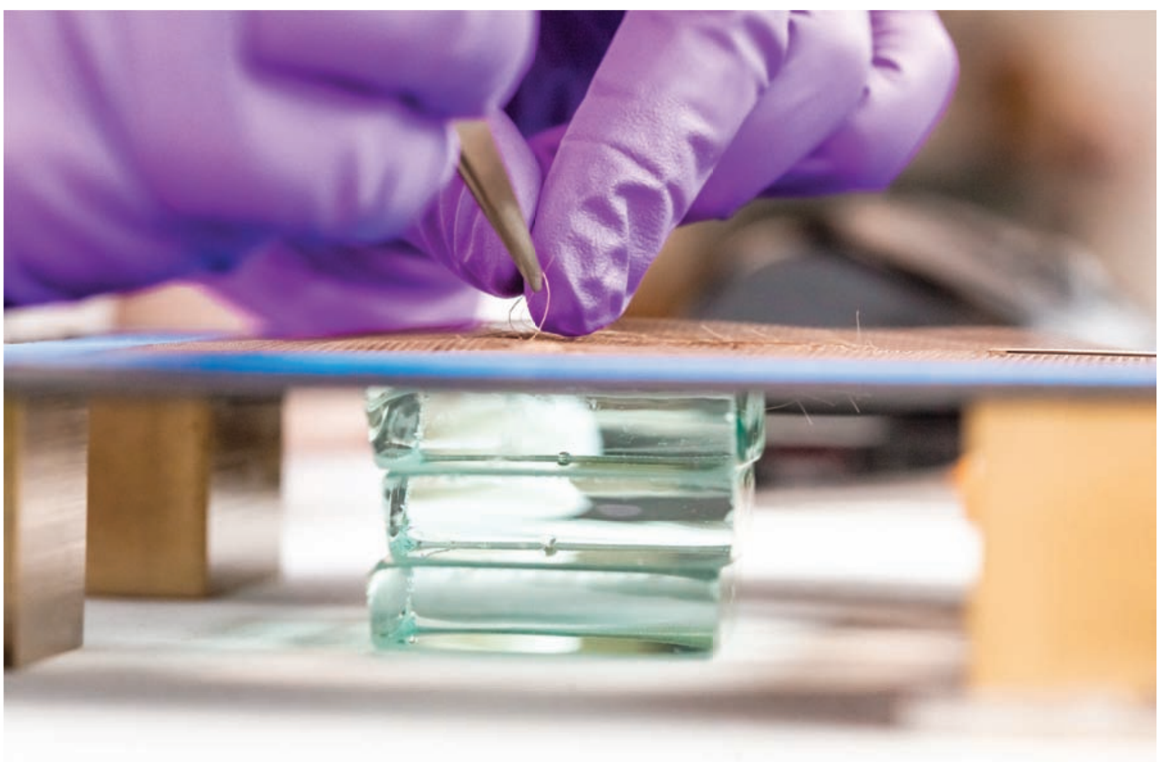


Fig. 8. Glass blocks supported the hair lock and silk ribbon while the sewing frame was inverted so that the sewing thread could be tied off.

Fig. 9. Tweezers were used to hold the hair back from the scalpel blade when trimming the nylon thermoset net.

Fig. 10. Removing the trimmed nylon thermoset net from the center of the hair lock.

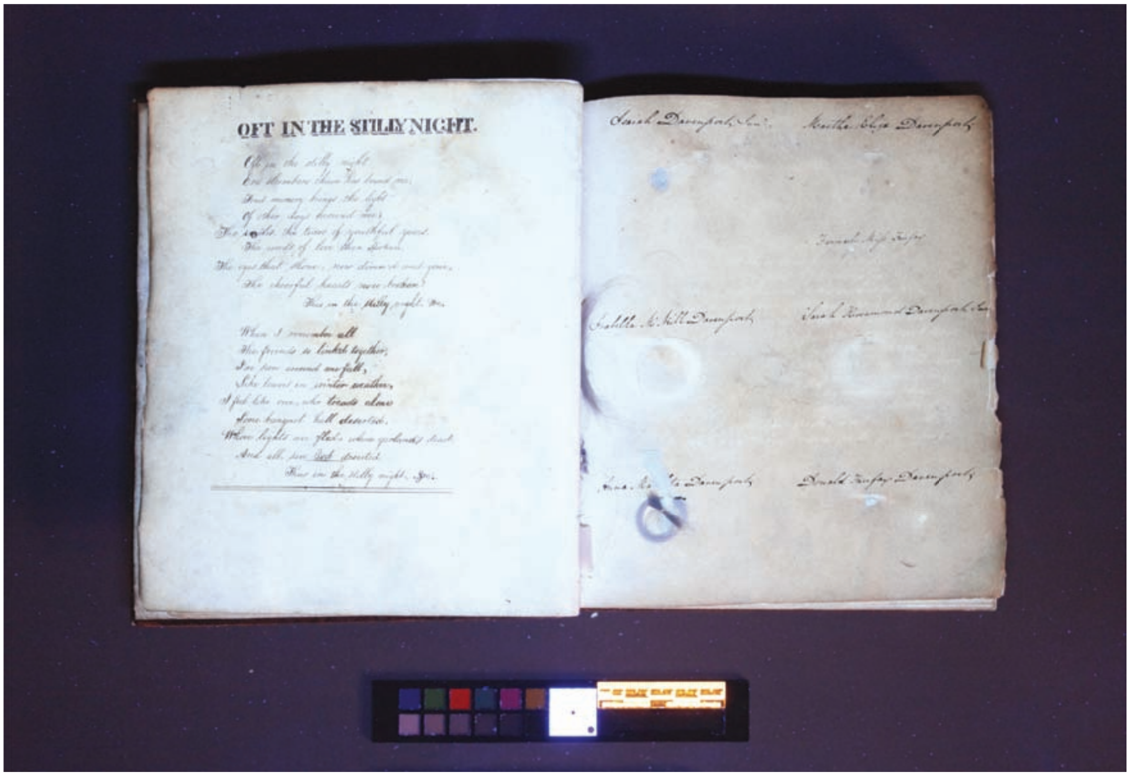


Fig. 11. Discoloration of the text block caused by hair lock staining was more visible when viewed under long-wavelength UV light.

identification was important. Identifications were made using visual cues from the hair, ribbons, or support leaf stains. In some cases, the shape of a ribbon fragment caught in the slit on the support leaf matched the shape of a loss in the silk ribbon tied to a hair lock. In other instances, the shape of staining on the support leaves exactly matched the precise outlines of the locks.

UV imaging was useful for determining hair lock locations when support leaf staining was not obvious under natural light. UV imaging also conclusively proved that locks of hair had gone missing from the album at some point in the past 200 years. The album contained a number of names with no associated hair or obvious support leaf staining. There were slits in the paper underneath the names, clearly made in preparation for mounting the hair, but no visible evidence that the hair had ever actually been there. Under UV light, many of these apparently blank support leaves suddenly showed pronounced areas of discoloration where hair locks had previously been attached (fig. 11). Although the hair locks are now missing, this tells us that the hair locks were lost after they had been attached long enough to stain the support leaf.

Two identical locks of hair on one support leaf proved to be a particularly puzzling challenge. Both were the exact same shade of brown, and one was tied with a pinkish beige silk ribbon, whereas the other was a larger untied curl of hair (fig. 12). When examining the support leaf where these two locks of hair were located, it was discovered that one named entry had hair attached in two places underneath the name, which was unusual for the volume. The left-hand attachment slit had an unbroken knot of brown thread laced through it, whereas the right-hand slit had a loss in the paper. It was thought that the two identical hair tufts were originally part of one whole lock. The lock broke at the left-hand attachment point, leaving the curl of hair detached and also unbound by thread, which remained in the paper slit. The right-hand attachment slit was broken, which explains why the silk ribbon was still attached and fully intact on the other tuft of hair. It was decided to stitch these two locks of hair onto one piece of textile, as there was strong evidence that they belonged together.

Remounting the Hair

The hair was reattached to the support leaves using slips of Japanese kozo paper lightly toned with Liquitex acrylic pigments. The paper slip was attached to the nylon thermoset net by sewing a little strip of net over the paper to the hair's support netting using Gutermann Skala 360 polyester thread (fig. 13). A couple of stitches passed through the paper slip to help secure it further (fig. 14).

Fig. 12. Two locks of hair, one bound with a silk ribbon and one unbound, were identical in hue and texture, and it was determined that they were originally part of the same lock.

Fig. 13. A slip of Japanese paper was sewn to the backing textile using a small piece of nylon thermoset net.

Fig. 14. Gutermann Skala 360 polyester thread was sewn through the paper slip to better attach it to the textile.

The perimeters of the slits in the support leaves were reinforced with a lightweight Japanese kozo tissue and wheat starch paste prior to the hair being remounted. Once the paper was stitched to the net, the ends of the paper slip were woven into the already-existing slits in the support leaves (fig. 15). The paper slips were adhered with wheat starch paste above and below the slits on the support leaf to avoid straining the fragile slit (fig. 16). Although all of the large locks of hair were able to be reattached to the support leaves, a number of loose hair knots, strands, and stubs were not because it was unclear which fragments had come from which lock. To keep loose hair stubs and knots safe, they were stabilized by stitching onto the nylon thermoset net and then the excess net was trimmed away. These hair and ribbon fragments were stored in labeled glassine bags and returned to the client.

Stabilizing the Silk Ribbons

The deteriorating silk ribbons were very fragile, so a decision was made to stabilize them where possible using a solvent-set silk crepeline lining made with a 3:1 Plextol B500:filtered water mixture (figs. 17, 18). The solvent-set lining was made by brushing the adhesive solution onto a piece of Melinex through a silk screen and then laying a piece of silk crepeline gently over the top of the adhesive film while the film was still wet. Any air bubbles were lightly tamped down with a soft brush. After the adhesive was dry, small pieces of the solvent-set lining were cut to the exact shape of the silk ribbons. The lining was lightly tacked in place with low heat (<80°C) from a tacking iron and then reactivated with ethanol to improve adhesion (Plextol B500 1998) and reduce shine from the adhesive (Varga, Herrmann, and Ludwig 2015, 116). This method was used to line intact but fragile ribbons, as well as unite broken ribbon fragments into one piece. The ribbons were lined on one side only to prevent them from becoming too stiff and to preserve the original appearance of the ribbons.

Imaging

The volume was digitally imaged by the NEDCC Imaging Lab in compliance with FADGI specifications before the binding was reassembled to provide better photographic access to the leaves without straining the binding's

Fig. 15. Once attached, the Japanese paper slip was threaded through the pre-existing slits in the support leaves where the hair lock had originally been tied with silk ribbon.

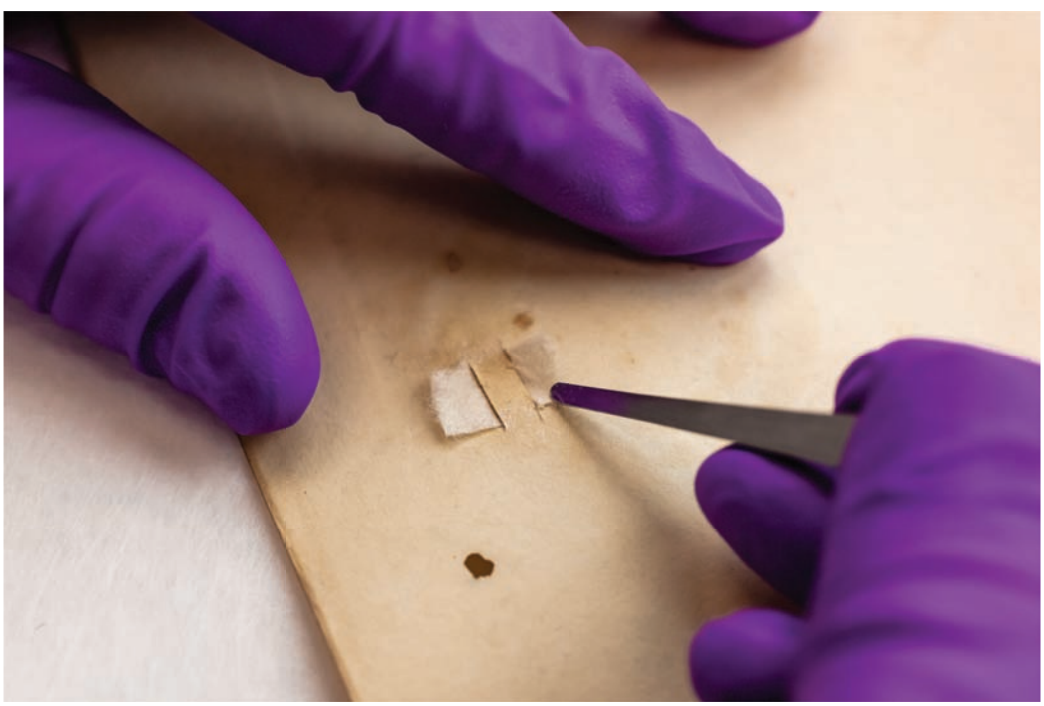


Fig. 16. The Japanese paper slip ends were pasted to the verso of the support leaf above and below the slits.

Fig. 17. The original silk ribbons were very fragile and needed stabilization.

structure. The images were placed on the Davenport House Museum website and are freely accessible to the public.[2]

Binding Repairs

After the hair was remounted, the sewing of the text block was reinforced using linen cords and linen thread waxed with microcrystalline wax. During sewing, space was added between the first three sections to accommodate the bulk of the hair so that the text block was no longer distorted. The linen cord sewing supports were frayed out and pasted onto the boards underneath the lifted leather to form a new board attachment. Because the majority of the original binding's leather covering was still intact and very little of the repair material would show when the repairs were finished, the binding was rebacked with Japanese kozo paper toned with Liquitex acrylic pigments with a layer of airplane cotton underneath for added stability. The original binding leather was re-adhered over the rebacked spine and boards using Jade 403 polyvinyl acetate adhesive.

Housing and Documentation

After conservation, the volume was housed in a custom-fitted cloth-covered drop spine box. The volume's post-treatment condition was documented photographically and also with a written report. A reduced treatment report containing the volume's initial condition, treatments carried out, and a materials list was adhered to the interior of the upper box lid. Additional written and photographic treatment documentation was kept by NEDCC and provided to the client.

Fig. 18. A silk ribbon after being stabilized with a solvent-set lining consisting of silk crepeline and a 3:1 Plextol B500:filtered water adhesive film.

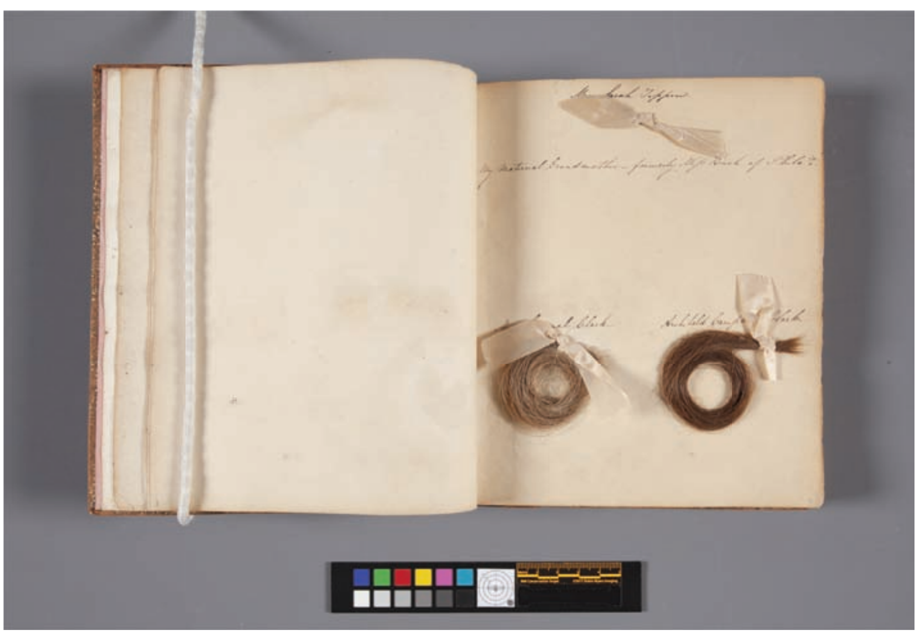


Fig. 19. The Sarah Davenport album after treatment.

CONCLUSION

This new treatment approach successfully balanced competing curatorial and conservation priorities by stabilizing and remounting the hair locks into the album without causing harm to the hair or the support leaves. The most minimally interventive approach of rehousing the loose hair and storing it separately would have stripped the album of its artistic and historical significance, and perhaps could have caused even more damage to the hair in the long run due to an increased need to handle the unbound locks.

Stitching the hair onto the net textile meant that individual hairs were less prone to breakage from mechanical wear since the nylon thermoset net and thread helped protect the hair from excess movement. Any stress sustained by pressure from the sewing thread on the hair was minimized by sewing loosely with relatively broad stitches, and by the large number of stitches, both of which diffused stress over the surface area of the lock. The sewing threads form an internal network of support, keeping the hair stable and secure without undue restriction.

Remounting the hair locks into the album will help prevent the hair from being lost in the future—an important priority since so many locks had already gone missing over the course of the past 191 years. The remounting method ensures that the nylon thermoset net and not the hair will take the strain of attachment. Additionally, by securing the Japanese paper slips to the support leaf above and below the slits in the support leaves, rather than around the slits themselves, the support leaves are less likely to tear from mechanical wear during use. Resewing the text block to include extra space between the bulkiest sections helped reduce stress along the spine and front joint, leading to greater long-term stability in the binding.

Reconciling the treatment needs of the hair locks with the curatorial need to maintain the album's historical and artistic integrity was challenging but not impossible. The decision-making process required thinking outside the box, consulting with conservation experts outside of the book and paper field, extensive research into historic human hair, and a full consideration of the practical and ethical aspects of all potential treatment options. The treatments performed on the hair, text block, and binding restored functionality to the binding and ensured that a modern-day visitor to the Davenport House Museum will have a very similar visual reading experience to Sarah Davenport herself (fig. 19).

ACKNOWLEDGMENTS

The author would like to thank Tim Gurczak, NEDCC Collections photographer, for taking the beautiful photographs that are shown in this article; Jeff Freeman, assistant director and collections manager of the Davenport House Museum, for his enthusiastic permission in letting the author present this conservation project to AIC; Camille Myers Breeze, director and chief conservator of Museum Textile Services, and Morgan Blei Carbone, associate conservator of Museum Textile Services, for their helpful advice and for generously supplying an assortment of stabilization textiles and polyester thread; Bexx Caswell-Olson, NEDCC director of Book Conservation, for encouraging the author to develop this project into a talk and then this article; Annajean Hamel, NEDCC lead preparator, for helping to make the sewing frame for the nylon net; and Graham Patten, book conservator at the Boston Athenaeum, for his helpful advice.

NOTES

1. Although a straight needle was used for this project, the author recommends using a curved needle for sewing the hair to the nylon net since the curved shape makes it easier to weave through the layers and speeds up the sewing process.
2. A digitized version of the Sarah Davenport album can be viewed at the following link: http://www.davenporthousemuseum.org/sarah-davenports-album/. Please note that this is not a complete collection of images from the album photographed by NEDCC, as pictures of the blank leaves have been omitted from the website for simplicity's sake.

REFERENCES

AIC Wiki. 2020. TSG Chapter VI. Treatment of Textiles—Section H. Consolidation/Stabilization—Non-Adhesive Methods. https://www.conservation-wiki.com/wiki/TSG_Chapter_VI._Treatment_of_Textiles_-_Section_H._Consolidation/Stabilization_-_Non-adhesive_Methods

Davenport House Museum. 2010. Household: Isaiah Davenport. http://www.davenporthousemuseum.org/wp-content/uploads/2018/05/DAVENPORT-HOUSEHOLD-final.pdf.

Davenport House Museum. 2015. Our Institutional History. http://www.davenporthousemuseum.org/wp-content/uploads/2018/05/Our-Institutional-History-1.pdf.

Everhart Museum. Mourning Hair Wreath. Accessed July 31, 2020. http://www.everhart-museum.org/Collection/Wreath.htm.

Fulkerson LaVallee, Donna. 2005. The abrasiveness of sheer overlay fabrics used in textile conservation. Master of arts thesis, University of Rhode Island.

Hawks, Catharine. 2001. "Historical Survey of the Sources of Contamination of Ethnographic Materials in Museum Collections." *Collection Forum. Society for the Preservation of Natural History Collections.* 16(1-2): 2-11.

Plextol B500. 1998. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Plextol%C2%AE_B-500.

Purewal, Victoria. 2001. "The Identification of Four Persistent and Hazardous Residues Present on Historic Plant Collections Housed Within the National Museum and Galleries of Wales." *Collection Forum: Society for the Preservation of Natural History Collections* 16 (1-2): 77–86.

Purewal, Victoria. 2012. Novel detection and removal of hazardous biocide residues historically applied to Herbaria. Ph.D. diss., University of Lincoln, UK.

Sheumaker, Helen. 2007. *Love Entwined: The Curious History of Hairwork in America*. Philadelphia: University of Pennsylvania Press.

Varga, Lauren M., Herrmann, Jennifer K., and Ludwig, Kathleen. 2015. "Heat-Set Tissue: Finding a Practical Solution of Adhesives." *The Book and Paper Group Annual* 34: 113-117.

SOURCES OF MATERIALS

Gutermann Skala 360 100% Polyester Thread
Testfabrics Inc.
415 Delaware Ave.
West Pittston, PA 18643
570-603-0432
570-603-0433 (fax)
info@testfabrics.com
http://www.testfabrics.com/

Nylon Bobbinet Tulle
Dukeries Textiles and Fancy Goods
Spenica House
15A Melbourne Rd.
West Bridgford, Nottingham
NG2 5DJ
UK
+44 115 981 6330
+44 115 981 6440 (fax)

100% Nylon Apparel-Grade CPSIA-Compliant Thermoset Tulle
Fabric.com
888-455-2940
http://www.fabric.com/

Silk Crepeline, Hair Silk, Curved Sewing Needles, and Plextol B500
Talas
330 Morgan Ave.
Brooklyn, NY 11211
212-219-0770
212-219-0735 (fax)
http://www.talasonline.com/

Stabiltex/Tetex
Plastok Associates Ltd.
79 Market St.
Birkenhead, Merseyside
CH41 6AN
UK
+44 151 666 2056
+44 151 650 0073 (fax)
assoc@plastok.co.uk
http://plastok.co.uk/

MARY HAMILTON FRENCH
Associate Book Conservator
Northeast Document Conservation Center
Andover, MA
mfrench@nedcc.org

yvonne (bonnie) hearn

The Read Muraqqa' Albums: Disbound Persian and Indian Album Leaves at the Morgan Library & Museum

INTRODUCTION

The Morgan Library & Museum holds a collection of 57 Persian and Indian leaves acquired by J. Pierpont Morgan from Charles Hercules Read in 1911. These are known as the Read Album Leaves. This collection consists of disbound album leaves that are mostly double-sided, depicting miniature paintings, drawings, and calligraphy that date between the early 16th century and the late 19th century. After acquisition, the leaves were divided into two groups based on style: one Persian (M.386.1-21) and the other Indian (M.458.1-36). Most of these leaves were once bound in muraqqa'-style albums and likely would have been presented as paired openings, two miniature paintings followed by two calligraphies, surrounded by decorative rulings and borders often matching in design or theme. Although the albums were disbound prior to acquisition by Mr. Morgan, many of the leaves have the remnants of cloth hinges attached to either the inner spine edge, suggesting a past codex binding, or remnants along both long edges, indicative of a past accordion-style binding.

The collection has not undergone thorough conservation examination as a group in recent times, although individual leaves are actively used for display, exhibition, and loan. The leaves are frequently requested for viewing by researchers and scholars and are regularly used for teaching. These uses often require access to both sides of the leaf. To make informed decisions about the treatment and rehousing of the collection, it is important to first understand how the leaves are made, how they relate to other leaves in and outside the collection, and how the leaves have been treated in the past. These elements will be discussed in this article to demonstrate both the complex structure and history of the collection. The article will also describe the condition and housing survey undertaken, the findings of the survey, and the subsequent treatment and rehousing of the collection.

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

BACKGROUND

Muraqqa'

Muraqqa' is a Persian word meaning "patched" or "patchwork" and relates to the garments of the Dervish members of the Sufi religion. The Dervish took vows of material poverty and would therefore wear garments that were patched and mended over time then passed onto other members (Thackston 2001; Roxburgh 2005, 188). Muraqqa' adequately describes the nature of both the construction and use of these albums. For example, leaves within an album are pieced together with many layers of paper, and an album often includes paintings, drawings, and calligraphy spanning many years, decades, and even centuries apart. Like the Dervish garments, muraqqa' were passed on to new owners such as family members.

Persian albums appear from the early 15th century in Timurid Herat and developed further during the 16th century in Safavid courts, spreading from Iran to India, Central Asia, and Turkey. Early albums were created in workshops and commissioned by emperors and courts. These albums were luxury objects that detailed events, history, and rulers of the time. They were used for intimate viewings, treasured and passed down within royal families, and often reformatted as ownership changed. However, by the late 16th century, albums were created and used for a wider audience and were no longer exclusive to royal courts.

Muraqqa' sprung from the production and distribution of religious and historical manuscripts incorporating imagery alongside text. Early albums were created using older specimens, as well as new ones, and by the turn of the 16th century, paintings, drawings, and calligraphy were produced specifically for albums (Hyden and Roxburgh 2018). Album pages were created to easily separate for the purpose of reformatting, reassembling, and adding more leaves as ownership changed. This inherent quality led to the disbinding of muraqqa' and the separating and splitting of leaves from the 18th century through to the 20th century by art dealers and Western owners.[1] Subsequently, this practice has resulted in dispersed muraqqa' leaves around the world (Roxburgh 2005).

The Read Album Leaves

Belle da Costa Greene played an integral role in securing acquisition of the leaves from Read. Greene was Mr. Morgan's personal librarian at the time of purchase of the leaves and was the first director of the Pierpont Morgan Library from 1924 to 1948. Correspondence between Greene and Read shows Greene's enthusiasm for acquiring the leaves as she writes to Read, "[I]t is very necessary for him (Mr. Morgan) to have a representation of this most important school, and I doubt if he would ever be able to find finer specimens" (Greene 1911). The Morgan collections are predominately of the Western tradition, and the Read Albums are one of only two collections of muraqqa' album leaves among the holdings; the second collection (MS M.848 and MS M.849) are a bequest from Greene.

Schmitz Study

The provenance of the Read Album Leaves has been surmised and changed over time.[2] The most recent study was undertaken by Barbara Schmitz in 1997. Although the leaves are accessioned by two groups, distinguished simply by "Persian" and "Indian," Schmitz's study concludes that the collection is derived from at least four separate albums.

The first album consists of 20 Persian leaves and 7 Indian leaves that belong to an accordion-style album containing specimens likely first collated during the 1580s in Herat, Afghanistan. Leaves of the group indicate that the album was added to and reformatted in Golconda, Deccan India. The second and third albums contain 20 Indian leaves that were bound in codex format and are speculated to be from a group of 60 leaves previously owned by Read (the other 40 leaves were sold upon Read's death in 1928). Many of these leaves have matching decorated frames and specimens that detail royals and events from the Mughal Dynasty. Nonoriginal paginations in Arabic and English indicate that these leaves were once a part of two larger separate albums. The fourth group of leaves are miscellaneous: 1 Persian and 9 Indian leaves that vary in size and format. Schmitz believes that this group may have been acquired from the New York art collector Vladimir Simkhovitch in 1913. The addition of this fourth group creates 57 leaves in total, and although the last group has dissimilar provenance, the collection is known as the Read Album Leaves.

FEATURES OF THE READ ALBUM LEAVES

There has been a long history of Western misunderstanding of muraqqa' leaves. This is potentially derived from the Western attitude that Persian albums were merely randomly composed collections, which ultimately played a large role in the practice of removing leaves and separating pages with little consideration (Roxburgh 2005). Many features of the Read Album Leaves, such as format and size, ownership and artistic attribution, calligraphic fragments, and decorative frames, can help us understand how the leaves connect as groups. Nonoriginal features such as wormhole damage, evidence of reformatting, and inscriptions and pagination can help us piece together the album's history.

Format and Size

An obvious distinction among the majority of the leaves is their format and size. For example, leaves of the accordion album are smaller in size (378 × 241 mm ± 3 mm), and they have hinge remnants along both long edges with centered specimens. The codex leaves are slightly larger (414 × 300 mm ± 5 mm) and have hinge remnants on the spine edge only, and the specimens are mounted slightly off center to create visual symmetry when the album is open. Figure 1 shows an example of a leaf from the accordion album on the left and a leaf from the codex album on the right.

Ownership and Artistic Attribution

Many leaves belonging to the accordion album have been attributed to Herat in Afghanistan, and the dedication on leaf MS M.386.3r connects the album to both ownership and place. The dedication reads, "In the library of his excellency (whose) watchword is justice Husain Khan Shamul, the Governor of Herat." Husain Khan Shamul was appointed as governor in 1598 and was arguably the most powerful man in Persia for the following two decades. He was a known patron of the arts, as was his son Hasan Khan, who likely would have inherited the album.

Below the dedication to Husain is a second inscription, "the painter Muhammad Mu'min' a native Herat artist." Although this miniature is suspected to be a copy, another leaf in the group, MS M. 386.5, has been attributed to the artist's hand (Schmitz 1997, 125). Other miniatures within the group have been attributed to artists working in Persia during Husain and Hasan's time. Furthermore, 16 leaves of this group have eight signatures of Persian calligraphers. Dedications and signatures like this help attribute leaves to album origins.

Calligraphic Fragments

Many leaves of the accordion album have been framed with calligraphic fragments on the inner border, around the centerpiece. This technique was known to be common in Persia and Turkey during the 16th century and later used in India during the 17th century (Schmitz 1997, 112). Translation of calligraphy fragments reveal that the leaves are connected in a literary sense, something that has been overlooked by Western owners in the past. Wheeler Thackston translated the poetry and prose within the Read Album Leaves collection in the 1990s and found that many of the calligraphy fragments adhered to inner borders across separate leaves had been cut from the same older manuscript. For

Fig. 1. Example of a leaf from the accordion style album shown on the left (MS M.386.11r) and an example of a leaf from a codex style album on the right (MS M.458.12r). Credit: Graham S. Harber, edited by Yvonne Hearn.

example, eight leaves in the accordion album were found to have snippets of prose cut from the manuscript *Munajat* by Ansari and pasted to inner borders surrounding the specimens. Figure 2 shows a photomicrograph of a calligraphy fragment adhered to the inner border that is lifting at the lower right edge.

Decorative Frames

There are a variety of decorative frames in the collection and the techniques used to create frames can help determine location and time of manufacture. The gold-sprinkled paper shown on the left of figure 3 is a technique common to both Persian and Indian manuscripts in the 16th and 17th century. The technique involves coating the paper with size and sprinkling flecks of leaf homogeneously over the surface (Wright et al. 2008, 200).

The frame shown in the center of figure 3 (details of the leaf shown on the left of figure 1) is a combination of gold-sprinkled paper and découpage, a paper-cutting technique first used in the Persian book arts during the 15th century (Roxburgh 2005, 67–68). A lemon-shaped cartouche is shown in detail at the upper center of figure 3, and a bar-shaped cartouche is shown in detail at the lower center of figure 3. These shapes have been cut out of a light blue gold-sprinkled paper. A cream-colored paper has been pasted below the lemon-shaped cut-out that is decorated with gold and silver paint depicting playing monkeys (shown in the upper center cartouche). A darker blue paper has been pasted below the bar-shaped cut-out depicting a golden painted bear prowling (shown in the lower center cartouche). Schmitz has more specifically attributed this framing style to Herat during the 1580s, connecting the practice to the reign of Ali Quli Khan Shamlu, who was Husain Khan's father (Schmitz 1997, 116).

Four leaves in the collection have marbled paper frames. The process involves floating colorant in a vat of solution that is then transferred to paper. This decorative technique was used by Persian artists from the late 15th century (Bloom

Fig. 2. Photomicrograph of a calligraphy fragment adhered to the inner border and lifting at the right side (MS M.386.12r).

2001, 72). The marbled borders shown on the right side of figure 3 are of a combed style that were prevalent in Golconda, in the Deccan region of India, during the first half of the 17th century (Schmitz 1997, 113).

Other frames in the collection are pictorial and figural, which can help determine pairings of leaves and reveal insight to cultural inspiration. For example, there are leaves with Chinese-inspired lotus frames, landscape scenes of royal Mughal events such as performances and hunting scenes, and frames that are highly detailed with a geometric illumination such as the leaf shown on the right of figure 1. This style of framing is generally reserved for an album frontispiece or

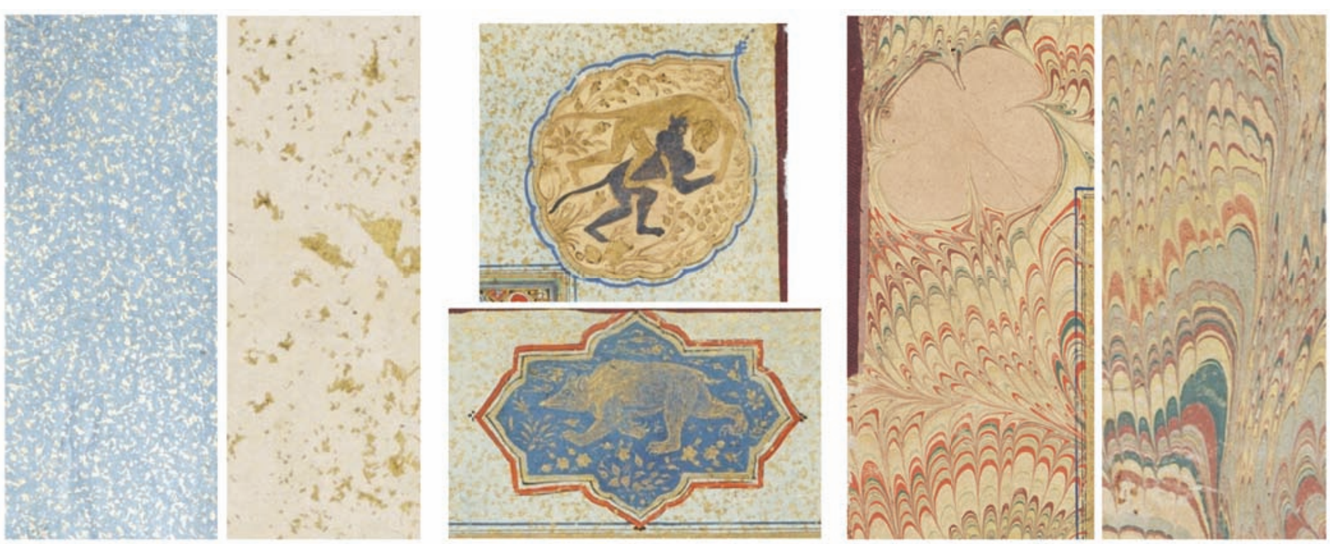


Fig. 3. Example of decorative frames: gold-sprinkled paper (left), gold-sprinkled paper with lemon shaped (upper center), and bar-shaped (lower center) découpage and marbled paper (right). Credit: Graham S. Harber, edited by Yvonne Hearn.

finispiece, which then gives insight to the orientation of such leaves within an album.

Wormhole Damage

The wormhole damage of the collection has been assessed.[3] There are 27 leaves showing evidence of this type of insect activity, and many of these leaves share connecting patterns of loss. When the leaves are arranged by order of wormhole damage, they are not found to be sequential, indicating that the damage likely occurred when the leaves were not bound but rather stacked randomly. Two leaves in a private New York collection were discovered to share the same distinct wormhole losses as those among the Read Albums, and this has served as a connecting nonoriginal feature (Schmitz 1997, 111). One can imagine that these leaves were stored away, perhaps with leaves currently in other collections, after the album was disbound and awaiting reformatting.

Evidence of Reformatting

Evidence of reformatting can be seen among some leaves in the collection. For example, the leaf MS M.386.5 has specimens on the recto and verso attributed to Herat during the late 16th century; however, the marbled frames on the verso are likely connected to Golconda in the 17th century. This suggests that the leaves were possibly reformatted at this time and place.

Leaves MS M.386.18 and MS M.386.21 have been split and reveal many matching torn paper layers and patterns when comparing their split sides. It is possible that they were once originally the recto and verso of the same leaf. A specimen has been removed from leaf MS M.458.35r, and in its place is a label added by a European owner stating "Specimens of Persian Writings & Some as Copies." Although these leaves show damage due to past intervention, they are relatively intact and stable, which speaks to both the extreme treatment and endurance of disbound muraqqa' leaves over time.

Inscriptions and Pagination

Added inscriptions such as seals and pagination have helped scholars trace leaves to albums. One leaf, MS M.458.11, shows a small oval seal of a Japanese collector named Miwa on the recto. On the verso of this leaf, there is a seal of a Persian owner, Fazl 'Ali (1794–1795), as well as an inscription written by an English owner. This demonstrates multiple possessors from different cultures and time. Leaves with Western and Arabic paginations from the codex albums have helped scholars connect them to 18 other leaves in various North American and international institutions. Western paginations added to these leaves do not necessarily fit the speculated order or orientation of the original albums (Schmitz 1997, 118) and therefore are a reminder of Western misunderstanding or misinterpretation of muraqqa'.

It is important to acknowledge both the original and nonoriginal features in which the leaves present. This helps to better understand the leaves for what they once were and what they are today while giving insight to their history and treatment between being bound and dispersed.

CONDITION AND HOUSING SURVEY

A Microsoft Access survey was specifically created for the Read Album Leaves as a way to efficiently collect and record data while quantifying findings to serve the collection.

Condition Findings

Data collected included the condition assessment of both the primary support (the centerpiece or specimen) and the secondary supports (the inner borders and frames). The condition of paper components and media were examined under a microscope. It was found that many leaves had media cracking and/or friability that was particularly common in leaves painted with heavy pigments. Some leaves had areas of loss to primary and secondary supports that were fragile and vulnerable to further damage. These types of losses could be related to paper separation or lifting, moisture, and/or insect damage. Secondary supports were often problematic due to their complex layering. For example, there was evidence of paper delamination, often visible at the corners of the leaf. Many leaves had numerous areas of lifting paper components: at the joints or overlap of inner borders, central specimens, and around calligraphy fragments. Examples of some damage described are shown in figure 4.

In summary, the survey found that 15 leaves are in poor condition and require immediate treatment, 36 leaves are in fair and stable condition, and 6 leaves are in good and stable condition requiring no treatment. The 36 leaves, although in fair condition, would benefit from some minor treatment.

Housing Findings

The housing of the collection was assessed for overall condition, hinge function, and materials used. All 57 leaves are housed in archival mats stored inside solander boxes. However, there are many matting inconsistencies observed throughout the collection. For example, many of the leaves are currently housed in mats created during a rehousing project undertaken in the late 1960s. These mats are flimsy and no longer structurally sound. Some have failing linen tape on adjoining boards, and in very few cases there is evidence of media offset or transfer (that may have occurred due to the slightly coarse texture of the mat board). This board is no longer a material used by Thaw Conservation Center preparators.

Some leaves are matted with "semisecure" hinges. These hinges are categorized as semisecure because they do not secure the leaf entirely and allow the leaf to be removed from the mat. Examples of semisecure hinges are shown in figure 5. Examples include paper corners, mat board clamps

Fig. 4. Example of some damage: delaminating paper layers (left), lifting specimen (center), and insect damages and loss (right).

(made with mat board pieces and linen tape that clamp the leaf to the backboard and require a sliding action for removal), and Mylar clips (that clamp the leaf at all edges). All of these systems enable access to the verso of the leaf by fully removing the leaf from the mat. Although this creates free access to the verso of the leaf, it also creates risk of damage to the leaf via excessive handling. The mats' purpose is to support and protect the leaf, so removing the leaf from the mat eliminates this safeguard. Furthermore, some leaves showed damage directly related to semisecure hinges, such as breaking, cracking, tearing, and scuffing at the corners of leaves in close proximity to these hinges. This damage indicates that semisecure hinges are not safely supporting the leaf inside the mat.

Some leaves are v-hinged with gummed linen tape, a material no longer used for this purpose by Thaw Conservation Center conservators, and Japanese paper. Locations of these hinges vary—some leaves are hinged along the upper edge of the leaf, and some leaves are floated—creating access difficulties when attempting to view the verso.

In summary, the survey found that 39 leaves are housed in older-style mats from the late 1960s, and 18 leaves are currently housed in new mats or a combination of new and old (i.e., a new window and old backboard). There are currently 20 leaves that are supported by semisecured hinges such as paper corners, mat board clamps, and Mylar clips. Of the remaining 37 leaves, 31 are v-hinged with gummed linen tape and 6 with Japanese paper. Most of the v-hinges are attached to leaves along the left side enabling a Western-style turn, except for 14 leaves that are currently v-hinged along the upper edge of the leaf.

Fig. 5. Example of semisecured hinges: paper corners (left), linen tape and mat board pieces (center), and Mylar clips (right).

TREATMENT AND REHOUSING

The findings from the survey were used to present the overall state of the collection to conservators and curators. Leaves in poor condition were flagged and made unavailable until they could be treated. Data was quantified to assess the amount of work, time, and associated costs for treating and rehousing the collection.

Treatment

Treatment of the 15 leaves in poor condition was prioritized to redeem access to the leaves. Many of these leaves had friable, cracking, and lifting pigments that required consolidation. This was executed under a microscope using a solution of 1.5% w/v isinglass in deionized water, applied locally with a fine brush. This consolidant was chosen for its high adhesive qualities at a low percentage, coupled with its matte and virtually undetectable drying finish. Areas of paper lifting, damage, and tears were stabilized and repaired using wheat starch paste and a variety of lightweight Japanese papers to strengthen weak areas. Methods of removing linen tape hinges were tested. Successful techniques included the use of a 5% w/v agarose gel in deionized water that proved effective for hinges placed on durable surfaces like original or near original cloth hinges. On more sensitive surfaces such as paper with previously skinned areas, or paper that was soft, dirty, and prone to tide lines, the hinges were slowly and carefully moistened with deionized water using a cotton swab. After the adhesive was softened using either method, the carrier and residue could be removed or reduced mechanically with a spatula. After removing hinges, a solution of 1% w/v methylcellulose in deionized water was applied locally with a brush to damaged or skinned areas to strengthen the surface.

Housing Research and Considerations

Determining appropriate housing for the muraqqa' leaves involved outreach to conservators from other institutions housing similar material to explore processes already in place. A variety of mock-up mats were constructed as a way of testing potential designs, including a double-window mat that displayed both sides of the leaves. However, due to the complex structure and weight of the leaves, mock-up mats designed to display both sides or have removable hinging systems were not feasible or safe. After many conversations and discussions among conservators and curators, it was decided that the housing approach would not detour far from the previous mat style. The assessment of the housing indicated that the most problematic factors are failing older materials and inconsistency of new materials. Therefore, it was clear that the collection would benefit immensely from a new standard mat style that met the functional needs for the collection.

New Housing

An example of the mat style chosen is shown in figure 6 with the following specifications:

- Standard size overthrow window mat with an eight-ply window and four-ply backboard. The eight-ply window provides strength and rigidity to the overall package, ensuring that the leaves do not flex when handled, whereas the depth of window caters to the undulations evident in many of the leaves.
- The leaf is hinged securely on the left side for a Western-style turn following the same direction as the window turn.
- Hinges are made of Japanese paper of an appropriate weight and sympathetic appearance to the leaf in color and surface finish.

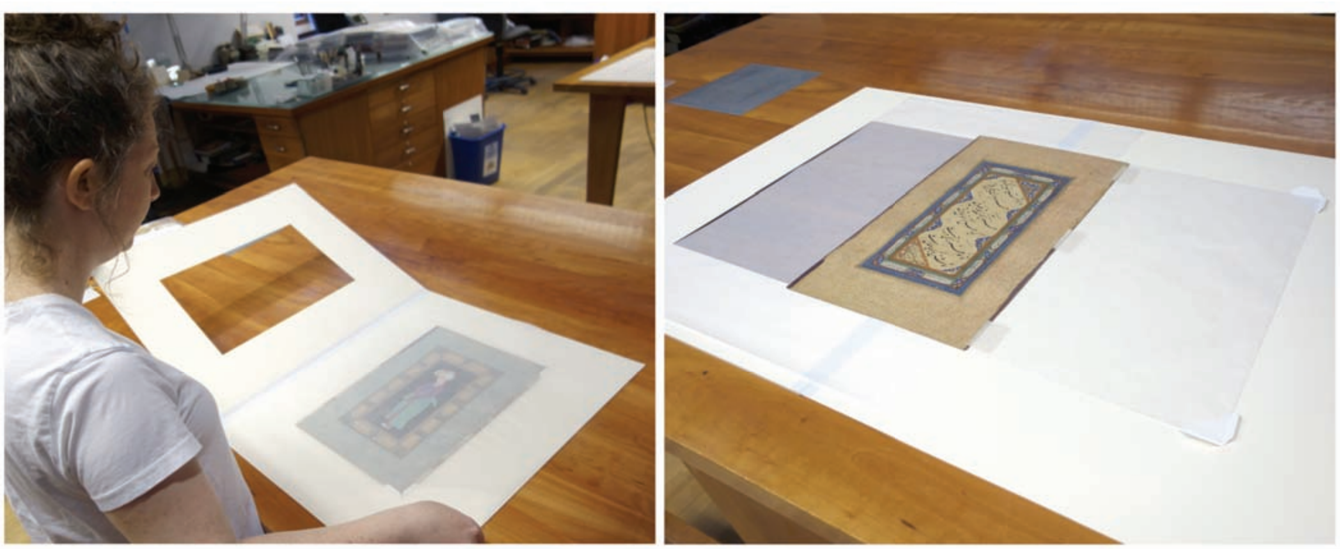


Fig. 6. Example of the mat style chosen for the Read Album Leaves. Opening the window (left) and the leaf turned (right).

- Interleaving is placed between the recto and window, and the verso and backboard (the latter is a preventive measure for future media transfer or offset to the backboard).
- Two small paper corners are attached to the backboard to secure the leaf on the right edge. This will relieve tension from the hinges when the mat is placed upright and is a measure to secure all corners.

This style of mat does create limited access to the verso of the leaf (i.e., the mat has to be opened and the leaf turned to view the verso). However, this method safely supports the leaf, whereas the turning action somewhat resembles the way in which these leaves were once viewed. Before rematting, each leaf will be individually discussed with curators to assess the display side of the leaf in accordance with where hinging can safely be applied. This discussion and review process aims to minimize the need for future rehinging of the leaves. Finally, these matting specifications and handling guidelines have been made available to the Morgan Library & Museum's collection staff.

CONCLUSION

Surveying the collection as a group has allowed conservators to revise condition and housing, which in turn ensures safe future use and preservation. Although the mat style chosen only displays one side of the leaf, it is hoped that this article demonstrates the reasoning behind this conservation decision. This decision is based on the complexity of the leaves, their inherently compromised construction and nature, and their history before and after entering the Morgan collection. As the Schmitz study aims to describe and catalog the Read Album Leaves as a group, likewise this project aims to conserve the leaves as a group. Although the Read Album Leaves are no longer bound physically, it is hoped that understanding the leaves collectively will keep them united to one another and also to those dispersed around the world.

ACKNOWLEDGMENTS

The author would like to acknowledge and extend special thanks to Xiaoping Cai, the 2017–2019 Pine Tree Fellow at the Morgan Library & Museum, for her collaboration during the project, and to colleagues from the Morgan Library & Museum, Frank Trujillo, Reba Fishman Snyder, Maria Fredericks, Lindsey Tyne, Lydia Aikenhead, James Donchez, Joshua O'Driscoll, and Chad Petrovay, for their advice and guidance throughout the project. The author is very grateful to the Sherman Fairchild Foundation for their support of the Fellowship position. Many thanks are extended to the conservators who kindly shared their knowledge and expertise: Kristine Rose-Beers (Chester Beatty Library), Yana van Dyke (Metropolitan Museum of Art), Emily Jacobson (Freer Gallery of Art & Arthur M. Sackler Gallery), and Abigail Quandt (Walters Art Museum). Last, a big thank-you to the AIC and the Book and Paper Group for a terrific 2020 AIC virtual meeting.

NOTES

1. Georges Demotte was a French dealer known to have split the *Late Shah Jahan Album* (ca. 1650–1658), then remounted the split leaves with paper or card before selling to increase profit (Wright et al. 2008, 107). Another known European art dealer, F. R. Martin, extracted leaves from albums at the Topkapi Palace in Istanbul, which are now dispersed in Western collections, and Heinrich Friedrich von Diez (1751–1817), a German diplomat and orientalist, sourced leaves from the Ottomon palace, which he later bound into an album in Berlin (Roxburgh 2005, 15).
2. Miniatures of the Persian accordion album have been attributed to Persia, Bukhara, and Turkey at various times (Schmitz 1997, 114).
3. Prior to the Schmitz study, in the late 1960s William Voelkle, then curator of Manuscripts at the Morgan Library & Museum, assessed the wormhole damage of leaves within this group. Voelkle also made the connection between leaves owned by a private New York collector (Schmitz 1997, 111).

REFERENCES

Bloom, Jonathan. 2001. *Paper Before Print: The History and Impact of Paper in the Islamic World*. New Haven, CT: Yale University Press.

Greene, Belle da Costa. 1911. Letter to Charles Hercules Read, June 1. Morgan Library & Museum.

Hyden, Hannah, and J. Roxburgh. 2018. *Preserved Pages: Book as Art in Persia and India, 1300–1800*. Auburn, MA: Miles Press.

Roxburgh, David J. 2005. *The Persian Album 1400–1600, From Dispersal to Collection*. New Haven, CT: Yale University Press.

Schmitz, Barbara. 1997. *Islamic and Indian Manuscripts and Paintings at the Pierpont Morgan Library*. New York: Pierpont Morgan Library.

Thackston, Wheeler M. 2001. *Album Prefaces and Other Documents on the History of Calligraphers and Painters*. Leiden, Netherlands: Brill.

Wright, Elaine, Susan Stronge, Wheeler M. Thackston, Steven Cohen, Charles Horton, Rachel Smith, and Jessica Baldwin. 2008. *Muraqqa' Imperial Mughal Albums from the Chester Beatty Library Dublin*. Alexandria, VA: Art Services International.

FURTHER READING

Hearn, Yvonne M. 2020. Materials and decorative techniques of the Read Album Leaves. *Thaw Conservation Center Blog*. https://www.themorgan.org/blog/materials-and-decorative-techniques-read-album-leaves.

YVONNE (BONNIE) HEARN
Melbourne, Victoria
ymhearn@gmail.com

IKA YI-HSIA HSIAO

Handle with Care: The Condition Assessment, Treatment, and Care Applied to East Asian Scrolls

BACKGROUND

With growing global interest in East Asian culture, there are increasing requests by scholars and art institutions to view East Asian Scrolls through loans, exhibitions, and in-house research. However, outside of Asia, there are only four museums in North America that have collections rich in East Asian scroll holdings, along with East Asian Conservation Studios: the Smithsonian's National Museum of Asian Art—the Freer Gallery of Art and Arthur M. Sackler Gallery (Freer/Sackler); the Museum of Fine Arts, Boston (MFA Boston); the Metropolitan Museum; and the Cleveland Museum of Art (CMA), where the author currently works.

East Asian scrolls necessitate careful and considered handling due to their complex structure. An East Asian scroll is neither composed of a single layer nor a completed sheet of paper or silk; rather, it can contain multiple layers of silk/paper and paste. A scroll's complicated structure means it could be damaged if displayed, handled, or stored inappropriately. To minimize potential damage, this article introduces East Asian scrolls as cultural objects and then discusses three common aspects of East Asian scroll preservation: conducting condition assessments; performing treatments; and ensuring care through safe display, exhibition, storage, and handling procedures. Since the author's primary responsibilities involve taking care of Chinese paintings, most of the following discussion will focus on objects from China, although the general recommendations will be useful for the care of all East Asian scrolls.

INTRODUCTION TO EAST ASIAN SCROLLS

East Asian scrolls are unique cultural objects in Western countries for three reasons: there are only a small number of East Asian conservation studios in North America; the scrolls themselves are composite objects with a complex structure; and the scrolls as cultural objects have a lengthy history circulating in East Asia and globally.

Because East Asian conservation requires highly specialized training not often taught in Western conservation schools, there are only four East Asian conservation studios among North American museums. All qualified East Asian painting conservators who are currently working in the North American museums have acquired training in Eastern conservation techniques before working in the West. The limited number of specialized facilities means that caring for these objects is the responsibility of a very small number of conservators who have expertise in this field.

East Asian paintings are commonly mounted in four different formats: hanging scrolls, handscrolls, album leaves, and panels. Each format has unique components and requires different techniques. Regardless, there are four criteria that a successful conservator must achieve to mount a good scroll: flatness, flexibility, thinness, and smoothness. For example, Chinese scrolls are created using thin *xuan* paper bound with watered-down paste in specific steps to achieve the thinness to the scroll. For mounting a large scroll, extra layers of xuan paper would be preferred for the final backing instead of using a single sheet of thick paper, which makes the scroll rigid but not flexible. Ideally, a good scroll must be flattened and fixed to a drying board for a whole year. Because the combined silk and paper scroll shrinks and expands while fixed on the drying board throughout the extremes of the changing seasons, the mounted painting is made more resistant to future changes in climate, resulting in fewer undulations. For the final step, a mounted Chinese scroll needs to be burnished with an oval (a smooth stone) and waxed on the back after it is removed from the drying board. This step compresses the multilayers of mounted painting, as well as smooths out the back to make the scroll more compact and easier to roll. With various formats, it adds up more complications when it comes to caring and handling.

In China, there is an adage that goes, "a Chinese scroll mounting plays a more critical role than the artist." Although it exaggeratedly emphasizes the importance of a mounting in

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

a Chinese scroll, this saying does emphasize just how essential a mounting is when assessing the entire object. In effect, a successful mounting takes the same effort as the painting by the artist. The first published Chinese mounting book was *Zhuang Huang* written by a 17th-century scholar, Zhou Jiazhou (1582–1658; Zhou and Shang 2012). There are 42 sections describing mounting techniques in this book. Zhou emphasizes the importance of mounting as it would direct the painting's "life" (Du and Du 1993).

Even today, contemporary scroll mounters still follow similar practices that Zhou detailed in his book. The mounting process for a Chinese painting scroll is labor intensive because it takes 20–30 steps to fully remount a painting. A successfully mounted scroll requires both a skilled mounter and appropriate materials. Attempting to remount a scroll without appropriate training or by misusing materials will result in damage.

An East Asian scroll is known for its rolling system. Much like a book, this rolling system is intentionally designed to be interactive, as it requires manipulation to be understood. When the scroll format was brought to the West, its unique rolling nature stood out since its design inherently protected paintings from dust and light exposure, minimized the amount of space used for storage, and decreased the cost of transportation. However, the complexity of the rolling structure and the fragility of its materials make it vulnerable to damages such as creases and tears that might occur during handling. Unlike the more static character of framed art, the primary challenge for these fragile artworks is the frequent rolling and unrolling required to access their interiors. Because East Asian scrolls have problematic conditions that often result in common damages, there is a need for greater awareness of methods of preventive conservation. It is imperative that people who handle these scrolls have a deeper understanding of their structures and how they are made.

Among the four formats of East Asian paintings, the handscroll and hanging scroll are the earliest ones. The handscroll (fig. 1) refers to the form used for books since the Western Han dynasty, China (202 BC–207 AD), whereas the hanging scroll as a pictorial object has been common in China for nearly 2000 years (Du and Du 1993). Du and Du (1993) state that Chinese handscroll format can be traced back to the Han dynasty. A rolled-up bamboo/wood slip was the earliest format before transitioning to a cloth substrate. Culturally, a traditional East Asian book is read from right to left; therefore, a handscroll is unrolled and is read from right to left, whereas in Western objects, the opposite direction prevails. Because of a long history in the development of Eastern culture, hanging scrolls were used with greater regularity from the 10th century through the Song dynasty (960–1297 AD) (Du and Du 1993). For example, an archeological T-shaped banner, a Chinese Western Han (202 BC–207 AD) painting on cloth (fig. 2) was excavated in 1972, found draped over the coffin of Lady Dai (ca. 168–206 BC) at the Mawangdui tomb near Changsha City in Hunan Province, China.

Fig. 1. A CMA handscroll is displayed on a low-angle platform of an enclosed case.

In another example, two painted fragments—*figure with phoenix* fragment (fig. 3) and *figure with dragon* fragment (fig. 4)—were excavated in 1949 and 1973 in Changsha City, Hunan, China. The *figure with dragon* fragment was found to have a pocket along the top edge, indicating there might have been a stick to help it hang. These objects are primary treasures in the Hunan Province Museum in China and are considered by scholars to be the earliest extant hanging scrolls (Lu 1996).

CHINESE HANDSCROLL STRUCTURE AND ITS DETERIORATION

A handscroll is a long, horizontal piece that opens from right to left. It contains several components, including the painting, silk borders, the first tier of silk, the frontispiece, and the end colophons (fig. 5). Colophons are usually inscribed with calligraphy by collectors or officials to praise the artist and the painting. Once the scroll is passed down through the next collector or generation, a new piece of colophon with or without inscription might be added at the end of the colophon when remounting it. Therefore, a handscroll is composed of paper/silk elements with different ages, various texture, and thickness. First, each element is individually lined with paper and paste. This process is called the *first lining*, and the paper used for this first lining is called the *life paper*, indicating the importance of this procedure. Each component is lined, flattened, and straightened before being narrowly joined to one another in a specific sequence, forming a long, horizontal piece. Then, the final backing, which consists of two layers of xuan paper laminated together, is applied to the back of the long, horizontal piece. This process is appropriately called the *final backing*. Because each consecutive lined component is narrowly joined with a thicker paste than the one used on

Fig. 2. The T-shape banner was excavated in 1972 at the Mawangdui tomb, China.

Fig. 3. *Figure with phoenix* fragment was excavated in 1949 at the Mawangdui tomb, China.

Fig. 4. *Figure with dragon* fragment was excavated in 1973 at the Mawangdui tomb, China.

the first lining process, the joins of the final backing must be overlapped in a way that staggers them apart from the joins of the first lining to ensure the greatest strength and stability (fig. 6). This explains why many joins are seen when viewing a handscroll with transmitted light.[1]

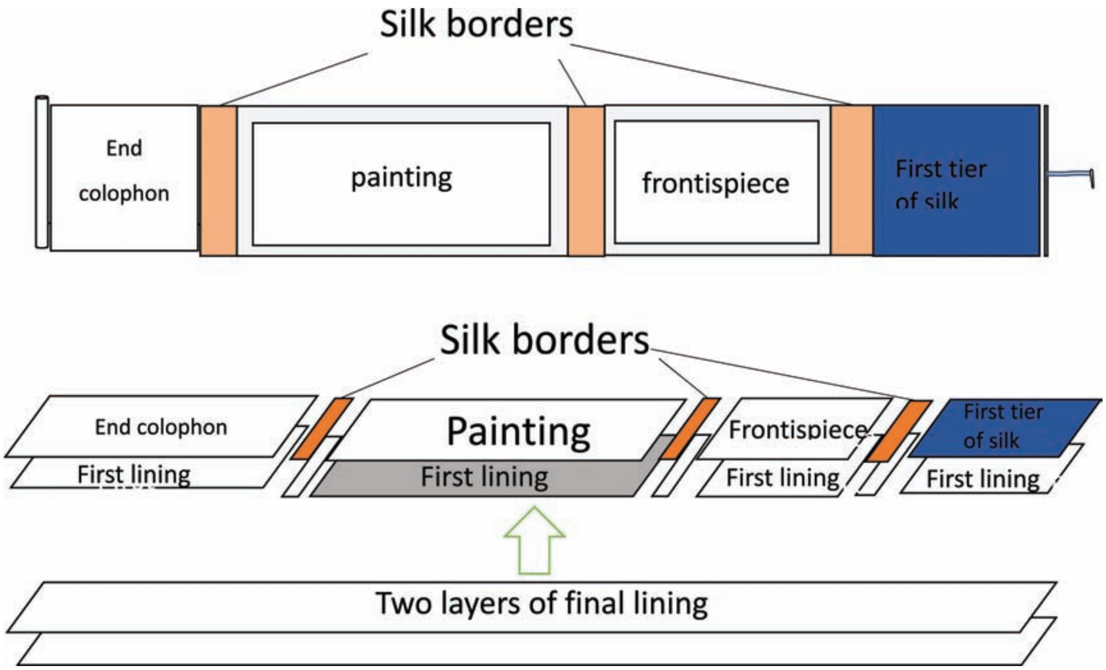


Fig. 5. An illustrated handscroll structure.

When a tear occurs in the joined section of a handscroll, the first lining may still be intact, whereas the two layers of final backing may be torn instead. By understanding the structure of the handscroll, it is thus easier to understand whether or not a tear is less severe (if it occurred in the final backing) or more severe (if located in the substrate). Another common damage that occurs with East Asian scrolls is delamination of layers, which is often seen on the back of scrolls. Therefore, understanding the inherent structure of a scroll will enable the caregiver to ascertain the level of treatment that is required.

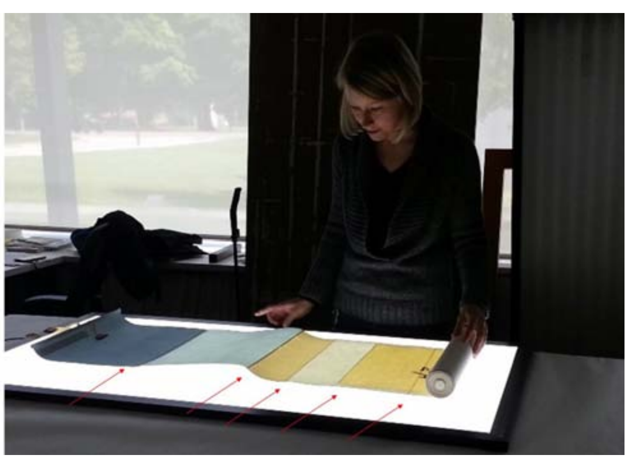


Fig. 6. Viewing a handscroll with transmitted light by Sara Ribbans, the CMA's East Asian painting conservator.

CHINESE HANGING SCROLL STRUCTURE AND ITS DETERIORATION

A hanging scroll is a long vertical piece that hangs on the wall. The overall dimension typically ranges from 6 to 8 ft. in height and 2 to 4 ft. in width. Traditionally, they used to be hung with a bamboo stick containing a metal fork at the top, as seen in the character wearing pink in figure 7. This traditional method is considered risky if one is not familiar with this tool, because the metal fork at the top can become loose over time.

Fig. 7. Hanging a hanging scroll bamboo stick; *The Eighteen Scholars*, painting by Anonymous in the Ming dynasty, China (1368–1644). Taipei Palace Museum, Accession No: 000859-00000.

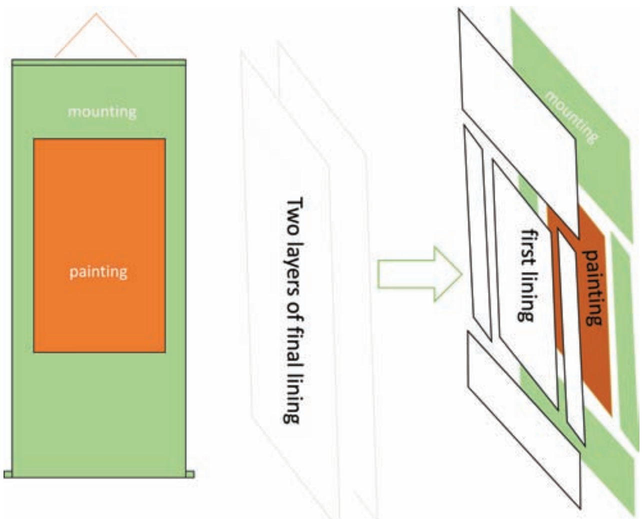


Fig. 8. An illustrated Chinese hanging scroll structure.

Structurally, there are three to five layers mounted on the back of the painting in a hanging scroll. These multiple layers are not continuous and have different dimensions. Figure 8 shows, from the right to left side, the painting with its mounting silk: the first lining layer and the two layers of final backing. Like handscrolls, the painting substrate and the mounting silk of a hanging scroll are lined with their own separate first lining. Then each lined piece is narrowly joined to each other with thicker paste to form a longer piece. Two long sheets of xuan paper are laminated ahead of the final backing process, and then this long, laminated sheet is applied onto the back of the previously joined piece with paste. Uniquely, each process requires different thicknesses of paste. Although delamination can happen with each layer, the most common delamination for Chinese hanging scrolls usually occurs after the first lining and before the final backing.[2]

CONDITION ASSESSMENT

Common deterioration present in scrolls can be divided into physical, chemical, and biological causes. Physical and chemical damages are more frequently seen in scrolls in North America and include substrate/paint lifting, creases, and delamination.

The author uses a system to assess damage through assigning grades from 1 to 5, with 5 being the most severe and 1 being the least (chart 1). Painting damages that are on the left of the chart, including lifting paint and lifting substrate, are the most severe. Creases, tears, and cockling can yield a fair condition designation. Delaminating layers can vary depending on which layers are impacted.

The right side of the chart indicates mounting damages, which can include a loose tying cord, a loose hanging cord, or loose or missing knobs, which are also graded on a scale of

Chart 1. Common Damages Seen in Scrolls

Painting	Mounting
Lifting paint (5)	Loose tying cord (1-5)
Lifting substrate (5)	Loose hanging cord (1-5)
Creases/tears/cockling (3-4)	Loose knobs or missing knobs (1-5)
Delamination (3-4)	Lifting silk threads/fringes (1-2)
Discoloration (1)	Creases (2-3)
Dirt (1)	Delamination (2-3)
	Discoloration (1)

Note: Damage is graded from 1 to 5, with 5 being the most severe.

1 to 5. Although these damages can be easily remedied, it is critical that they be noted because the scroll might fall during or after it is installed. Other mounting damages like lifting silk threads or fringes, creases, delamination, or discoloration on the mount are typically less severe and can be treated with remedial methods. However, one damage that cannot be undone and can be quite severe is light damage. Additionally, cosmetic issues such as discoloration and dirt can be difficult to treat and require primarily preventive conservation methods for their preservation.

The following are a few examples of common damages and simple measures that can be taken to address them:

- *Lifting substrate* (fig. 9): Cover the flaking area with a slightly bigger sheet of rayon paper as a triage method if the scroll needs to be rolled up. Put a note in the scroll box to warn handlers to avoid unrolling until the lifting substrate is secured.
- *Sharp creases* (fig. 10): These can lead to pigment flaking, substrate tears, or cracks; thus, cover these areas with a slightly bigger sheet of rayon paper to roll up the scroll.
- *Silk substrate loss* (fig. 11): Although silk substrate loss might look severe, it is sometimes stable if the old inpainting shows on the first lining. Usually it can easily be determined whether the damage occurred before the object's previous conservation treatment (see fig. 11, left). By contrast, if there is no old inpainting on the first lining, then this might indicate that the flaking occurred after its last conservation treatment (see fig. 11, right). Avoid rolling the scroll until a

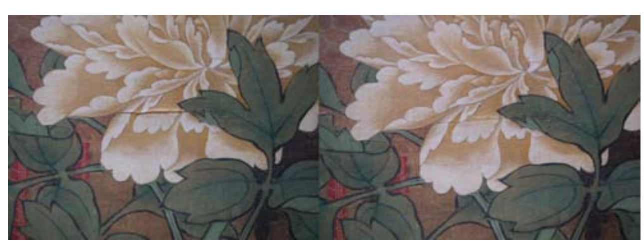


Fig. 9. Left: Lifting substrate before treatment. Right: Lifting substrate after treatment.

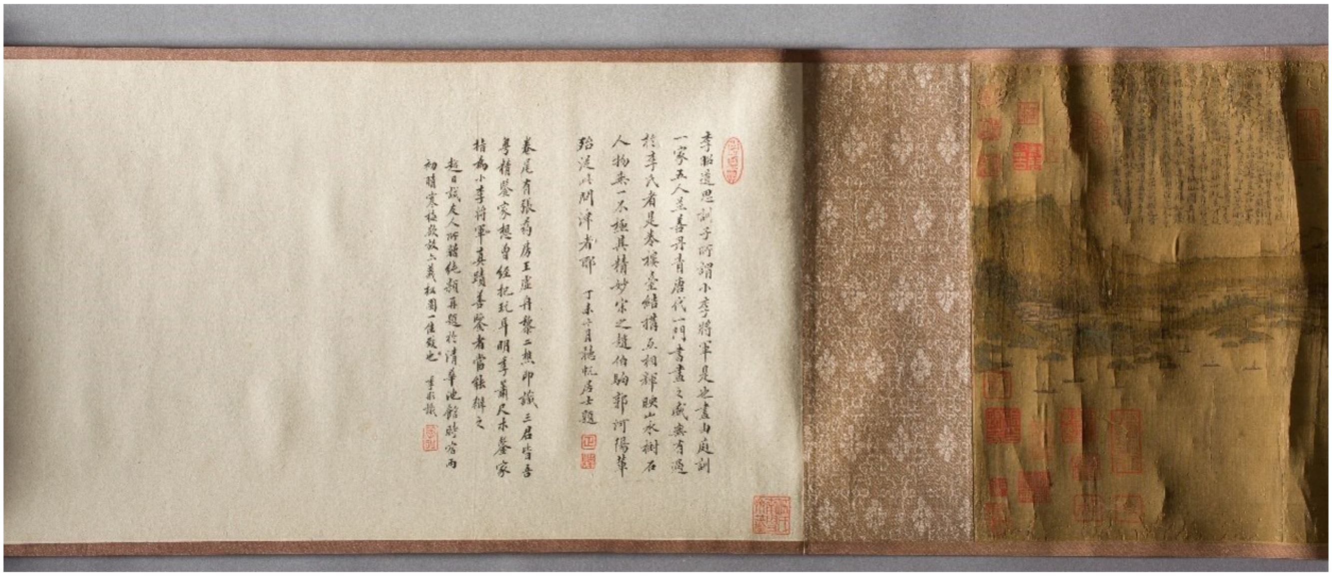


Fig. 10. Sharp creases shown in the right of the handscroll *Waiting for the Moon in the Mid Autumn Festival*, Shi Rui (Chinese, ca. 1400–1470). Cleveland Museum of Art, Accession No: 1973.72.

stabilizing treatment can occur. The substrate on the left is relatively stable compared to the right.

- *Delamination* (fig. 12): This can occur between the final and first layers, the substrate and first lining layers, and the two final layers. Delamination between the two-layered final layer is less severe because this layer is the farthest from the substrate, whereas the delamination between the substrate and the first lining is the most critical. The single layer of the substrate is usually made of a sheet of thin xuan paper or silk, so it is vulnerable to damage without the support of the first layer. Should this delamination occur, it is the most in need of urgent treatment. Restrict handling until treatment.

REMEDIAL MINOR TREATMENT

The following are common damages and proposed treatments:

- The flaking paint layer can be consolidated with a gelatin solution.
- The flaking substrate and delaminating mounting silk joins can be secured with paste.
- Loose mounting threads can be adhered to the fabrics with a mixture of Japanese seaweed solution, *funori* or methylcellulose, and paste. The proportion can vary depending on how weak the mounting silk is.

Fig. 11. Identifying new and old flacking of pigment and substrate: the substrate is relatively stable on the left compared to the right.

Fig. 12. Delamination between layers.

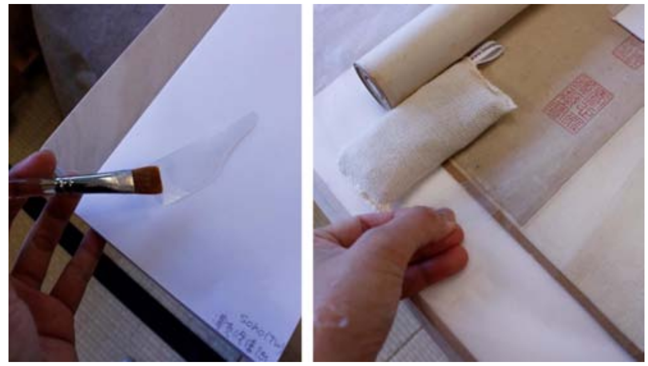


Fig. 13. Inserting paste into the delaminated layer. The picture on the left shows the shaped Mylar was pasted, and the picture on the right shows the pasted Mylar was inserted into the delaminated layer as a carrier.

- The final backing delamination can be injected with a thinner paste by a syringe followed by weighting with the "sandwich" method. If extensive delamination is seen on the back of the final layer, inserting paste would cause new stains or stiffness. It would then need a full remounting.
- The tears can be patched with pasted and toned *kozo* paper, which is known for its long fibers and semitransparency. Even though Chinese scrolls are lined with xuan paper, the tears should be patched with a Japanese kozo paper for remedial minor treatment, as xuan paper is lacking strength.
- The delaminated layers can be secured by inserting a pasted Mylar strip as a carrier (fig. 13, left) trimmed in various shapes between layers (see fig. 13, right). Abrading this surface with sandpaper can help to carry more paste.
- Although some Chinese painting conservators use double layers of xuan paper strips to mend the creases on the back of Chinese scrolls, the author adopted long-fibered paper such as Japanese kozo paper to mend creases (fig. 14). The creases need to be reinforced with one or two layers of strips of Japanese kozo paper on the back of the scrolls. The Japanese sheet of kozo paper is first trimmed along the fiber direction, which is positioned perpendicular to the paper chain line with one wider and another one narrower. The wider and narrower trimmed strips are then laminated with paste ahead of time, with the narrower strip on top of the wider strip like steps, and then air-dried. These premade strips reduce moisture and minimize tide lines or undulations on scrolls. Having stepped edges also avoids sharp edges from forming when the scroll is rolled. Using feather-cut edges is not recommended, as the feathered edges absorb more paste and "grab" the paper more aggressively, resulting in undulation and delamination. When all creases are reinforced, humidification with the sandwich method, which, introduced in the next section, is usually executed as a final step to reduce undulation.

Fig. 14. Reinforcing strips application. (1) Twist off the prelaminated strip to be a bit longer than the length of the crease. (2) Paste and lay down the strip along the direction of the crease. (3) The upper circle shows the dried strip using the stepping technique, and the lower circle shows the old strip with two laminated xuan paper strips without the stepping technique. (4) Immediately insert the rayon paper and blot on the top of the treated areas along with weights. (5) Because the process can take more time in relation to the extensiveness of creasing, do it on a big table from one direction with raking light to avoid missing any areas.

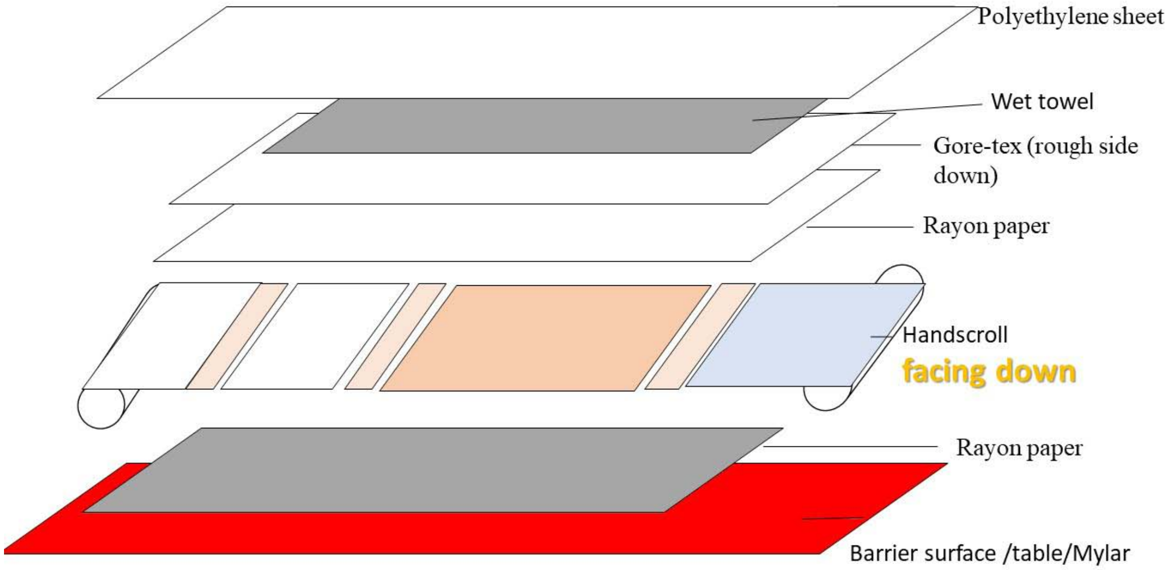


Fig. 15. The illustrated sandwich method for humidifying.

- After applying the paste on the substrate or gelatin on the paint layer, the layers of a scroll begin to expand and shrink as the treated areas move between wet and dry. The treated areas would not be as flat as before treatment, so humidification with the sandwich method, done in sections, can be executed after all components have been made secure (fig. 15). Because the scroll is a complex structure, the timing of moisture introduction is critical, and every scroll absorbs moisture differently. Some scrolls have wax on the back due to the traditional method of burnishing the back with stone and wax. The waxy surface will prolong the humidifying process. Some areas absorb moisture efficiently, whereas other areas do not. Stubborn areas need to be humidified beforehand. For instance, the reinforcement strips on the top of the final backing are more resistant to moisture, so those areas need more moisture. A small amount of water can be introduced with a small brush on the strips, not around them. Please note that the sandwich technique is not as efficient if the undulation is severe.

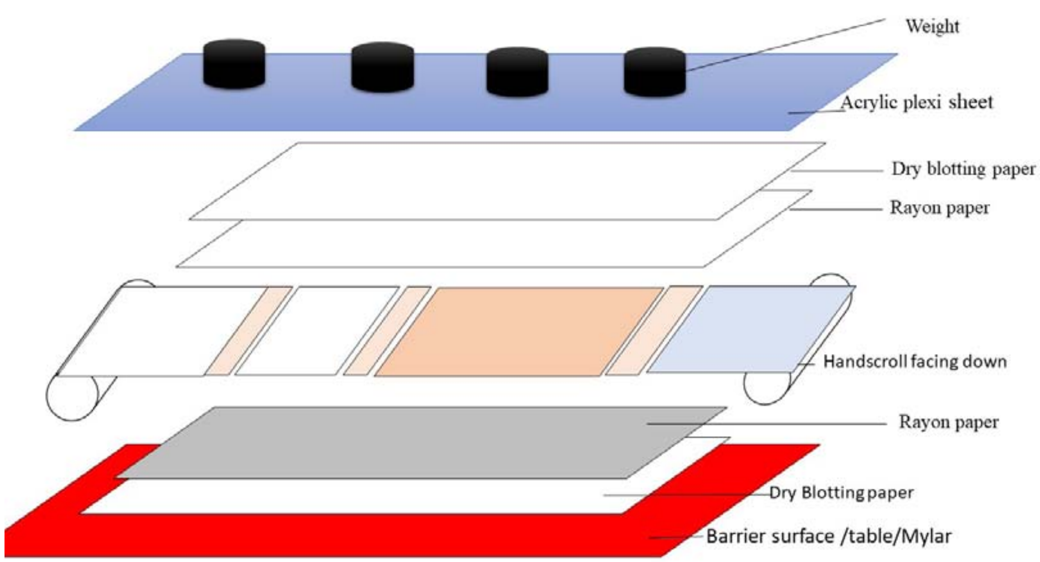


Fig. 16. The illustrated sandwich method for flattening.

- Once the humidification process is completed, the wet towel is removed, and two dry blotting papers are quickly inserted on the top and bottom. A sheet of Plexi and weights are then applied to the top (fig. 16). Change the blotting paper as needed. Because the scroll is long, this process can be repeated with different sections. The moisturized section should be ended at the joined sections to prevent undulation. Two or three people are recommended because this process should be conducted as fast as possible to avoid shrinking. Because the Chinese scrolls are relatively large, larger sizes of blotting paper can be butt-joined lying down.[3]

CARING FOR THE SCROLLS

Museums like the CMA encourage the public to access their collections. With more access to the collection, instituting a handling policy will ensure that damage is limited. Such a policy should prohibit pens or mechanical pencils from being used near the scrolls when they are unrolled. In the case of mechanical pencils, the graphite might break off, land on the surface of the scroll, and consequently be rolled up, causing abrasive smears or even holes. Readers will find excellent suggestions in developing a policy by consulting "Guidelines for the Care of East Asian Paintings, Display, Storage and Handling" written in 2006 by Andrew Hare, supervisory conservator in the East Asian Painting Conservation Studio of the Department of Conservation and Scientific Research at the Freer/Sackler.

Although museums such as the Freer/Sackler have been offering annual workshops to teach museum staff how to properly handle East Asian Scrolls, the need for sustained and holistic training continues. Because conservators cannot always be on call for requests by scholars to handle scrolls, one of the most effective preventive methods for handling is the use of support pillows that can be custom made at different sizes. The method of making these pillows and the effectiveness of their use in creating a gentler rolling procedure must be demonstrated to those who handle scrolls. In the case of an exhibition, the handling team should receive specialized training in how to handle these objects (fig. 17).

The following are additional handling guidelines for examination, display, storing, and training curators and art handlers:

- Chinese handscrolls have a hard object as a fastener for the scroll. It is called a *toggle* and is usually made with jade (fig. 18), ivory, bone, or wood. By contrast, Japanese scrolls usually have a cord on one end to tie the scroll without a fastener (fig. 19, left). To unroll a Chinese handscroll, the fastener/toggle can be covered with a tissue, which will prevent damage to the handscroll while rolling (see fig. 19, right).

Fig. 17. Training the art handler at the CMA, Tony Cisneros.

- To prevent the handscroll from squeezing while unrolling, a support pillow with a slot can be used (fig. 20). Put the fastener into the slot of the pillow and then roll it together with the handscroll (fig. 21).
- Rolling up a handscroll is more challenging than unrolling. Because the edges of the handscroll are thinner and more fragile, rolling it tidily and tightly is difficult. A couple

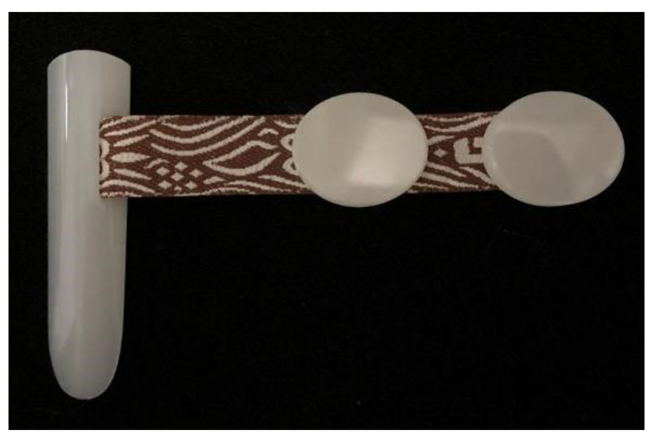


Fig. 18. A jade toggle and a pair of the "bottom roller ends" of the Chinese handscroll.

Fig. 19. Handscroll tying cords. The Japanese one is on the left, and the Chinese one is on the right.

of circles should be rolled up first, then two sides of the handscroll should be gently pressed by placing two hands on both sides simultaneously to keep the sides tidy. Roll up the scroll sectionally until the handscroll is fully rolled up from left to right. If the handscroll's "bottom roller ends" (see appendix 1) is missing, it will be difficult to roll the handscroll tidily (fig. 22).

- For displaying a handscroll on a flat platform/case, some museums prefer angled surfaces for viewing comfort. If the platform is not flat, a 30° angle is acceptable with a stopper to prevent the scrolls from sliding down. The ends of the bottom roller in Chinese handscrolls are flat, and thus supports can be made to keep the scroll from sliding down (fig. 23, right). By contrast, the knobs of a Japanese handscroll stick out, and thus two pins can be installed to secure the scroll (see fig. 23, left).
- When handling a hanging scroll, determine if the scroll can be hung. A loosened knob is sometimes missed while condition checking. Check that all components are secured as well.

Fig. 20. A customized support pillow is used in unrolling a handscroll.

- If it cannot be hung due to the torn hanging cords or loosening "copper eyelets" from the "hanging stave" (see appendix 2), the scroll should be unrolled on a big steady table with a sheet of white acid-free paper on top. The white sheet helps with spotting new flaking. A restricted note can be put in the storing box with the handling instruction.

Fig. 21. The handscroll pillow slot.

Fig. 22. A handscroll is missing a "bottom end."

Fig. 24. Only hold the bottom roller with hands, leaving space away from the roller. Japanese painting conservator, Philip Meredith, demonstrates handling a hanging scroll at the MFA Boston.

- When unrolling and rolling scrolls, clean hands are preferred instead of gloves because of the need to have a sensory experience of the scroll to understand its condition.
- If the hanging scroll can be hung on a wall, spot weak points first, and determine the best locations for handling. The weak areas of an ancient hanging scroll usually are located along the edges and at the fabric near the hanging stave. After hanging the scroll with a hanging cable on a wall, one should unroll with only fingers, leaving out some space from the wall and the bottom roller (fig. 24). Avoid touching the roller with palms, as sweat and oil from the palms can easily transfer to the scroll.
- When displaying a large hanging scroll, use three hanging points to hang (fig. 25, right) and a set of J-hooks at the bottom for additional support. The fixed hooks can be distracting since they stand out. After toning the J-hooks with paint, they become almost invisible to the audience (see fig. 25, left). Many museums already hang scrolls with J-hook supports. Yet these J-hooks must be fixed to the back wall or board. The backboards might be damaged and leave a hole behind, which makes reuse difficult without repairing the holes. At the CMA, the hanging scroll backboard is a layer of fabric on a wooden structure, with no solid back to affix the J-hooks. The CMA's mount maker, Philp Brutz (2020), designed a set of two hooks on the sides of the scroll that connect to hanging cables (fig. 26). The scrolls are secured by the hanging cable at the top and the J-hooks at the bottom using the same hanging cables. This balances the weight between them. These J-hooks are reusable because they can be detached from the hanging cable.
- If the hanging scroll is too long or the exhibition space has a low ceiling, an upper roller support is required for hanging (fig. 27). The original design was borrowed from the MFA Boston and then modified by Philip Brutz (2020) to further strengthen it. If the tying cord is too torn to use as a hanging mechanism, this upper roller system can be applied to unroll the scroll and hang on a wall for photograph or examination (fig. 28).
- Since the diameter of the rolled scroll on the bottom is narrower than on top, creases are more likely to occur in this area. For this reason, increasing the diameter

Fig. 23. Provide stoppers from shifting. The Japanese handscroll is on the left, whereas the Chinese one is on the right.

Fig. 25. Left: J-hooks with toning paint. Right: There are three hanging points at the top.

Fig. 26. Left: Metal supporting J-hooks. Right: The J-hooks are behind the hanging scroll.

Fig. 27. A detailed picture of upper roller support for a hanging scroll.

Fig. 28. An upper roller support is useful when examining a hanging scroll on a wall viewing with transmitted light.

Fig. 29. A customized support is recommended to increase the diameter of the bottom roller of a hanging scroll. On the left, a scroll is inserted with a tunnel-shaped Zoneform tube that is wrapped with a stockinette. On the right, a scroll is inserted with an acid-free paper tube with a slot that is attached with a sheet of paper for carrying the bottom roller.

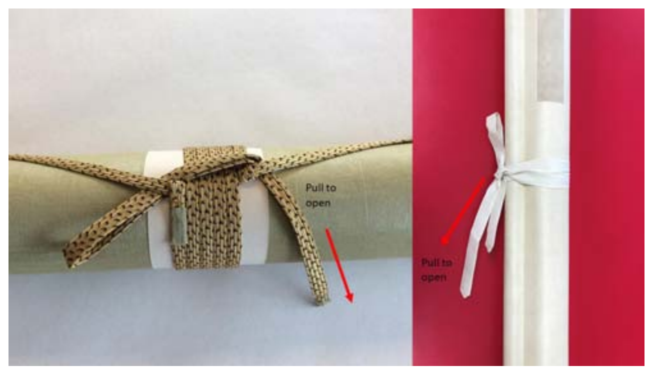


Fig. 30. Left: The Japanese hanging scroll tying cord. Right: The Chinese variation. The red arrows show where to pull to open the tie.

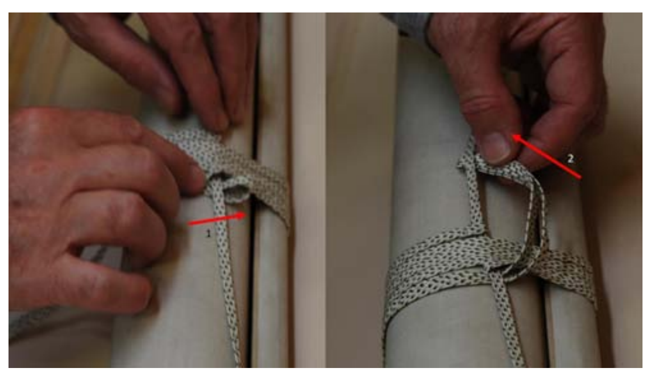


Fig. 31. The tucking sequence for a Japanese tying cord.

when rolling up the scroll should minimize creases. To prevent creases through increasing the diameter of the scrolls, the bottom roller of an oversized Chinese hanging scroll can be inserted into a modern customized support that is made of an acid-free paper tube or

Fig. 32. Paper slip on a handscroll.

Zoneform to shape the tunnel, then wrapped with a stockinette (fig. 29).

- Tying and untying Chinese hanging scrolls is different from that of their Japanese counterparts. Chinese hanging scrolls, as depicted in the right side of figure 30, have two ends to form a bowtie. The red arrows show where to pull open the tie. There is only one end for the Japanese tying cord. After several circles, the cord needs to be tucked in (fig. 31).
- The cover silk of a scroll will be naturally abraded over time by the tying cord. Placing a slip of long fiber paper around the scrolls where the tying ribbons are fastened will protect the cover silk (fig. 32). Some East Asian museums prefer wooden Paulownia boxes to store scrolls, whereas an acid-free box and muslin fabric wrapper are often used in North American museums due to materials accessibility and budget concerns.
- Finally, training for handling must be made available to museum staff to reinforce and refresh their knowledge of these issues. In this way, new discussions regarding sustainability can continue on a yearly basis.

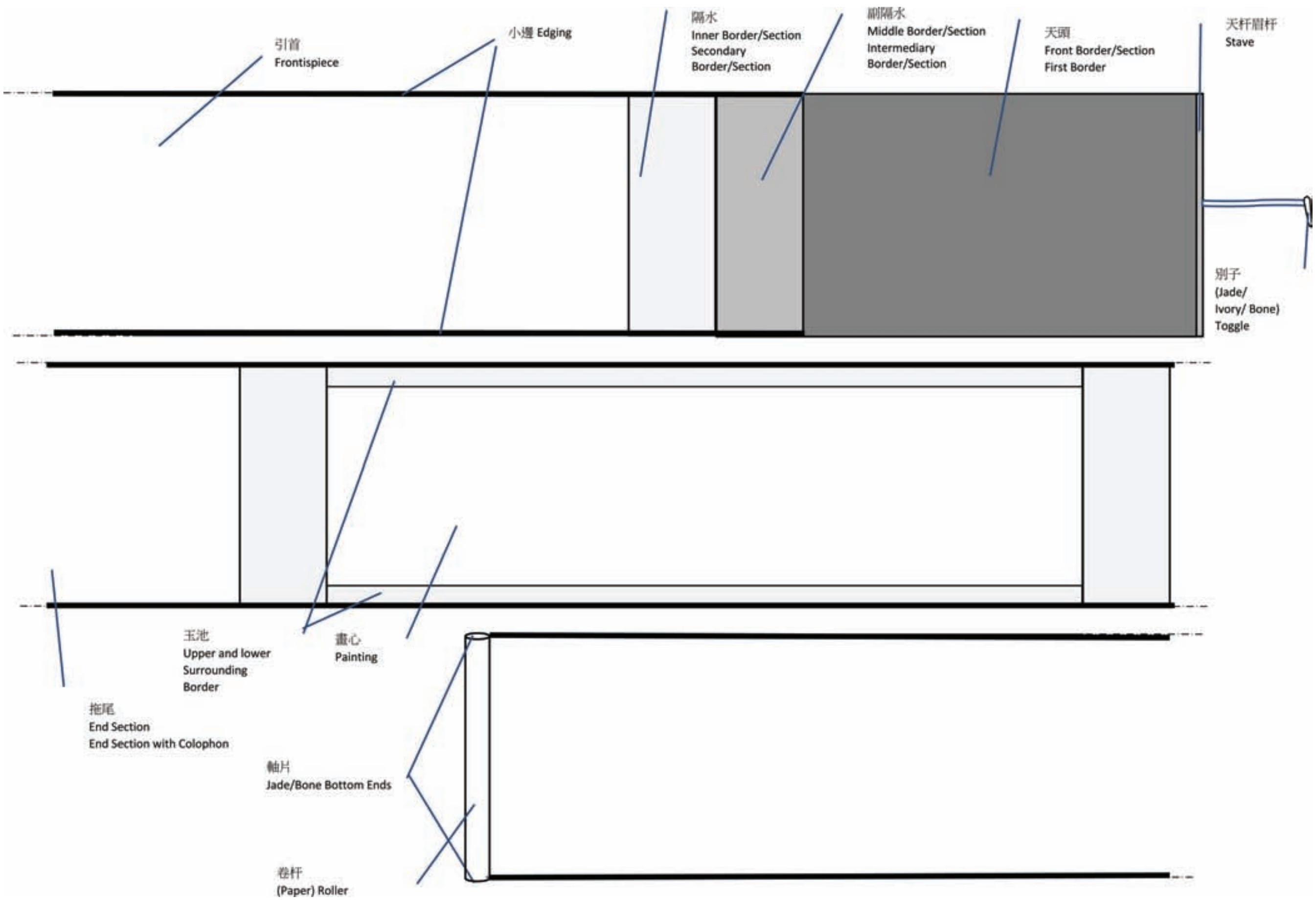
ACKNOWLEDGMENTS

The authors are grateful to Sarah Scaturro, Sara Ribbans, and Philip Brutz of the Cleveland Museum of Art; Xiangmei Gu, Andrew Hare, and Grace Jan of the Freer and Sackler galleries; and Jing Gao, Philip Meredith, Jacki Elgar, Tanya Uyeda, and Hsin-Chen Tsai of the Museum of Fine Arts, Boston.

APPENDIX

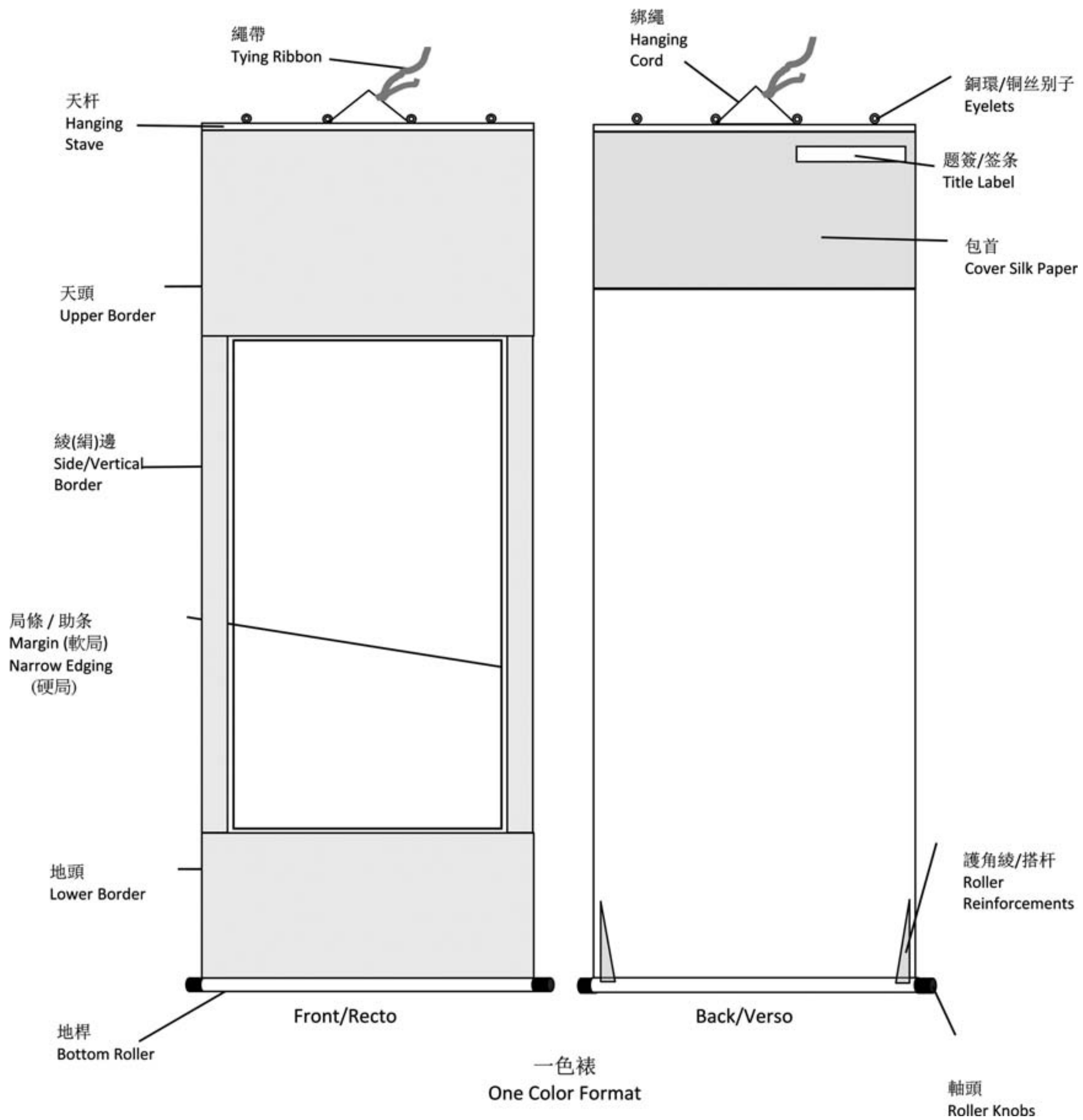
All terminologies in the appendixes are defined and translated by the team of Hsin-Chen Tsai, Grace Jan, Melody Chen, Qian He, Zhizhao Lv, Jiangxiang Zhou, and the author with supervision by the East Asian painting conservators at the Museum of Fine Arts, Boston and the Freer and Sackler galleries.

Appendix 1

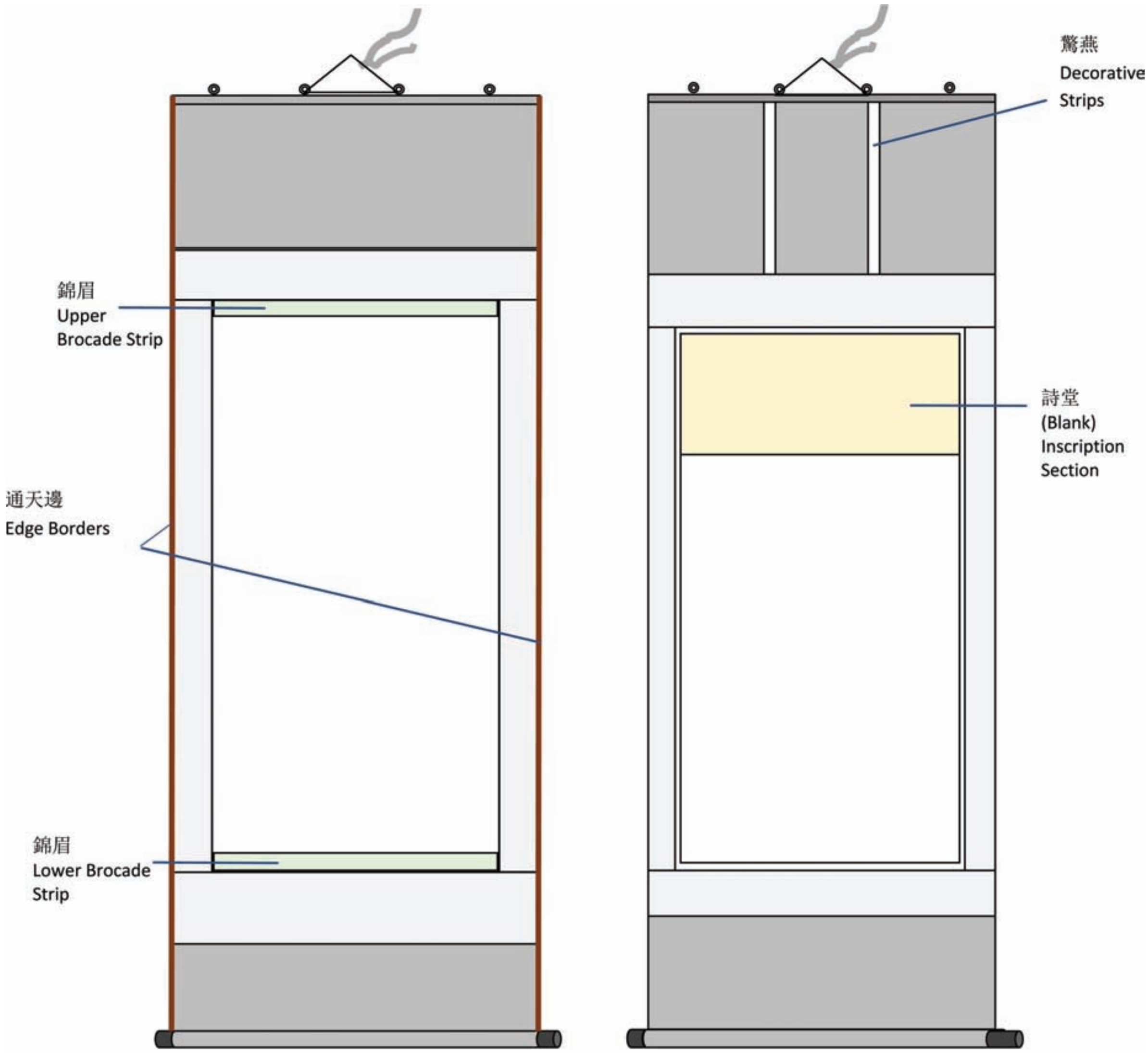


引首
Frontispiece
小邊 Edging
隔水
Inner Border/Section
Secondary
Border/Section
副隔水
Middle Border/Section
Intermediary
Border/Section
天頭
Front Border/Section
First Border
天杆眉杆
Stave
別子
(Jade/
Ivory/ Bone)
Toggle
玉池
Upper and lower
Surrounding
Border
畫心
Painting
拖尾
End Section
End Section with Colophon
軸片
Jade/Bone Bottom Ends
卷杆
(Paper) Roller

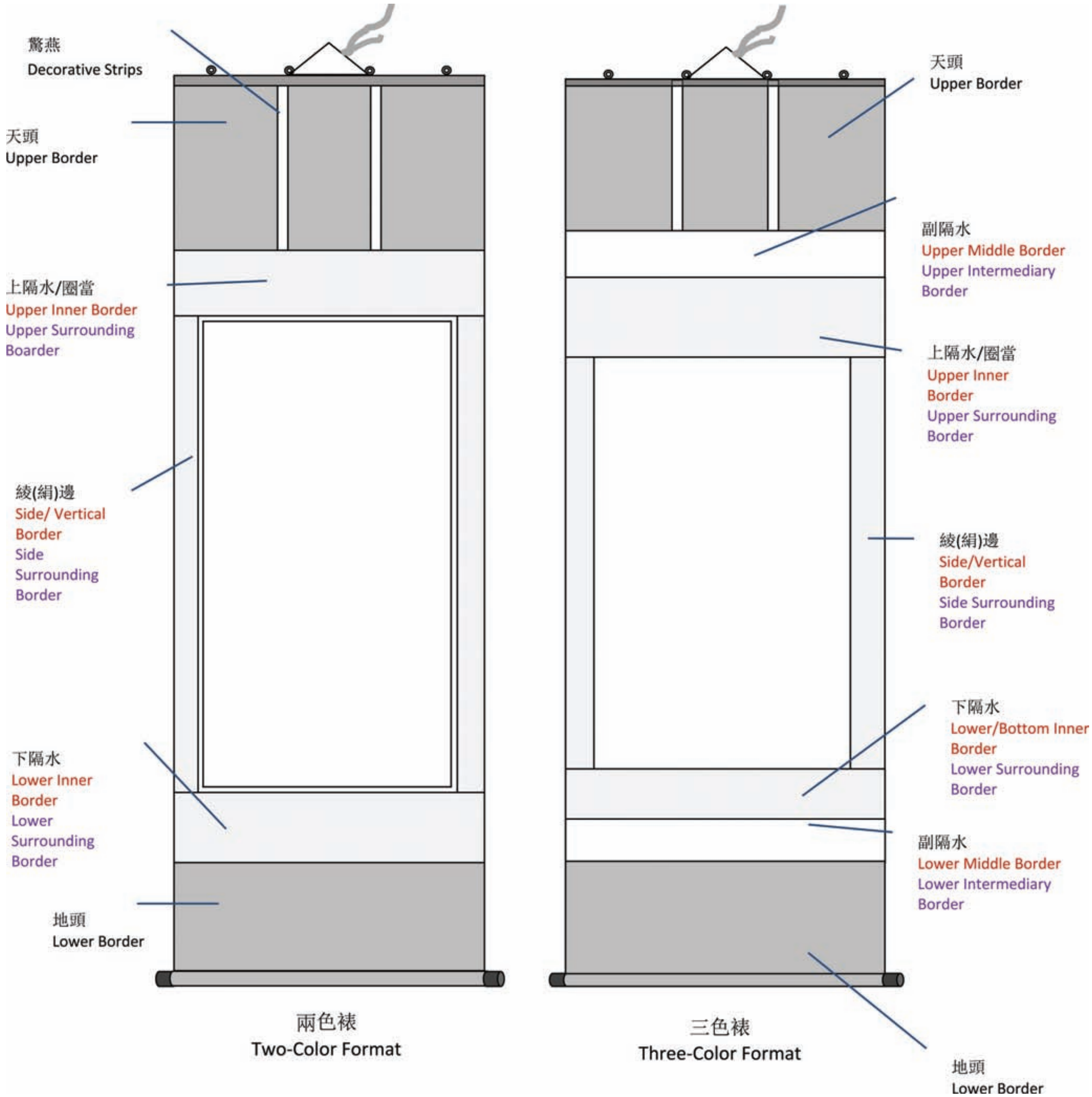
Appendix 2



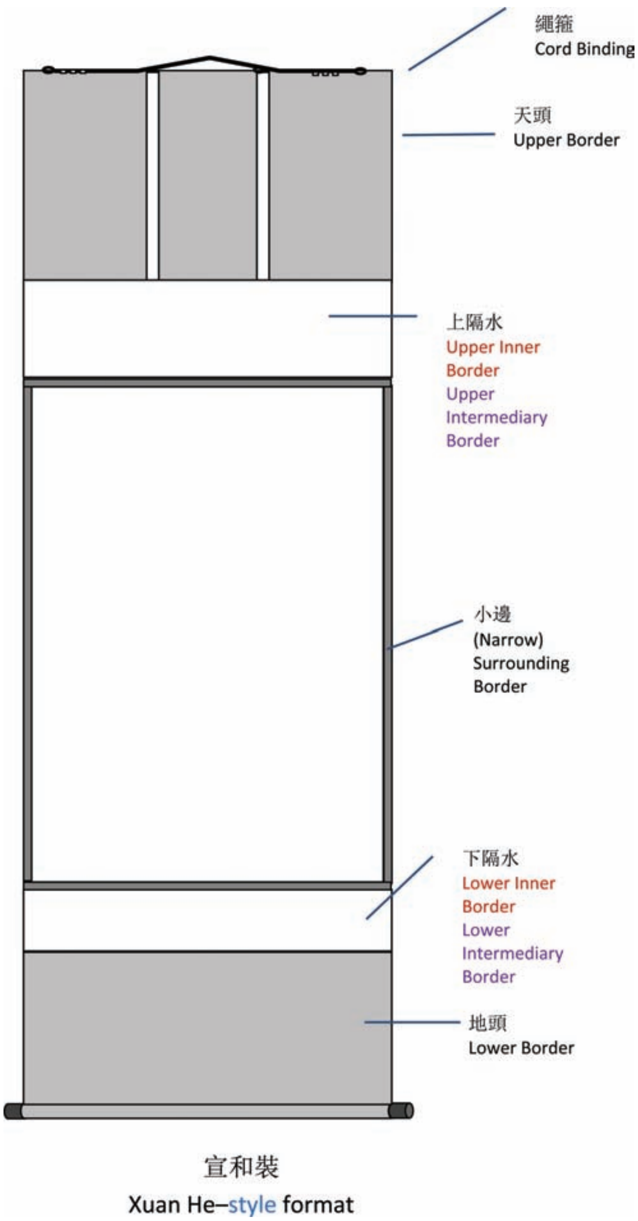
一色裱
One Color Format



兩色裱
Two-Color Format



驚燕
Decorative Strips
天頭
Upper Border
上隔水/圈當
Upper Inner Border
Upper Surrounding Boarder
綾(絹)邊
Side/ Vertical Border
Side Surrounding Border
下隔水
Lower Inner Border
Lower Surrounding Border
地頭
Lower Border
兩色裱
Two-Color Format
天頭
Upper Border
副隔水
Upper Middle Border
Upper Intermediary Border
上隔水/圈當
Upper Inner Border
Upper Surrounding Border
綾(絹)邊
Side/Vertical Border
Side Surrounding Border
下隔水
Lower/Bottom Inner Border
Lower Surrounding Border
副隔水
Lower Middle Border
Lower Intermediary Border
三色裱
Three-Color Format
地頭
Lower Border



NOTES

1. Japanese handscroll has fewer joins when viewing under transmitted light because the final backing step for a Japanese handscroll is in a different sequence.

2. The final backing process for Japanese hanging scrolls uses different materials and techniques such as aged paste, kozo paper (misu and uda paper), and brushes. Therefore, the delamination mentioned applies to Chinese hanging scrolls only.

3. The sandwich method technique, followed by remedial minor treatment for scrolls, has been commonly practiced by Xiangmei Gu, the senior Chinese painting conservator, of the Smithsonian's National Museum of Asian Art—the Freer Gallery of Art and Arthur M. Sackler Gallery.

REFERENCES

Brutz, Philip. 2020. Personal communication. Cleveland Museum of Art, Cleveland, Ohio.

Du, Bingzhuang, and Zixiong Du. 1993. *Shu hua zhuang biao ji yi ji shi.* Shanghai: Shanghai gu ji Book Co.

Hare, Andrew. 2006. "Guidelines for the Care of East Asian Paintings, Display, Storage and Handling." *Journal of the Institute of Paper Conservation* 30 (1): 73–92.

Lu, Zongrun. 1996. "Shuhua zhuanbiao di qiyuan (The Origin of the Mounting of Chinese Paintings and Calligraphic Works)." *Bulletin of National Museum of History* 6 (4): 94–96.

Zhou, J., and L. Shang, eds. 2012. *Zhuang Huang Zhi—Zhonghua Shenghuo Jingdian*. Beijing: Zhonghua Book Co.

FURTHER READING

AIC Wiki. 2020. Terminology (Illustration: Chinese painting terminology for hanging scroll and handscroll). http://www.conservation-wiki.com/w/images/a/a6/Chinese_hanging_scroll_terminology_and_diagram_26July202.pdf.

East Asian Painting Conservation Studio. 2017. Making East Asian Scroll Storage Boxes. https://asia.si.edu/wp-content/uploads/2017/08/StorageBoxInstructions.pdf.

East Asian Painting Conservation Studio. 2017. Making Mylar Preservation Rollers for Storing East Asian Scrolls. https://asia.si.edu/wp-content/uploads/2017/08/Making-a-Mylar-roller.pdf.

IKA YI-HSIA HSIAO
Associate Conservator of Chinese Paintings
Cleveland Museum of Art
Cleveland, OH
yhsiao@clevelandart.org

The Gentling Collection: Establishing a Treatment Protocol for Multilayered Works on Transparent Paper

INTRODUCTION

Stuart and Scott Gentling were local Fort Worth artists and authors, known for their realistic, dry-brush watercolor, figurative paintings, and portraitures. Although the twin brothers were both respected artists in their own right, they were best known for their collaborations. These collaborations included the murals in the Bass Performance Hall in Fort Worth and *Of Birds and Texas*, an elephant folio of 50 high-quality reproductions of the Gentlings' Texas birds and landscape paintings that are accompanied by essays and commentaries that were printed in hand-set type (Doss, 2021). The folio was dedicated to John James Audubon who greatly influenced the Gentlings' work (Barker, 2021).

The collection of Gentling works acquired by the Amon Carter Museum of American Art form the basis for the museum's new Gentling Study Center. The collection consisted of more than 700 works on paper, sketch books, manuscripts, and a large number of objects, including costumes, model ships, and plaster casts. The works on paper included watercolor paintings, a large number of sketches, preparatory works for the Bass Hall Performance Hall murals and *Of Birds and Texas*, and plans for the Gentlings' studio, which was designed by the brothers. Many of the preparatory works for *Of Birds and Texas* demonstrated the Gentlings' artistic process.

The Gentlings had an intensive process for creating their paintings, which can be seen in figure 1. They would begin by creating an original drawing. The drawing would then be traced. The tracing would be used to transfer a line drawing onto the watercolor paper. The Gentlings would then add gray modeling to the line drawing to give it form prior to painting. The image would then be painted using a thick, opaque application of watercolor. Often, this finished painting was not the end of the Gentlings' process. They would commonly make prints of their paintings and continue to rework the image by painting over the print. Within the collection of works at the Amon Carter, there are examples from all stages of the Gentlings' process.

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

MULTILAYERED WORKS

Description

Included in the collection of preparatory works were complex, multilayered pieces comprised of numerous drawings attached to a support with a variety of tapes (fig. 2). These works consisted of individual line drawings of birds on tracing paper that were arranged and taped to the paper support with pressure-sensitive tape in the desired layout. The paper support that the Gentlings used was often the verso of prints of their other works on a heavily filled paper. After the arrangement was decided, the background was drawn. The final composition was then traced as a whole and transferred to the watercolor paper prior to painting. Many of these multilayered works were the preliminary pieces for the watercolors from the *Of Birds and Texas* book.

Condition

Prior to the museum's acquisition, the collection was stored in the Gentlings' vacant studio for years after the brothers' deaths. The multilayered works ranged from approximately 12 × 8 in. to almost 5 × 5 ft. The condition tended to vary, but the works were often in fair to poor condition due to the brittleness of the tracing papers, the large number of oxidized tapes present, and the previous storage conditions. There was a heavy layer of surface dirt, planer distortions, staining, and tears throughout the pieces.

Multiple varieties of tracing paper were used on the layered works. However, most of the tracing papers used by the Gentlings appeared to be either overbeaten or acid-treated tracing papers. All of the tracing papers showed a high reactivity to moisture and fluctuations in the environment. The tracing papers ranged from brittle, yellow, and almost brown to showing very little deterioration.

The Gentlings appeared to favor two types of pressure-sensitive tape: white artist tape and masking tape. However,

Fig. 1. A group of sketches showing the stages of the artistic process: original drawing (a), tracing of original drawing (b), transfer of line drawing to watercolor paper (c), addition of grey modeling to the line drawing (d), painted image (e), and print of original painting (f); Stuart and Scott Gentling, *The Artists' Process*, ca. 1981–1985, graphite, watercolor, and printing ink on paper, 76.4 × 93.6 cm, Amon Carter Museum of American Art, Fort Worth, Texas, gift of the Fort Worth Museum of Science and History, 2018.43.

other tape varieties, like blue painter's tape, were occasionally seen. Like the tracing papers, the tapes were in a range of degradation states. The majority of the tapes were either tacky or brittle. The adhesive of the masking tapes had often penetrated the paper, leaving localized staining in the tape area. The artist tapes, however, rarely showed signs of staining.

Conservation and Protocol Needs

Once the condition of the works was known and documented, the conservation needs were considered and a treatment protocol was developed. The treatment needed to maintain the appearance of the multilayered works while preventing further deterioration. The artists' intentions and the fact that these were archive pieces needed to be considered. These pieces were never meant to be the finished works but were an integral part of the Gentlings' process.

The materials used in the multilayered works added to the complexity of the treatment. Considering that transparent paper can be highly reactive to moisture, can lose transparency with solvents (van der Reyden, Hofmann, and Baker 1993), and repairs show through from the verso, treatment with traditional conservation methods and materials can be challenging and at times inappropriate.

With tape being such an integral part of the Gentlings' process, careful attention also needed to be paid to how the tape would be treated. Generally, the tapes would be removed to prevent further deterioration of the work. However, with these multilayered works, removing the tape would change both the artist intent and the structure of the works. Beyond that, some works had drawings on the tape's carrier. This presented further complications when considering how to approach the treatments.

Treatment of the collection needed to include an overall approach, considering the collection as a whole, while remaining adaptable enough to incorporate the needs of the multilayered works on tracing paper. The time constraints of the project meant that the treatments needed to avoid time-consuming processes while maintaining the artists' intent and stabilizing the objects and materials present. Treatments also needed to be low moisture and minimize any changes to the transparency of the tracing papers within the collection. Due to these needs and the complex nature of the multilayered works, multiple treatment options were explored prior to the development of the treatment protocol.

TESTING PRIOR TO TREATMENT

The difficulties involved with treating tracing paper and the complex nature of the multilayered works made it imperative

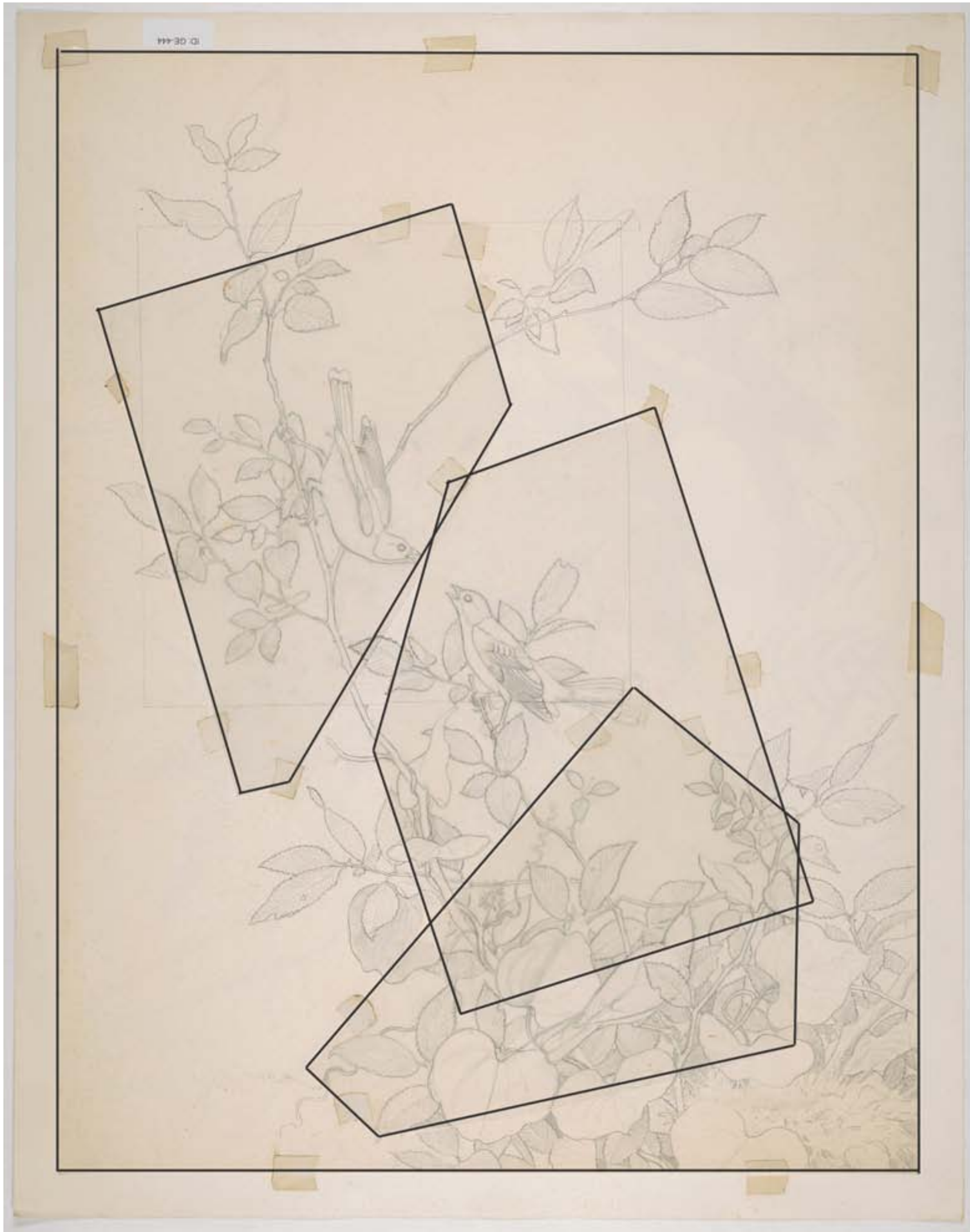


Fig. 2. Multilayered work with each individual sheet of paper outlined in black; Stuart and Scott Gentling, *Untitled*, graphite on paper, 66 × 50.8 cm, Amon Carter Museum of American Art, Fort Worth, Texas, gift of the Gentling Family, A2016.019.10.0085.

that the treatment options were first tested on tracing papers similar to those used by the Gentlings. Nanocellulose films and heat-set and solvent-set tissues were tested as repair materials. Gels were evaluated as a method of delivering moisture or solvents for any adhesive or tape removal within the collection. Methods of replicating and preserving the tape present were also explored. The goal of the testing was to determine the most appropriate route of treatment for the Gentling collection while accounting for the time allotted for treatment of the collection. Therefore, speed and ease of use were considered, along with the need to preserve the artists' intent and documentation of the Gentlings' working process.

Nanocellulose

In recent years, nanocellulose films have been introduced as a transparent material for tear repairs, infills, and as a coating to strengthen paper (Dreyfuss-Deseigne 2017a, 2017b, 2017c; Völkel et al. 2017; Williams 2018; Douglas and Coulthard 2019). The benefits of nanocellulose include the fact that it is pure cellulose, suggesting a high level of stability, and the strength of the films despite their thin and transparent appearance (Dreyfuss-Deseigne 2017b). This led to nanocellulose being tested as repair material for transparent papers and other transparent materials (Dreyfuss-Deseigne 2017c).

Nanocellulose is available in pre-formed sheets and as a gel or paste that can be used to make the films in the lab (Nanopaper-Art Films 2020; Weidmann Fiber Technology 2020). With the large number of transparent papers in the Gentling collection, and the fact that works are archive items, the preformed sheets were determined to be cost prohibitive for this project. Subsequently, a process to create nanocellulose films in the laboratory was developed using the 3% Celova for Art Conservation, a microfibrillated cellulose gel from Weidmann Fiber Technology (2020). Microfibrillated cellulose is created by mechanically fibrillating the fibers under a high shearing force until a three-dimensional network of long nanosized cellulose fibrils are formed (Dufresne 2013). To create the nanocellulose films in the laboratory, the 3% Celova for Art Conservation was mixed with deionized water to create a 0.2% solution that was then poured into a silicone tray with a flat bottom and allowed to dry (Knauf 2019).

Multiple studies have compared nanocellulose to Tengucho tissue, commonly finding that both have a high level of transparency compared to other repair tissues, with nanocellulose being slightly more transparent (Dreyfuss-Deseigne 2017c; Williams 2018). However, since the nanocellulose films used were created in the laboratory, their transparency likely varied from the nanocellulose films tested in the studies. Therefore, a comparison of the nanocellulose films produced in the laboratory and 6 g/m^2 Tengucho tissue was undertaken (fig. 3). The tests included repairing tears on sample transparent papers and measuring the opacity of both the Tengucho tissue and the nanocellulose films when applied to similar tracing papers that were used by the Gentlings. Although Klucel G was the advised adhesive for use with nanocellulose films (Dreyfuss-Deseigne 2017a), other adhesives were also tested, including wheat starch paste, methyl cellulose, Aquazol 200 in isopropanol, Aquazol 500 in isopropanol, and Klucel G in isopropanol. All adhesives were tested at a 5% w/v concentration.

The nanocellulose films were found to be highly reactive and difficult to work with when used with wheat starch paste and methyl cellulose. Aquazol 200, Aquazol 500, and Klucel G were easier to apply and performed better with the nanocellulose films than the water-based adhesives. All adhesives worked well with the Tengucho tissue. After application, the nanocellulose films seemed more prone to detaching from the sample tracing papers when exposed to fluctuating environmental conditions than the Tengucho tissue.

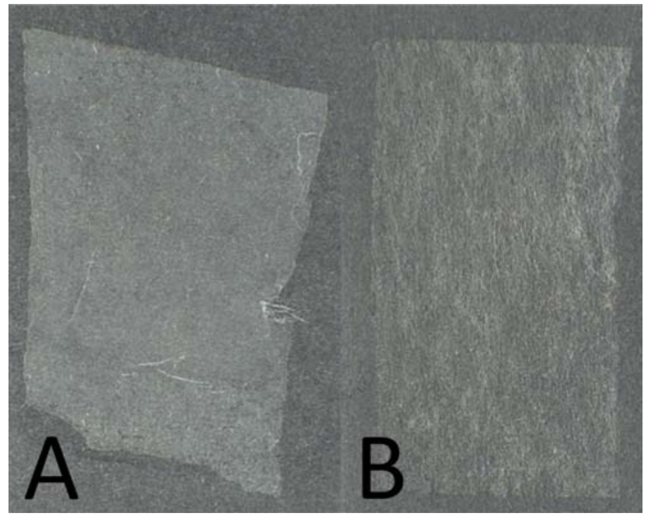


Fig. 3. (a) Nanocellulose film made in the laboratory and adhered to sample tracing paper with Klucel G in isopropanol. (b) Tengucho tissue adhered to sample tracing paper as a solvent-set tissue made with Aquazol 200 and reactivated with isopropanol.

The opacity of the nanocellulose films and the Tengucho tissue were then measured using the VSC 8000 (see appendix 1). As can be seen in figure 4, it was found that the Tengucho tissue was more transparent than the nanocellulose films. Although the Tengucho tissue was more transparent, its fibers were visible, leading the eye to be drawn to the repair. It was also found that although creating the nanocellulose films in the laboratory was more cost effective, it was more time consuming, but being able to adjust the nanocellulose films to the needs of each object was seen as beneficial. Yet due to the cost of premade nanocellulose sheets, the time it took to make the more cost-effective nanocellulose sheets in the laboratory, the occasional detachment of the nanocellulose films from the support, and the higher transparency of the Tengucho tissue, it was determined that nanocellulose films would not be a practical repair material for this collection.

	SAMPLE TRACING PAPER	SAMPLE TRACING PAPER WITH NANOCELLULOSE FILM	SAMPLE TRACING PAPER WITH TENGUCHO TISSUE
OPACITY	29%	37.5%	34%

Fig. 4. Calculated opacity for the sample tracing paper, the nanocellulose, and the Tengucho tissue.

Heat-Set and Solvent-Set Tissues

Heat-set and solvent-set tissues are often used for their ease and speed of application. They are commonly applied to moisture-sensitive papers and media because they require little to no moisture to adhere to the substrate and can be adjusted for each paper's needs. The tissues can be made with a range of adhesives, including methyl cellulose, wheat starch paste, Klucel G (hydroxypropyl cellulose), and resin- or acrylic-based adhesives (Anderson and Reidell 2009; Beenk, Kaye, and Miller 2009; Varga, Herrmann, and Ludwig 2015). Aquazol, a synthetic poly(2-ethyl-2-oxazoline) resin, has also gained popularity as a successful adhesive for heat-set and solvent-set tissues since it can also be reactivated with water, with a large range of organic solvents, and with heat (Pataki 2009; Lechuga 2011).

The adhesives tested for application on the Gentling collection included methyl cellulose, wheat starch paste, Klucel G in isopropanol, Aquazol 200 in water, and Aquazol 500 in water. All of the adhesives were applied in 5% w/v. Aquazol 200 and Aquazol 500 differ by their molecular weight and their viscosity, with Aquazol 500 being more viscous (Arslanoglu 2004). In addition, 6 g/m^2 of Tengucho tissue was tested for tear repairs, whereas kozo hinge tissue was tested for use as the hinge material. To create the repair tissues, the tissues were laid on a piece of Mylar. A fiberglass screen was placed over the tissue, and the adhesive was brushed through the screen. The screen prevented the distortion of the fibers and was particularly necessary for the thin Tengucho tissue.

Methyl cellulose and wheat starch paste were both reactivated with a small amount of water. However, even the minimal amount of water needed was enough moisture to cause localized distortions in the highly reactive transparent papers that were in the Gentling collection. Although Klucel G was successful when reactivated with isopropanol, it was determined that the adhesive did not produce a strong enough bond to properly stabilize the works, and any handling of pieces at the Gentling Study Center could cause the repairs to fail.

The Aquazol 200 and Aquazol 500 were tested as both a heat-set and solvent-set tissue. Due to the high reactivity to heat of some of the tracing papers used by the Gentlings, it was decided that a solvent-set application would perform better than a heat-set tissue for these works. During the tests, both molecular weights of Aquazol appeared to dissolve easier in water and produce a better adhesion when reactivated with water than when reactivated with isopropanol or acetone. Although both molecular weights had similar results, it was found that having the flexibility of using the stronger Aquazol 500 was beneficial, as Aquazol 200 did not adhere well to all paper supports in the collection.

Over the years, concerns over Aquazol's yellowing (Arslanoglu 2004) and failure in high relative humidity (Pataki 2009; Lechuga 2011) have been raised. However, aging tests had shown Aquazol to have a color change that is barely perceivable to the human eye (Wolbers, McGinn, and Duerbeck 1998; Herrmann et al. 2019). Because these works were archive items and would be stored in a controlled environment, the possible color change and failure with high humidity were of less concern for this collection. Since the tracing papers can lose their transparency with solvents, the large range of solvents that can reactivate Aquazol allowed for more flexibility in the solvent choice depending on the reaction of the tracing papers to the solvents. Therefore, Aquazol was selected as the adhesive for the solvent-set tissues for both the repair and hinging of works on transparent paper within the Gentling collection.

Gels

Since there was potential that moisture or solvents may need to be applied to the tracing papers during treatment, especially during tape removal, gels were tested to determine their usability on the transparent papers within the collection. Gels, particularly gellan gum and agarose, have become relatively popular in paper conservation for treatment of sensitive objects. Gellan gum and agarose are both polysaccharides that, when formed into a gel, restrict the flow of water into the object. The gels can also be adjusted by adding solvents, enzymes, chelators, and other solutions to meet the treatment needs (Maheux 2015; Hughes and Sullivan 2016; Magee 2019).

Gellan gum can be used as both a high acyl gellan gum and a low acyl gellan gum. The difference in the number of acyl groups, a double-bonded oxygen to carbons on the gellan gum substituent, impacts how the gel looks, its stiffness, and the retention of water in the gel (Maheux 2015; Magee 2019). Gels are commonly used between 1% and 10%, with the higher the percentages providing more control of the water transferred to the paper while increasing the capillary action of the gel (Iannuccelli and Sotgiu 2010; Hughes and Sullivan 2016). Due to the reactivity of the tracing papers, it was decided to work on the higher end of the percentages in most cases. High acyl gellan gum was the exception because, even at low percentages, its water retention is high, and producing well-made high acyl gellan gum gels can be difficult due to the tendency for it to form clumps.

The first round of gel test was used to gauge what gel showed the most potential. A 2% and a 3% high acyl gellan gum, a 6% and an 8% low acyl gellan gum, and an 8% and a 10% agarose were all tested. All of the gels, except for the high acyl gellan gum, were cast to approximately 5 mm thick. Due to the quick cooling and difficulty of pouring a thin cast, the high acyl gellan gum was heated in a glass tray with a flat bottom, allowing the gel to form a relatively thin gel as it cooled in the tray. When applied to the sample tracing paper, the most success was seen with the 3% high acyl gellan gum. However, this gel still produced a significant amount of expansion in the tracing paper sample.

Thus, a 6% high acyl gellan gum was tested. The 6% high acyl gellan gum was more difficult to make due to the clumping that is common when mixing, but sieving the mixture prior to heating helped reduce the lumps in the high acyl gellan gum. At this percentage, the transparent paper expanded less, allowing for the paper to be dried under weight with little to no signs of the localized treatment. However, it was still found that the gels worked best on the tracing paper samples when applied for no more than a minute or two per application.

Replicating vs. Preserving Pressure-Sensitive Tapes

The final method compared replicating the existing tapes vs. preserving the tape carriers. Replicating the tapes was attempted by layering multiple toned kozo tissues to produce a similar color to the oxidized tapes present throughout the Gentling collection. The method used to preserve the tape began with removal of the adhesive from the tape's carrier. The carrier was then lined on to a thick kozo tissue using 5% methyl cellulose.

Considering that there were concerns about the time constraints of the project and the amount of time that it would take to preserve the large number of tapes present, it was decided that there would be multiple approaches to the tapes within the collection. The multilayered pieces would have their tape removed, the tape carrier lined, and then re-adhered to the works. This decision was made because of the integral role the tape played in the works format and the fact that many of the pieces of tape had been drawn on, making them an invaluable part of the process.

However, due to the time constraints and the large number of works with tape in the collection, this decision was not applied to all of the works. It was decided that if the tape did not play an integral role in the work, the tape would be documented and removed. A sample of the tapes from a large number of works within the collection was then saved in an objects file, allowing for future research of the tapes used by the Gentlings without further deterioration of the objects.

TREATMENT PROTOCOL

After the treatment options were explored, the treatment protocol for the multilayered works were developed. The protocol took into consideration that these objects were archive items whose structure and appearance needed to be preserved while resolving issues that would cause further deterioration. Therefore, a multistep process was developed that would allow for removal of the pressure-sensitive tape adhesives, repairs to be made to all components of the work, and for the tapes to be preserved while preventing further deterioration to the objects.

To fully treat the works, it was known that they would need to be taken apart, each piece treated, and then put back together. Thus, ensuring that each component was placed in the correct location when put back together was a major concern. Ironically, to solve this issue, tracing paper was utilized for the first step of the treatment of these works. Prior to deconstructing the work, a sheet of tracing paper was aligned along two edges of the support. The alignment was notated on the tracing paper to ensure that the tracing paper would be placed in the same location when putting the work back together. The pieces of the multilayered works were then outlined, as was each piece of tape, essentially mapping the location of each component of the work. Each piece of tape was assigned a number that was notated on the piece of tape and on the tracing paper "map." An example of the tracing paper map can be seen in figure 5.

The works were then taken apart. As each sheet of tracing paper was removed from the primary support, full photography and documentation of the individual components took place. Then the tapes were removed from the tracing paper. Due to the degradation state of the tapes present, the tapes were able to be removed mechanically with localized heat and the application of solvent gels was not required. Because of the reactivity of the tracing paper, the heat was applied as minimally as possible with a heated spatula that was used to locally warm the adhesive while slowly removing the tape carrier. Any remaining adhesive was then removed mechanically, often with a crepe eraser. After removal, each piece of tape had the corresponding number from the tracing paper map written lightly in graphite on the carriers that did not have a drawing present. This allowed for easy identification and placement of each tape back in the correct location when the works were reassembled.

Then any general repairs to the tracing papers and the supports were made. Because these were archive pieces, staining from the tapes were not treated as part of the general repairs made. However, fold and crease reduction and tear repairs were commonly completed on the works. The Tengucho solvent-set tissue made with Aquazol 200 was used for the tear repairs on the tracing paper. Acetone was generally the solvent chosen for reactivation of the Aquazol. The high rate of evaporation and the lack of expansion to the tracing paper made acetone the ideal solvent choice, especially for the most reactive tracing papers in the collection.

Once the tracing paper was stabilized, the pieces of tape were treated. The adhesive on the tape's carrier was removed. Occasionally, acetone was used to soften the adhesive. However, in most cases, this was not necessary, as the adhesive layer could be removed mechanically with a crepe eraser. With the removal of the adhesive layer from the tape carriers, the tape was often thinner than it was originally. In some cases, the difference in thickness was very apparent. The tape carriers were lined onto a thick kozo tissue with 5% methyl cellulose, as seen in figure 6. The use of the thick kozo tissue for lining allowed for the lined tapes to have a

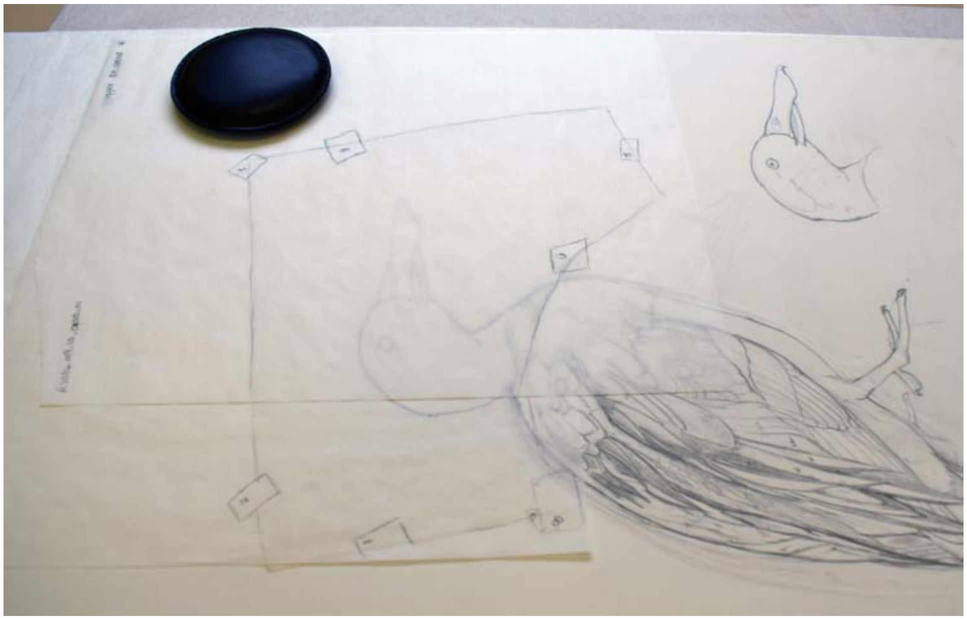


Fig. 5. Tracing paper "map" being made; Stuart and Scott Gentling, *Untitled*, graphite on paper, 61 × 48.4 cm, Amon Carter Museum of American Art, Fort Worth, Texas, gift of the Gentling Family, A2016.019.10.0100.

thicker appearance that was closer to the original thickness of the tape. The thicker kozo tissue also allowed for more of a buffer between the masking tape's acidic carriers and the work.

The tracing paper map made at the beginning of the treatment process was then used to place each component in the correct location, ensuring the layout of the works did not shift post treatment. The tracing paper was aligned according to the annotation on the tracing paper map. Weights were used to hold the tracing paper map in place, allowing areas of the map to be lifted and the components of the work to be aligned in the correct location.

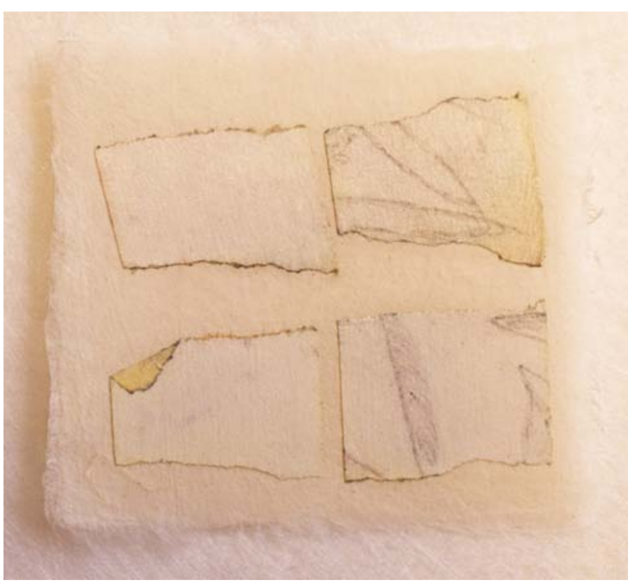


Fig. 6. Tape carrier lined on thick kozo tissue with methyl cellulose.

After the tracing paper pieces were put in the correct place, the tracing papers were hinged, using V-hinges made from kozo hinge tissue prepared as an Aquazol solvent-set tissue. Although the kozo hinge tissue was more visible, its thickness allowed for a more stable hinge than the Tengucho tissue would have produced. Aquazol 200 was the original adhesive used. and acetone was used for reactivation. However, this combination of Aquazol 200 and acetone had issues adhering to the heavily filled paper that was used as a support for many of the drawings. Therefore, the adhesive was changed to the slightly stronger Aquazol 500, and the solvent used to reactivate the adhesive was switched to a 70% isopropanol. The 30% water helped remoisten the adhesive, allowing for a stronger bond with the support.

The location of the hinges was carefully selected to prevent the hinges from being as visible and distracting from the work. This often meant the hinges were placed under the areas that would be covered by the lined tape carriers, as can be seen in figure 7, or in areas with heavy media application. The hinges were folded over a small strip of Hollytex. Both sides of the V-hinge were reactivated with the 70% isopropanol, and the hinge was placed between the tracing paper and the support. Weights were put in place, and the hinge was left to dry. After drying, the Hollytex was pulled out from the middle of the hinge.

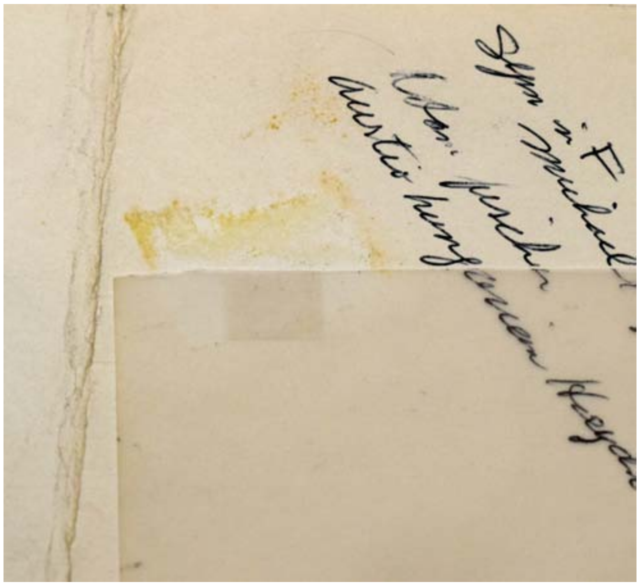


Fig. 7. Tracing paper's V-hinge placed under an area that would be covered by the lined tape carrier.

The lined tape carriers were then hinged into place using a similar method as the hinging of the tracing papers (fig. 8). The number that had been lightly written on the tape carrier was used to correctly place the lined carrier in the corresponding position labeled on the tracing paper map. After placement, this number was erased from the tape carrier. Two V-hinges, one on each side, were used on each lined tape carrier to secure the lined tape carrier in place.

Fig. 8. Lined tape carrier hinged in place.

The multilayered works were then photographed and prepared for storage. Each item was interleaved with acid-free paper. Blue board was used as a support between the pieces to support the works. The works that were small enough to be stored in archival boxes were placed in the boxes with the blue board support between each work. The larger works were placed in map cases.

CONCLUSION

The Gentling collection presented a variety of challenges due to the inherent qualities of the materials that made up the multilayered composition of the pieces treated. Preserving the evidence of the artists' process while stabilizing the deteriorating works was of the utmost importance. Because of the presence of the highly reactive tracing papers, treatment methods were carried out on sample tracing papers similar to those used by the Gentlings. This helped determine the most appropriate treatment materials and methods, allowing for the development of a treatment protocol for the multilayered works. The protocol developed allowed for each treatment to be approached with an understanding of what treatment needed to be completed and how those treatments could be executed in a manner that allowed for preservation of both the artist's intent and the structure of the work.

Although the repairs and hinges are not completely invisible, the before and after images in figure 9 show that the choice of materials and the hinge placement allowed for the majority of the treatment to be barely noticeable to the viewer. And although it was not practical for all tapes in the collection to be lined and re-adhered to the works, the multilayered pieces, which demonstrated the Gentlings' intricate artistic process, were deemed important enough to undertake this time-consuming process. Understanding the range of treatments and materials that could be successfully used allowed for adjustments to the adhesives and solvents to be easily made during treatment. This helped make the standardized treatment protocol flexible enough that the protocol could be applied to the full range of works in the collection.

ACKNOWLEDGMENTS

This project would not be possible without the amazing staff and volunteers at the Amon Carter Museum. Many thanks go to Fernanda Valverde, conservator of photographs, Callie Heimburger, conservation intern, Paul Leicht, photographer/videographer, Steve Watson, media production manager, Jonathan Frembling Gentling curator and head museum archivist, Janelle Montgomery, Gentling curatorial assistant, Rachel Panella, assistant register for data management, and Will Gillham, head of publications.

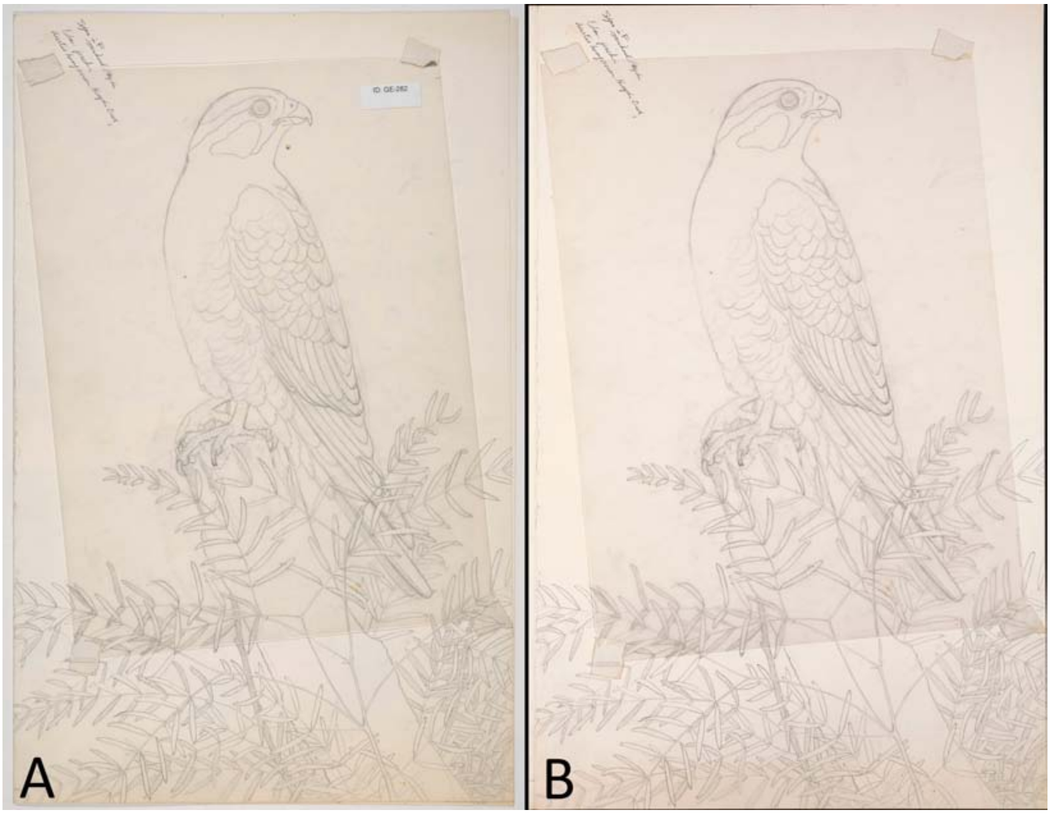


Fig. 9. Before treatment (a) and after treatment (b) images of a multilayered work within the Gentling collection; Stuart and Scott Gentling, *Untitled*, ink and graphite on paper, 71.2 × 56 cm, Amon Carter Museum of American Art, Fort Worth, Texas, gift of the Gentling Family, A2016.019.10.0038.

APPENDIX 1

Measurements were taken in two consecutive readings as described by Roger Williams (2018). The samples were placed on white backing for the first reading. The second reading was taken with the sample placed over a black background. The following formula was then used to calculate the opacity.

$$\textit{Opacity } (y) = \frac{Y\ (black)}{Y\ (black)} \times 100$$

APPENDIX 2

High acyl gellan gum recipe

100 mL deionized water
0.4 g calcium acetate
2–6 g high acyl gellan gum (2 g for 2%; 3 g for 3%; 6 g for 6%)

Mix calcium acetate into the deionized water. Add high acyl gellan gum and stir until all clumps are gone (6% was sieved at the point to help remove clumps). Place mixture in a microwavable glass tray with a flat bottom. Cover the tray with a lid and heat in the microwave until bubbling. Let cool in the tray.

APPENDIX 3

Low acyl gellan gum recipe

50 mL deionized water
0.2 g calcium acetate
3–4 g low acyl gellan gum (3 g for 6%; 4 g for 8%)

Cut two pieces of Mylar and label. Add calcium acetate to the deionized water in a microwave-safe container. Add the low acyl gellan gum and stir until all clumps are gone. Cover with a lid and heat in the microwave until bubbling. Remove from the microwave. Quickly pour mixture onto one sheet of Mylar and cover with the second sheet of Mylar. Use a flat surface to apply pressure on top of the Mylar to spread the mixture out into a thin sheet. Let cool.

APPENDIX 4

Agarose recipe

50 mL deionized water
4–5 g agarose (4 g for 8%; 5 g for 10%)

Cut two pieces of Mylar and label. Add agarose to the deionized water in a microwave-safe container. Stir until all clumps are gone. Place the mixture in the microwave, cover with a lid, and heat until bubbling. Remove from the microwave. Quickly pour mixture onto one sheet of Mylar and cover with the second sheet of Mylar. Use a flat surface to apply pressure on top of the Mylar to spread the mixture out into a thin sheet. Let cool.

REFERENCES

Anderson, Priscilla, and Sarah Reidell. 2009. *Adhesive pre-coated repair materials*. Handout from the Archives Conservation Discussion Group and Library Collections Conservation Discussion Group, AIC 37th Annual Meeting, Los Angeles, California.

Arslanoglu, Julie. 2004. "Aquazol as Used in Conservation Practice." *Newsletter (Western Association for Art Conservation)* 26 (2): 10–15.

Barker, Scott Grant, "How Good They Were: Scott and Stuart Gentling and Fort Worth." In *Imagined Realism: Scott and Stuart Gentling* (Fort Worth, TX: Amon Carter Museum of American Art, 2021).

Beenk, Jody, Marieka Kaye, and Laura O'Brien Miller. 2009. "Archives Conservation Discussion Group 2009: Conservation and Preservation Approaches for Stabilizing Large-Scale Collections." *Book and Paper Group Annual* 28: 99–106.

Doss, Erika, "The Art of the Gentling Brothers: Contemporary Realists in the Lone Star State," In *Imagined Realism: Scott and Stuart Gentling*. (Fort Worth, TX: Amon Carter Museum of American Art, 2021).

Douglas, Kiri, and Sophie Coulthard. 2019. Introduction to Nanocellulose Films. Poster presented at the ICON Triennial International Conference, Belfast, Northern Ireland.

Dreyfuss-Deseigne, Rémy. 2017a. A New Mending Material: Nanocellulose Film. *Journal of Paper Conservation* 18 (1): 36–37. https://doi.org/10.1080/18680860.2017.1339401.

Dreyfuss-Deseigne, Rémy. 2017b. Nanocellulose Films: Properties, Development and New Applications for Translucent and Transparent Artworks and Documents. *Book and Paper Group Annual* 26: 108–14.

Dreyfuss-Deseigne, Rémy. 2017c. Nanocellulose Films in Art Conservation. *Journal of Paper Conservation* 18 (1): 18–29. https://doi.org/10.1080/18680860.2017.1334422.

Dufresne, Alain. 2013. "Nanocellulose: A New Ageless Bionanomaterial." *Materials Today* 16 (6): 220–27. https://doi.org/10.1016/j.mattod.2013.06.004.

Herrmann, Jennifer K., Katherine Kelly, Alisha Chipman, Andrew Davis, Yasmeen Khan, Steven Loew, Katherine Morrison Danzis, et al. 2019. Analytical Testing of Heat and Solvent Set Repair Tissues. Paper presented at the AIC 47th Annual Meeting in New England: New Tools, Techniques, and Tactics in Conservation and Collections Care.

Hughes, Amy, and Michelle Sullivan. 2016. "Targeted Cleaning of Works on Paper: Rigid Polysaccharide Gels and Conductivity in Aqueous Solutions." *Book and Paper Group Annual* 35: 30–41.

Iannuccelli, Simonetta, and Silvia Sotgiu. 2010. "Wet Treatments of Works of Art on Paper with Rigid Gellan Gels." *Book and Paper Group Annual* 29: 25–39. https://cool.culturalheritage.org/coolaic/sg/bpg/annual/v29/bp29-04.pdf.

Knauf, Diane E. 2019. Tip: Producing nanocellulose films for repairs on transparent paper. *BPG Wiki*. https://www.conservation-wiki.com/w/images/4/43/Dknauf_Tip_Producing_Nanocellulose_Films_for_Repairs_on_Transparent_Paper.pdf.

Lechuga, Katherine. 2011. "Aquazol-Coated Remoistenable Mending Tissues." *Proceedings of Symposium 2011: Adhesives and Consolidants for Conservation: Research and Applications*. Ottawa, Canada.

Magee, Cathie. 2019. "High Acyl Gellan Gum for Parchment Conservation." *Book and Paper Group Annual* 38: 112–19.

Maheux, Anne F. 2015. "Cross-Disciplinary Uses for Gellan Gum in Conservation." *Book and Paper Group Annual* 34: 69–79.

Nanopaper-Art Films. 2020. Art Conservation. https://nanopaper.us/art-conservation/.

Pataki, Andrea. 2009. "Remoistenable Tissue Preparation and Its Practical Aspects." *Restaurator* 30 (1-2): 51–69. https://doi.org/10.1515/rest.004.

Reyden, Dianne van der, Christa Hofmann, and Mary Baker. 1993. "Effects of Aging and Solvent Treatments on Some Properties of Contemporary Tracing Papers." *Journal of the American Institute for Conservation* 32 (2): 177–206. https://doi.org/10.1179/019713693806176490.

Varga, Lauren M., Jennifer K. Herrmann, and Kathleen Ludwig. 2015. "Heat-Set Tissue: Finding a Practical Solution of Adhesives." *Book and Paper Group Annual* 34: 113–17.

Völkel, L., K. Ahn, U. Hähner, W. Gindl-Altmutter, and A. Potthast. 2017. Nano Meets the Sheet: Adhesive-Free Application of Nanocellulosic Suspensions in Paper Conservation. *Heritage Science* 5 (1): 1–17. https://doi.org/10.1186/s40494-017-0134-5.

Weidmann Fiber Technology. 2020. Microfibrillated Cellulose for Art Conservation. https://shop.weidmannfibertechnology.com/celova-for-art-conservation-500ml-72373307.html.

Williams, Roger. 2018. "Optically Cleared Repair Tissues for the Treatment of Translucent Papers." *Book and Paper Group Annual* 37: 96–110.

Wolbers, Richard C., Mary McGinn, and Deborah Duerbeck, eds. 1998. "Poly(2-Ethyl-2 Oxazoline): A New Conservation Consolidant." In *Painted Wood: History and Conservation*. Los Angeles: Getty Conservation Institute. 514–27.

Wilson, Helen. 2015. "A Decision Framework for the Preservation of Transparent Papers." *Journal of the Institute of Conservation* 38 (1): 54–64. https://doi.org/10.1080/19455224.2014.999005.

FURTHER READING

Anderson, Priscilla, and Alan Puglia. 2003. "Solvent-Set Book Repair Tissue." *Book and Paper Group Annual* 22: 3–8.

Homburger, Hildegard, and Barbara Korbel. 1999. "Architectural Drawings on Transparent Paper: Modifications of Conservation Treatments." *Book and Paper Group Annual* 18: 25–33. http://cool.conservation-us.org/coolaic/sg/bpg/annual/v18/bp18-06.html acesso.

Kelly, Katherine S., Jennifer K. Hermann, Alisha Chipman, Andrew Davis, Yasmeen Khan, Steven Loew, Katherine Morrison Danzis, et al. 2019. "Heat- and Solvent-Set Repair Tissues." *Book and Paper Group Annual* 38: 40–42.

Laroque, Claude. 2004. "History and Analysis of Transparent Papers." *Paper Conservator: Journal of the Institute of Paper Conservation* 28: 17–32. https://doi.org/10.1080/03094227.2004.9638639.

McClintock, T. K. 1992. "Observations on Developments in the Treatment of Works on Paper." *Journal of the American Institute for Conservation* 31 (1): 107–15. https://doi.org/10.1179/019713692806156303.

Page, Susan. 1997. "Conservation of Nineteenth-Century Tracing Paper: A Quick Practical Approach." *Book and Paper Group Annual* 16: 67–73. http://cool.conservation-us.org/coolaic/sg/bpg/annual/v16/bp16-09.html.

Santos, Sara M., José M. Carbajo, Nuria Gómez, Ester Quintana, Miguel Ladero, Arsenio Sánchez, Gary Chinga-Carrasco, and Juan C. Villar. 2016. "Use of Bacterial Cellulose in Degraded Paper Restoration. Part I: Application on Model Papers." *Journal of Materials Science* 51 (3): 1541–52. https://doi.org/10.1007/s10853-015-9476-0.

Santos, Sara M., José M. Carbajo, Nuria Gómez, Ester Quintana, Miguel Ladero, Arsenio Sánchez, Gary Chinga-Carrasco, and Juan C. Villar. 2016. "Use of Bacterial Cellulose in Degraded Paper Restoration. Part II: Application on Real Samples." *Journal of Materials Science* 51 (3): 1553–61. https://doi.org/10.1007/s10853-015-9477-z.

Smith, Merrily A., Norvell M. M. Jones, Susan L. Page, and Marian Peck Dirda. 1984. "Pressure-Sensitive Tape and Techniques for Its Removal from Paper." *Journal of the American Institute for Conservation* 23 (2): 101–13. https://doi.org/10.1179/019713684806028241.

SOURCES OF MATERIALS

Agarose
Stellar Scientific
2833 Smith Ave., Box #256
Baltimore, MD 21209

Aquazol 200 and Aquazol 500
TALAS
330 Morgan Ave.
Brooklyn, NY 11211

Celova for Art Conservation
Weidmann Fiber Technology
Neue Jonastrasse 60
8640 Rapperswil SG
Switzerland

Gellan Gum (High and Low Acyl)
Modernist Pantry
25 Harold Dow Hwy.
Eliot, ME 03903

Hinging Paper
Hiromi Paper Inc.
9469 Jefferson Blvd., Suite 117
Culver City, CA 90232

Nanocellulose Films
Nanopaper
1650 Summit Lake Dr., Suite 103
Tallahassee, FL 32317

DIANE E. KNAUF
Assistant Conservator of Work on Paper
Amon Carter Museum of American Art
Fort Worth, TX
diane.knauf@gmail.com

JODIE UTTER
Senior Conservator of Works on Paper
Amon Carter Museum of American Art
Fort Worth, TX
jodieu@cartermuseum.org

EMILY M. K. MÜLLER

Analysis of Varnish Patterns in Indian Oleographs at the Metropolitan Museum of Art Using UV Reflectance Photography

INTRODUCTION

The Metropolitan Museum of Art, New York, hosts a collection of more than 50 Hindu devotional prints dating from the 1880s through the 1940s. These chromolithographic prints on paper were once mass produced in India but today are extremely rare. The origins of Hindu devotional prints, called *god prints*, are deeply rooted in India's tradition of depicting deities and episodes from the epics and Puranas. These images played an important role in the country's cultural and historical development (Pinney 2004).

Even though chromolithographic printing presses were introduced in India in 1878, Indian publishers continued to send their drafts of god prints to European lithographic presses, where they could be printed in better quality (Pinney 2004). This practice encouraged European printmakers to take advantage by selling replications of Indian Hindu motives at prices that undercut the Indian publishers (Davis, Baron, and Narayan 2012; Relia 2014) (fig. 1A). One subgroup of chromolithographs, called *oleographs*, are characterized by the application of a shiny varnish over the printed surface. The glossy appearance is supposed to imitate oil paintings. This multifunctional varnish layer not only increased the aesthetic value of the prints by enhancing the color saturation but also provided physical protection (Marzio 1979; Johwari 2009; Twyman 2014).

One popular painter, whose images appeared as oleographs, was Ravi Varma (1848–1906). In his painting style, he introduced Western techniques of perspective, combining religious themes with European approaches in his renderings of historical and sacred mythological scenes (Chawla 2010). With his increasing popularity, Ravi Varma decided to make copies of his work to satisfy the high demand of patrons and admirers (Relia 2014). For that purpose, he made use of the chromolithographic printing process, but the mass production of oleographs resulted in severe damage to Varma's reputation as a serious painter. He was denounced by many as a "calendar artist." Nevertheless, his prints (see figs. 1B, 1C; fig. 2) laid the foundation for a growing interest in popular art and religious illustration, and his success encouraged many competitor presses (e.g., the Ravi Vaibhav Fine Art Lithograph Press) to set up their own ventures, trading on Varma's name and plagiarizing his prints (Relia 2014; Mahadevan 2016; Pinney 2018; Sarma 2019). In 1894, Ravi Varma and his brother Raja Varma opened the Ravi Varma Fine Art Lithographic Press in Bombay, India. This press moved several times due to social unrest in India, first to Ghatkopar (see figs. 1B, 1C) and one year later to Malavi (see fig. 2D). Financial difficulties led to the sale of the press in 1901, after which the press moved to Karla-Lonavla (see figs. 2E, 2F). There, in 1972, it was destroyed in a fire (Sharma and Chawla 1993; Chawla 2010).

The Metropolitan Museum of Art's collection of Indian lithographic prints includes 51 chromolithographs, of which 23 are varnished and thus considered oleographs. This study focuses on the examination of the varnish layers in the collection of 23 Indian oleographs. Looking at this layer using UV reflectance (UVR) imaging techniques offered a novel perspective and approach to analyzing historic varnish production and application methods on paper. Studying the varnish and identifying patterns could help distinguish originals by the Ravi Varma Press from copies, or prints published in Europe from those published in India. Individual oleographs were carefully selected for this study to demonstrate a variety of printing presses and dates of origin as represented in the collection of the Metropolitan Museum of Art. A comparative close-up examination using UVR was used to highlight material relations between the different prints based on their production characteristics.

OVERVIEW OF TECHNIQUES

As background to this preliminary study of the Metropolitan Museum of Art's collection of oleographs and different varnish patterns, an overview of techniques, technology, and

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

Fig. 1. (A) *Radha*, India, ca. 1880–1900, 34.6 × 24.8 cm, printed in Italy, Reg. No. 135, purchase, gift of Mrs. William J. Calhoun, The Metropolitan Museum of Art, New York, 2013.9. (B) *Rama, Lakshmana, and Hanuman*, India, 1910–1915, 35.6 × 24.8 cm, Ravi Varma Udaya F. A. L Press Ghatkopar Bombay, Reg. No. 113, gift of Mark Baron and Elise Boisanté, The Metropolitan Museum of Art, New York, 2015.441.2. (C) *The Descent of the Ganges (Gangavatarana)*, India, ca. 1910–1920, 35.4 × 24.9 cm, Ravi Varma Udaya F. A. L Press Ghatkopar Bombay, purchase, Marie-Hélène Weill gift, 2016.483.

Fig. 2. (D) *Kali*, India, ca. 1910–1920, 50.8 × 36.2 cm, Ravi Varma Press Malavi-Lonavla, Reg. No. 68, purchase, gift of Mrs. William J. Calhoun, The Metropolitan Museum of Art, New York, 2013.17. (E) *Portrait of Maharajas*, India, 1910s, 35.6 × 25.1 cm, Ravi Varma Press Karla-Lonavla, Reg. No. 546, purchase, bequest of Nina Bunshaft, The Metropolitan Museum of Art, New York, 2014.91. (F) *Matsya Avatara* (Vishnu's Fish Avatar), India, undated, ca. 1900–1915, 35.2 × 25.4 cm, Ravi Varma Karla-Lonavla, Reg. No. 642, purchase, gift of Mrs. William J. Calhoun, The Metropolitan Museum of Art, New York, 2013.13.

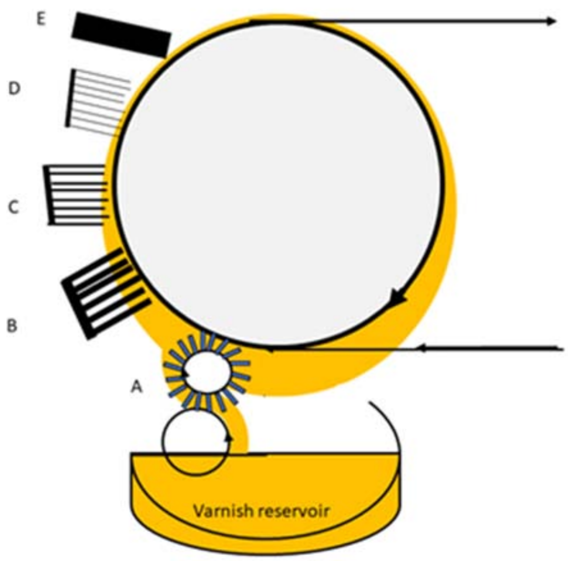


Fig. 3. Sketch illustrating ways of dispersing varnishing on the roll before final application (Mosier, Van der Reyden, and Baker 1992; Marchessault and Skaar 1967, 314). (A) Splatter brush. (B) Coarse brush. (C) Firm brush. (D) Light brushing with badger hairbrush. (E) Circulating bars.

tools for chromolithographic printmaking in India at the end of the 19th and beginning of the 20th centuries is provided, as well as an overview of varnishing technology, which was generally imported from Europe to India during this time (Chawla 2010).

Varnish could be applied either manually with a flat camel hair brush (Wyman & Sons 1882, 93) or by a varnishing machine. For mass reproduction, varnishing machines such as the machine by Messrs. Wm. Rawcliffe & Sons, of Radford's buildings, Parklane, Liverpool (Wyman & Sons 1882, 112), or "Newsum Varnishing machine" (Rhodes 1924, 264), were in use in England at the end of the 19th century. These machines applied varnish evenly by feeding the print into a system of rollers, one of which deposited varnish. Similar to the way printing machine functions, a large cylinder is placed above, but closely aligned to a composition roller, working in a pool of the varnish (fig. 3A). The sheets being fed by the grippers are carried between the cylinder and the roller. The literature describes several options for further smoothing the varnish on the roller before it is applied onto the paper. For example, several brushes of different sizes and refinement could be installed to further disperse the varnish once on the roller (see figs. 3B, 3C, 3D). This coating system was described in 1880 as highly effective but not very uniform. Brushes were later replaced by roll-circulating bars that lightly touched the paper surface (see fig. 3E). Another, later option was the use of a horizontal blade that thinned the varnish on the roll, creating a very even application (Mosier, Van der Reyden, and Baker 1992). In the 1880s in England, some sources recommend using the varnishing machine immediately after printing (Wyman & Sons 1882, 113), whereas others recommended maintaining a certain safety distance between the press and the varnishing location to reduce the risks associated with the preparation of the highly flammable varnish and inks. The storing and mixing of varnish at room temperatures, which could easily reach 90°F or above, sometimes produced flash fires that completely destroyed several presses.

Several common solvent-based varnishes were used to varnish lithographic prints toward the end of 19th century in Britain. Aqueous solutions were made of gums to coat the paper prior to varnish application. Without this coating, varnish when it was applied would penetrate the substrate and make it semitransparent. Alcoholic and turpentine varnish combinations were applied to achieve the glossy surface. The use of ethanol-based varnishes—for example, natural resins such as shellac (Twyman 2014)—required that the room and surface temperature of the print be warm and constant so that the ethanol and the water would evaporate simultaneously (Wyman & Sons 1882).

Spirit varnishes, such as combinations of gum sandarac, gum mastic, camphor, and alcohol, and turpentine varnishes, such as variations of Canada balsam, dammar gum, gum mastic, gum sandarac, and spirits of turpentine, were frequently used. Their advantages were a more suitable varnish color and a viscosity that allowed physical manipulation and fast drying (Wyman & Sons 1882, 113). To keep the brightness of colors and to simulate the appearance of a painting, the varnish needed to be as colorless as possible. This transparency could be achieved with oils, such as bleached linseed oil (Twyman 2014).

METHODS

UVR is a noninvasive imaging technique based on the reflection and absorption response of materials to sources of light in the UV region of the spectrum. Resulting images enable differentiation between materials with different responses. This photographic technique not only helps visualize the presence of substances of different chemical compositions when placed next to each other but can also enhance the visualization of characteristics such as distribution, thickness, and agglomeration of these substances on the surface of an object.

Because of its capability to enhance the visibility of certain characteristics of the surface of materials, UVR was chosen as a method to study the varnish patterns of oleographs in the collection of the Metropolitan Museum of Art. Scientific research must follow standardized procedures to achieve reliable and reproduceable results. Even though an attempt to establish general standards for multispectral imaging procedures for digital photography and conservation documentation has been done in the past (Frey et al. 2011), in reality, standards as carried out can vary even in a single

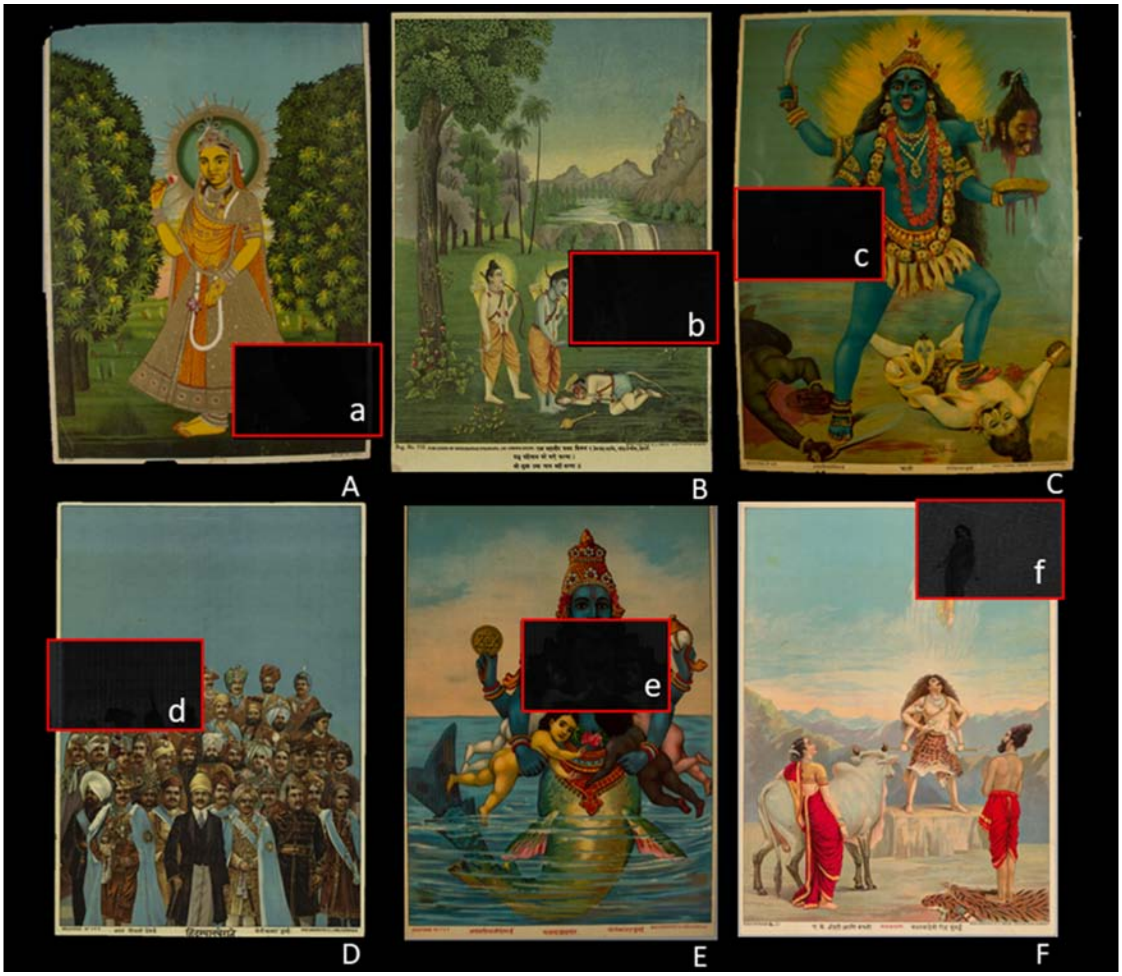


Fig. 4. Oleographs in normal light and under UVR (section in red frame in each print); UVR images are not modified; red frames (a–f) locate details of figures 5–10. (A) *Radha*, 2015.441.2. (B) *Rama, Lakshmana, and Hanuman*, 2013.9. (C) *Kali*, 2013.17. (D) *Portrait of Maharajas*, India, 2014.91. (E) *Matsya Avatara (Vishnu's Fish Avatar)*, 2013.13. (F) *The Descent of the Ganges (Gangavatarana)*, 2016.483.

institution and end up with different results. Accordingly, it is important to document procedures and techniques used.

The technical photography performed in this study followed the protocols established within the paper conservation department of the Metropolitan Museum of Art. A Nikon D90 (modified, infrared filter removed) and lens APO crystal lens UV-VIS-IR 60 mm (1:4 APO Macro lens) were used with PECA 900 (67-mm) and X-Night BP1 (72-mm) filters. All images were captured with the software Camera Pro 2 including the following color charts in each shot to provide standardized results: X-Rite Color checker Passport, and 99% and 5% Spectralon Diffuse Reflectance Standards. Additional steps included flat fielding and post-processing of images in Photoshop Lightroom and the Adobe Flat Field Plug-In. Detail images have been additionally adjusted in Photoshop by increasing the brightness/light exposure to further enhance the visibility of varnish patterns in the obtained UVR images. Adjustments are acknowledged in the captions.

RESULTS

Examination with UVR, without any adjustment of brightness, showed overall widely varying results. The majority of these oleographs showed a completely dark surface under UVR analysis. Examples of this state are represented in figures 4B and 4C. Only a few had moderate (see figs. 4A, 4E) to minor (see figs. 4D, 4F) visibility under UVR examination.

Adjustment of light exposure and brightness levels in Photoshop allowed a more accurate and detailed examination of varnish structures. Optical analyses of distinct samples of the 23 oleographs in the Metropolitan Museum's collection are represented in enlarged form. Figures 5–10 exemplify three different varnish patterns.

Pattern I. In pattern I, a systematic pattern of small grooves is visible (figs. 5, 6). Single grooves may vary in thickness and distinctness. Occasional dark dots are scattered over the

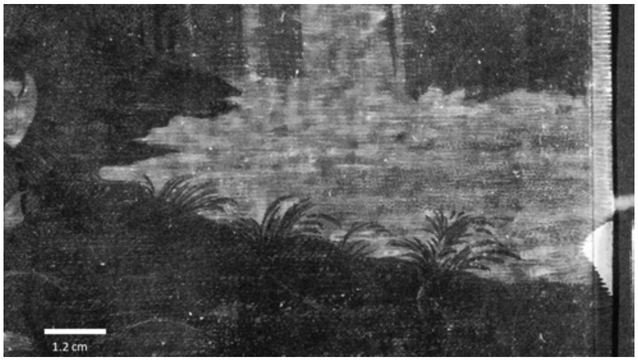


Fig. 5. Detail b: *Rama, Lakshmana, and Hanuman*, 2015.441.2; adjusted UVR detail-photo (see Fig. 4B).

Fig. 7. Detail d: *Portrait of Maharajas*, India, 2014.91; adjusted UVR detail-photo (see Fig. 4D).

surface (see fig. 6). Overall, the pattern can show a slightly mottled and uneven appearance. Irregularities along the margins can be observed in figure 5.

Pattern II: In pattern II, there are irregular distances between the grooves, and the distances are rougher and larger (figs. 7, 8) than in pattern I. The dimensions of the grooves differ considerably, ranging from 0.1 to 0.5 cm. The main varnish pattern can be seen to be vertical, but a blurred and indistinct secondary pattern that is horizontal can also be observed. Only very few dark spots of varnish accumulation are found (see fig. 7).

Pattern III. In pattern III, the varnish application is homogeneous (figs. 9, 10). The grooves are not visible in figure 9 or are barely visible in figure 10, even when digitally adjusted. On the surface, mostly scratches and past physical handling are visible. The light, soft grooves visible in figure 10 are similar in size to those in pattern I.

DISCUSSION

Although this study is focused primarily on the examination under UVR of varnish applied by machine, it should also be mentioned that in most cases the varnish application can also be visible to the naked eye. Thick and uneven varnish accumulations especially tend to discolor. At the same time, spots with less varnish (see fig. 6) create a mottled pattern and cannot necessarily be identified without further analysis.

Nonadjusted UVR images of oleographs displayed only very few visible parts of the printed image, whereas the margin still stayed visible to a certain degree on most prints under study. This difference can be explained by the presence of certain underlying colors or inks that obscure the appearance of the varnish if the varnish application is thin. The presence of inks containing chrome yellow and Prussian blue pigments was confirmed in the Metropolitan Museum's Indian oleographs under study.[1] Mock-ups were created to investigate possible interactions between the varnish and ink layers when observed with UVR. Experiments[2] showed that chrome yellow and Prussian blue appear differently under UVR, depending on the proportions of ink to water, viscosity, and general density when applied. Furthermore, they also showed that the thicker and denser the applied varnish, the fewer the characteristics of varnish details that are generally visible in UVR images (fig. 11).

Fig. 6. Detail f: *The Descent of the Ganges (Gangavatarana)*, 2016.483; adjusted UVR detail-photo (see Fig. 4F).

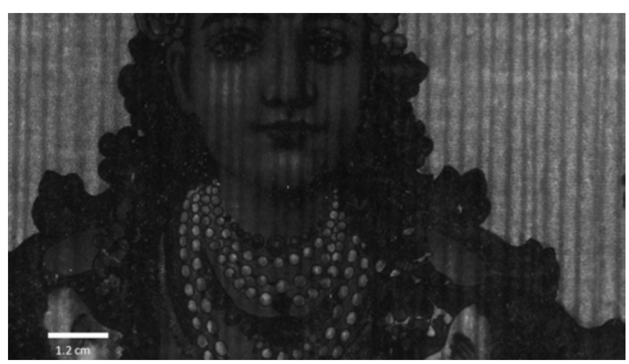


Fig. 8. Detail e: *Matsya Avatara (Vishnu's Fish Avatar)*, 2013.13; adjusted UVR detail-photo (see Fig. 4E).

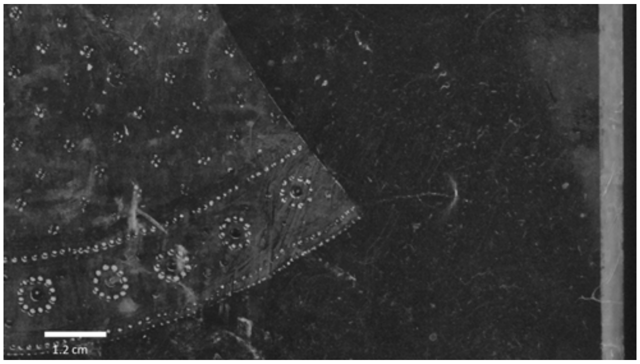


Fig. 9. Detail a: *Radha*, 2013.9; adjusted UVR detail-photo (see Fig. 4A).

To exclude these interactions from the current study, observations also focused on areas of the prints that did not contain any inks, such as the margins. Examples of applied varnish on margins studied with UVR showed a varying degree of darkening. This level of darkness was visually evaluated and ranked from level 1 (visible) to level 5 (invisible) (table 1).

Pattern I showed a more mottled general background pattern, including spotty, lighter areas, as well as darker spots. Although the darker spots could be identified as dust, dirt, or impurities in the varnish, the general light spottiness could be explained by the rather thinly applied varnish. Or, if ethanol evaporated too fast from the varnish composition, it could also leave behind water, which breaks the surface and results in a dull appearance (Wyman & Sons 1882), or creates a bubble in the varnish layer (Gottsegen 2006). It should be noted that air bubbles can also be introduced as a natural occurrence within the liquid varnish during application.

In figure 5, a specific uneven application of varnish could be observed in the margins. This unevenness was a result either of the paper expanding, causing deformations that prevented sufficient substrate to be in contact with the roller for the varnish to be applied, or of the varnish reservoir being depleted of medium. In this specific area of the margins, one can see how the varnish medium is accumulated on the roller at the moment of its application. Raised grooves that are visible represent differences in varnish surface topography on the roller that were transferred to the varnish by the brushes. More important, this flaw illustrates how the pattern in the background can be attributed to the actual roller structure, whereas the grooves represent imprints by the brush distributing the varnish on the roller.

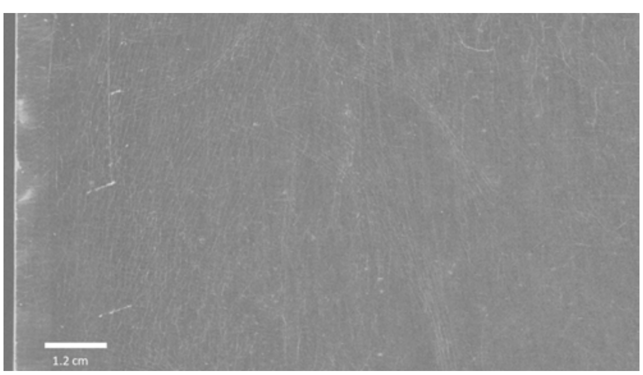


Fig. 10. Detail c: *Kali*, 2013.17; adjusted UVR detail-photo (see Fig. 4C).

The use of a splatter brush for distribution of the varnish could produce the unevenness seen in pattern II. Pattern I, however, showed grooves, but they were much finer, indicating finer brushes. Evenly applied varnish suggests that the printed and varnished oleograph was produced in Europe, where the technology and equipment were able to produce this surface condition. Or evenly applied varnish might suggest that another tool—a blade not a brush—was used to distribute the varnish on the roller in a much finer way. In India, since most of the equipment, tools, and materials would have been imported from Europe, it can be assumed that similar techniques were used. Consequently, it is important that any interpretation of the appearance of the varnish as analyzed be informed by literature sources.

Today's provenance and literature research pertain to only a fraction of Hindu devotional prints that were initially printed. A complete catalog of prints, both physically or visually/digitally, is exceedingly difficult to collect, because it is unclear how many variations of one image were reproduced. Images were printed in numerous versions. For example, the image of *The Descent of the Ganges (Gangavatarana)* (Ravi Varma Udaya F. A. L Press Ghatkopar Bombay, 2016.483) can be found in several catalogues (Johwari 2009; Davis, Baron, Narayan 2012), but each has a different registration number, marking the lithographic stone from which it was printed.

However, most prints did not survive, given the poor quality of their materials and heavy handling in the past. They were a part of everyday life and used in religious practice. Furthermore, exposure to extreme environmental conditions, such as highest daily temperatures exceeding 31°C (87.8°F; 12-month moving average data from India, 1880–1920) (Muller et al. 2013) and high humidity in India, ultimately degraded the materials and attracted insects. Even dating the prints that survive is a challenge, since they were mass produced in large editions. Dates currently assigned are a range from one to several decades as a potential period of production. To illustrate complexities through a typical example of *Kali* (see fig. 4C), production is dated to a period ranging from ca. 1910 to 1920, but the Ravi Varma Press Malavi-Lonavala moved to Karla-Lonavla in 1901. Accordingly, the print must have been printed from an outdated lithographic stone, long after the press moved. This situation raises the question of how to handle dating in general when dealing with potential "reprints" of already mass-produced oleographs.

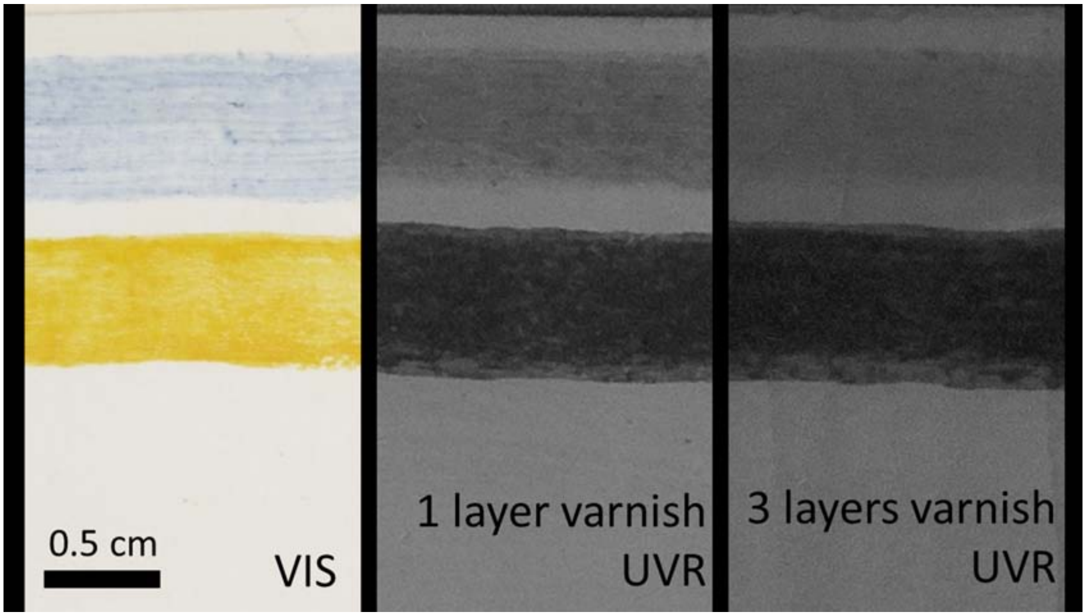


Fig. 11. Images in normal light (left) and unmodified UVR (middle and right) with chrome yellow (lower stroke) and Prussian blue (upper stroke), on coated paper, covered with one layer (middle) and three layers (right) of light shellac.

Based on the chronology of technical developments in varnishing/coating machinery, a compilation of data sets was established to cluster prints based on their varnish pattern (see table 1). The initial study included UVR analyses of all 23 oleographs of the Met's collection. Distinctive aspects of each include the decoded varnish patterns based on UVR analysis (adjusted and nonadjusted) and the representation of prints in literature and their challenges in provenance. Including only representative samples in this publication may circumscribe the results reported in this essay, but several issues complicated grouping the prints based on material characteristics. As already discussed, both dating and the origin of prints need to be interpreted with caution. Although varnish patterns can be distinguished and prints can be grouped by size, assignment on these bases to specific printing presses and dates was not possible. Observations suggest that although these patterns cannot yet be attributed to specific printing presses or dates of origin, they provide a way to explore the relation of these prints to technology and materials available in 19th- and 20th-century India.

CONCLUSION

Table 1 summarizes these findings. Although inconsistences of single data sets prevented a coherent grouping, based on

Accession number	Origin	Evaluation under in UVR (1 as visible – 5 as completely dark)	Grouping of Varnish pattern under adjusted UVR	Varnish orientation (horizontal/ vertical grooves)	Print size
2015.441.2	India, 1910–15, Ravi Varma Udaya F.A.L Press Ghatkopar Bombay	5	I	H	35.6 × 24.8 cm
2016.483	India, ca. 1910-20, Ravi Varma Udaya F.A.L Press Ghatkopar Bombay	1	I	H	35.4 × 24.9 cm,
2013.17	India, ca. 1910–20, Ravi Varma Press Malavi Lonavla	5	III	H	50.8 × 36.2 cm,
2013.13	India, Undated, ca. 1900–15, Ravi Varma Karla-Lonavla	4	III	V	35.2 × 25.4 cm,
2013.9	1880-1900, printed in Italy	2	II	-	34.6 × 24.8 cm
2014.91	Portrait of Maharajas, India, 1910s, Ravi Varma Press Karla-Lonavla	3	II	H	35.6 × 25.1 cm

Table 1

the reported characteristics of the three different varnish pattern groups, it can be concluded that appearance under UVR is connected with the characteristics of the roller, the way the varnish was distributed on the roller, its surface topography, and the consistency of the varnish itself. Even though the varnish patterns could be matched to historic varnishing techniques and machines, a connection between these patterns and specific dates or places of origin, or presses and formats, was not possible due to inconsistent results and the relatively small scope of the study.

The issue of dating and accurately locating the origin of prints raises the question of whether it is important to correctly date these mass-produced prints at all. What qualifies as an original Ravi Varma print, printed by a printing technician in thousands of editions, when compared with a reproduction of similar quality (Sarma 2019)? More research and analyses of oleographs are needed to establish a quantitative study. Perhaps the specific dating of a mass-produced oleograph is not relevant, so long as it can be contextualized within the practice of a printing press during its active existence. However, more research could potentially lead to a noninvasive identification method of "reprints" produced by individuals who were plagiarizing prints by Ravi Varma and the Ravi Varma Fine Art Lithographic Press.

ACKNOWLEDGMENTS

The author gratefully acknowledges the Andrew W. Mellon Foundation for providing funding for the fellowship in the paper conservation laboratory at the Metropolitan Museum of Art, New York, as well as support from Marina Ruiz-Molina from the paper conservation department, Silvia Centeno and Yao Yao from the scientific research department, and John Guy from the Asian art department.

NOTES

1. Scientific analysis was carried out by the Department of Scientific Research at the Metropolitan Museum of Art, New York, to identify blue and yellow colorants in three Indian prints. XRF and Raman spectroscopy were used to confirm the presence of Prussian blue and chrome yellow in *The Descent of the Ganges (Gangavatarana)* (2016.483).
2. To create mock-ups for further investigation of color appearances below a varnish layer, a coating of kaolin bound in gum arabic was evenly applied on chromatography paper. Two parallel lines of chrome yellow and Prussian blue (applied by brush) were applied on top of the coating. Finally, one thin layer of commercially available light shellac (Kremer: order number 60440) was applied by transferring the varnish with a smooth glass roll evenly onto the paper.

REFERENCES

Chawla, Rupika. 2010. *Raja Ravi Varma: Painter of Colonial India*. Ahmedabad, India: Mapin Publishing.

Davis, Richard H., Mark Baron, and Vaashua Narayan. 2012. *Gods in Print: Masterpieces of India's Mythological Art—A Century of Sacred Art (1870–1970).* San Rafael: Mandala Publishing.

Frey, Franziska S., Jeffrey Warda, Dawn Heller, Dan Kushel, Timothy Vitale, and Gawain Weaver. 2011. *The AIC Guide to Digital Photography and Conservation Documentation*, edited by the American Institute for Conservation of Historic and Artistic Works. 2nd ed. Washington, DC: American Institute for Conservation.

Gottsegen, Mark David. 2006. *The Painter's Handbook: A Complete Reference.* New York: Watson-Guptill Publications.

Johwari, D. Jegat. 2009. *Raja Ravi Varma Oleographs Catalogue.* Tamil Nadu, India: Shri Parasuraman.

Mahadevan, Sudhir. 2016. *A Very Old Machine: The Many Origins of the Cinema in India.* New York: State University of New York Press.

Marchessault, R. H., and Christen Skaar. 1967. *Surfaces and Coatings Related to Paper and Wood.* Syracuse, NY: Syracuse University Press.

Marzio, Peter C. 1979. *The Democratic Art: Pictures for a 19th-Century America.* Boston: David R. Godine.

Mosier, E., D. Van der Reyden, and M. Baker. 1992. "The Technology and Treatment of an Embossed, Chromolithographic 'Mechanical' Victorian Valentine Card." *Book and Paper Group Annual* 11: 100–125.

Muller, Elizabeth, Will Glaser, Bill Shireman, Richard Muller, Jim Boettcher, and Bob Budnitz. 2013. Berkeley Earth. http://berkeleyearth.lbl.gov/regions/india#.

Pinney, Christopher. 2004. *Photos of the Gods: The Printed Image and Political Struggle in India.* Hong Kong: Reaktion Books Ltd.

Pinney, Christopher. 2018. *Lessons from Hell: Printing and Punishment in India.* Mumbai.

Sharma, R. C., and R. Chawla, eds. 1993. *Raja Ravi Varma: New Perspectives.* New Delhi: National Museum.

Relia, Anil. 2014. *The Indian Portrait—III: A Historical Journey of Graphic Prints up to Independence.* Ahmedabad, India: Archer Art Gallery.

Rhodes, Henry J. 1924. *The Art of Lithography, London 1924.* London: Print Quarterly Limited.

Sarma, Dibyajyoti. 2019. The Science and Commerce of the Art of Printmaking. https://www.academia.edu/23115018/The_Science_and_Commerce_of_the_Art_of_Printmaking.

Twyman, Michael. 2014. *A History of Chromolithography: Printed Colour for All.* London: Oak Knoll Pr.

Wyman & Sons. 1882. "The Printing Times and Lithographer." *An Illustrated Monthly Technical and Fine-Art Journal of Lithography, Typography, Engraving, Paper-Making and the Auxiliary Trades.* 8: 55–126.

EMILY M. K. MÜLLER
Andrew W. Mellon Fellow at the Sherman Fairchild Center for Works on Paper
The Metropolitan Museum of Art, New York
New York, NY
emilymueller91@hotmail.de

Shiny, Lined, and Brown: Building Conservation Context for Harry Jander's Document Restorations

INTRODUCTION

From 1947 to 1954, Harry Jander worked in document restoration at the Texas General Land Office, a state agency charged with land and resource management. His treatments on hundreds of maps and paper records were idiosyncratic and easily recognizable. In Jander's self-devised method, documents were coated with a varnish-like protective consolidant (fig. 1). The coating served as an adhesive for a lining made of open-weave nylon mesh. The lining's edges were trimmed with pinking shears, giving them a distinctive, zig-zag shape. Jander then signed many of his treatments with black ink on the verso (fig. 2).

Time was unkind to Jander's treatments. Fifty years later, treated materials had become dark brown, brittle, and translucent. The coating was shiny and waxy, sometimes showing remaining evidence of brushstrokes. A distinctive, medicinal odor wafted from the documents. Staff members at the Texas General Land Office coined a special term to describe these materials: *Janderized*.

Jander was proud and secretive about his methods and materials, saying, "they're safer in my own mind" (*Austin American* 1948). No treatment documentation accompanies his work. These realities have challenged modern-day understanding of his practice. Testing has shown that acetone is an effective solvent for Jander's coating, and many of his treatments have been reversed with successive acetone baths. Nevertheless, many questions remain about the full scope of Jander's materials, goals, and influences.

By modern understanding, Jander's treatment was invasive and challenging to reverse. Its impact on the appearance and structural viability of historical paper seems heavy-handed. Jander's autograph reveals a bravado long since passed from conservation aesthetics. But past mistakes were often made with the best intentions. How should today's conservator assess a past treatment like that of Jander? Was Jander a sole actor who improvised a preservation treatment and misrepresented himself as an authority? Or was he part of larger preservation trends, acting within the best understanding of conservation science and practice in the 1940s and 1950s?

A complex story like Jander's benefits from a multifaceted research strategy. This study builds upon archival research and chemical analysis to establish conservation context for Jander's work. Through examination of Jander's background, his possible treatment materials, the contemporaneous treatments of his day, the chemistry underlying his work, and analytical testing, a fuller understanding of Jander's rationale and materials may be achieved.

WHO WAS HARRY JANDER?

Jander's life story is full of elusive and contradictory details. He spent his early years in eastern and coastal Texas; visited England around the time of World War I; lived in St. Louis, Missouri, in mid-life; and then returned to central Texas around the time of World War II. However, Jander's specific activities in each chapter of his life are somewhat unclear, and Jander's stories about himself sometimes challenge the bounds of believability.

Harry Garnett Jander (fig. 3) was born in the early 1890s and grew up in the small town of Palestine, Texas; (War Department 1943). Between 1911 and 1915, he lived in Galveston, Texas, where he worked as a cashier at a brewery. When a devastating hurricane struck Galveston in 1915, Jander relocated to his father's hometown of St. Louis, Missouri, where he took a job with the YMCA (Alonzo and Tuggey 2019).

In September 1918, near the conclusion of World War I, Jander traveled to England with the YMCA. Sources disagree as to whether Jander remained in England until January 1919 (Alonzo and Tuggey 2019) or for a period of "several years" (War Department 1943). During this time, Jander claimed to have studied at the University of London, although he did not say which member institution of this large educational system was his alma mater (Barnes 1952; Alonzo and Tuggey 2019). During this relatively short period in England, he reportedly received "a Doctor's degree" (Adair 1953) in an unspecified field. Jander spoke of taking an apprenticeship

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

Fig. 1. Raking light reveals the shiny surface of the recto of a typical Jander treatment. Courtesy of S. Norris.

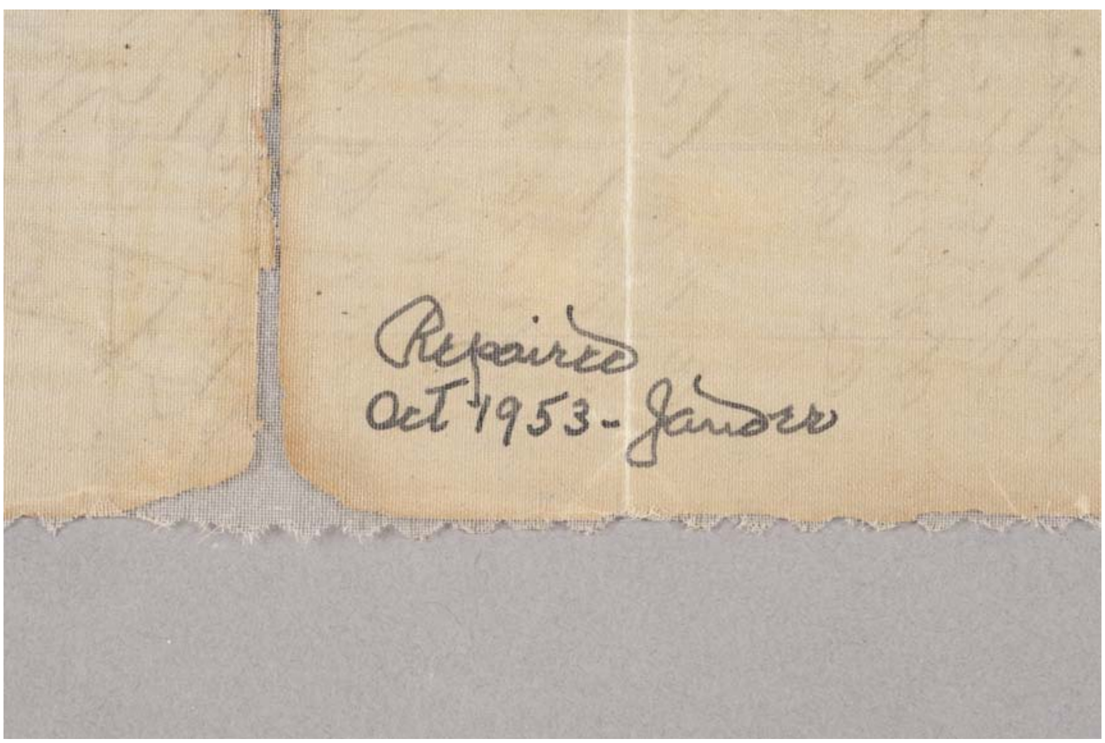


Fig. 2. The verso of a typical Jander treatment is lined with nylon mesh, trimmed with pinking shears, and signed. Courtesy of S. Norris.

Fig. 3. Harry G. Jander displays a textile in his home. Nolan Borden, *Austin American-Statesman*, March 3, 1959. Austin History Center, Austin Public Library, AS-59-22006.

in interior decorating and of working in Buckingham Palace. He even recalled a personal conversation with Queen Mary, during which the queen purportedly gave him a diamond ring (Barnes 1952).

Two sources note that Jander studied at Columbia University and practiced interior decorating in New York (Barnes 1952; *Austin Statesman* 1962). However, Jander cannot be identified in New York City directories of the era (Alonzo and Tuggey 2019).

By 1922, Jander had returned to St. Louis and was employed as a decorator at Scruggs Department Store. He also took private decorating work, perhaps as early as 1920. Although one report placed him in St. Louis until about 1940, Jander has not been identified in St. Louis city directories after 1933 (War Department 1943; Alonzo and Tuggey 2019). Documentation of Jander's life then resumes in early 1940s Texas.

There are disparate narratives of Jander's World War II–era relocation to Texas. Newspapers report that Jander worked with aircraft fabrics at Randolph Field in San Antonio, Texas, and transferred to Bergstrom Field in Austin, Texas, in 1945 (*Austin American* 1948; Barnes 1952). However, a 1942 Austin city directory listed Jander as a professor at St. Edward's University in Austin; he was served an eviction notice from a residence on university property in 1943 (Alonzo and Tuggey 2019). Archivists at the Texas General Land Office estimate that Jander worked there preserving documents from 1947 to 1954 (Alonzo, pers. comm., December 11, 2019). He may also have treated documents in private practice during this era (Adair 1953).

Jander died in Austin, Texas, in 1962. No next of kin were identified. His remains were sent to Indiana (*Austin Statesman* 1962), although biographical research has not identified family connections in that state.

JANDER THE COLLECTOR

In addition to working as an interior decorator, Jander was also a textile collector. At its peak, his collection may have included about 1,000 items, with an estimated 1952 value of $50,000 (Barnes 1952; *Austin Statesman* 1962). By one account, Jander regularly relaxed at his home wearing an 800-year-old Ming dynasty robe from his collection, along with the diamond ring received from Queen Mary. (An 800-year-old robe would have originated in the Song dynasty, 960–1279.) Jander gave lectures about his collection at Austin-area civic clubs and society events. An exhibit of his textiles was at least briefly displayed at the Texas Memorial Museum (Barnes 1952).

Later in life, Jander reportedly donated parts of his collection to George Washington University (possibly a misstatement of Washington University) in St. Louis, Northwestern University, the Metropolitan Museum of Art, and the University of London (Barnes 1952; *Austin American* 1962). To date, these donations cannot be confirmed. Henry Francis DuPont declined an offered donation from Jander in 1951 (Alonzo and Tuggey 2019). A portion of Jander's collection was recently identified at St. David's Episcopal Church in Austin, where Jander was a member. It has been transferred to the conservation laboratory at the University of Texas School of Information (Alonzo, pers. comm., December 12, 2019).

A 1943 Army Service Forces report evaluating Jander's character and loyalty states the following opinion:

> SUBJECT has a display of silverware and fabrics which are supposed to be very rare and valuable, but because SUBJECT is somewhat of a prevaricator, informants doubt the value of these articles and also doubt the claims of SUBJECT's wide travels and past experience that SUBJECT relates. (War Department 1943)

JANDER IN PRESERVATION

Jander's biography raises many questions. It also offers several possible clues about the origins, processes, and materials of his document restoration process.

Jander's earliest thoughts on preservation may have come around 1933. While working as an interior decorator in St. Louis, he seems to have envisioned using a type of preservative varnish:

> [He] conceived the idea . . . of perfecting a formula that would preserve wall paper without discoloring it so that it would be impervious to water or any stains, be thoroughly washable, and retain its beauty as long as it stayed on the wall. (Adair 1953)

Another report states that Jander began experimenting with paper preservatives after a World War II–era experience at Randolph Field in San Antonio. This account introduces the practice of lining paper with textile and of working with the varnish-like substance known as airplane dope:

> [A]n Air Corps officer came to him with a problem. The Army had been mounting navigators (sic) maps on fabric with glue or shellac. Both cracked and buckled badly. Jander took the map and mounted it with aircraft "dope." It far outlasted the other maps. (*Austin American* 1948)

Jander himself described his treatment process at the Texas General Land Office as suitable for paper, parchment, photographs, and even furniture. His methodology of applying a nylon lining and a varnish-like "formula" was described as follows:

> The finest grade of nylon guaze (sic) is applied on one side to give body and strength to the old paper and then the formula is applied on both sides. The article so treated is thereby sealed in airtight for all time and is proofed against dampness and discoloration. Ink or oil may even be poured on the treated article and washed off readily with soap and water without any damage to the surface of the formula or the paper so treated, and silverfish, roaches, mice and all paper destroying insects or rodents shun paper treated with the formula as they would poison. (Adair 1953)

Jander explained that his treatment results were "tough as leather," and as an added benefit, they rendered "old paper maps transparent so that they can be blueprinted or photostated, saving endless hours of redrawing" (*Austin American* 1948). Transparency (or more likely translucency) is a trait shared with early oiled and waxed repair papers. This trait may indicate that Jander's coating filled spaces between the paper fibers, changing the refractive index of the treated document.

Jander was secretive about his solution, claiming, "The formula cannot be analyzed. Three laboratories have tried." The identity of these laboratories is unknown. Jander also reported that two tests were conducted on his treated papers. In one test at the National Bureau of Standards, a treated sample of newsprint was subjected to "accelerated aging equivalent to 100 years." Results showed that the sample was "slightly discolered (sic), but has no frayed spots, normally found in old deteriorating paper." Another test conducted at the Texas Highway Department subjected a treated paper sample to conditions typically used to evaluate road signs: "1,000 hours at 150 degrees of heat, in light 15 times as powerful as the sun." The resulting samples were "slightly browned, but with the print still legible" (*Austin American* 1948). Attempts to locate documentation or results from these test results have proven unsuccessful.

Jander's Secret Recipe

While researching the details of Jander's background, Texas General Land Office archivists made an intriguing discovery. On a small slip of paper in Jander's records, there appeared to be a handwritten recipe for Jander's secret preservation formula (fig. 4). Ingredients listed were as follows (Jander n.d.):

3 gal distilled water
24 oz. glycerine
6 oz. carbolic acid (phenol)
90 oz. spirits of camphor
72 oz. alcohol

Like much of the evidence about Jander's life, this discovery raised as many questions as it answered. No mixing instructions accompanied the ingredient list. It was unclear what chemical reaction might occur among these ingredients, as there were no obvious kinetic forces at play. Accordingly, the list seemed to represent only a partial recipe, with one or more missing ingredients. Despite these challenges, several types of compounds could be hypothesized.

Initial conjectures for the identity of Jander's compound based on the handwritten recipe were a cellulose ether, ester gum, or a long-chained alkylphenol compound. These compounds can produce thermoplastic or pressure-sensitive adhesives. They were feasible options during the 1940s and 1950s, given advances in the manufacturing industry.

Additional possibilities were also considered. Was Jander's compound a solvent solution used to solubilize nylon from his lining (Stavroudis, pers. comm., May 20, 2019)? Was cellulose nitrate the missing ingredient, diluted by the other, known ingredients (Lee, pers. comm., May 9, 2019)? The research team hypothesized that Jander's mixture was at least slightly acidic, with increasing acidity over time. Additionally, given the known aging properties of the starting compounds, it was believed that the mixture had a high risk of cross-linking with both the paper and the lining.

To learn more, an informal test of Jander's recipe was conducted at the Summerlee Conservation Laboratory at the Texas State Library and Archives Commission in August 2019. Two reduced batches of the recipe were mixed: one using spirits of camphor (84% alcohol, 10% camphor) and one using pure camphor oil. Jander did not specify alcohol type; this test used isopropanol 70% (with water). The test also omitted phenol due to health concerns. This omission

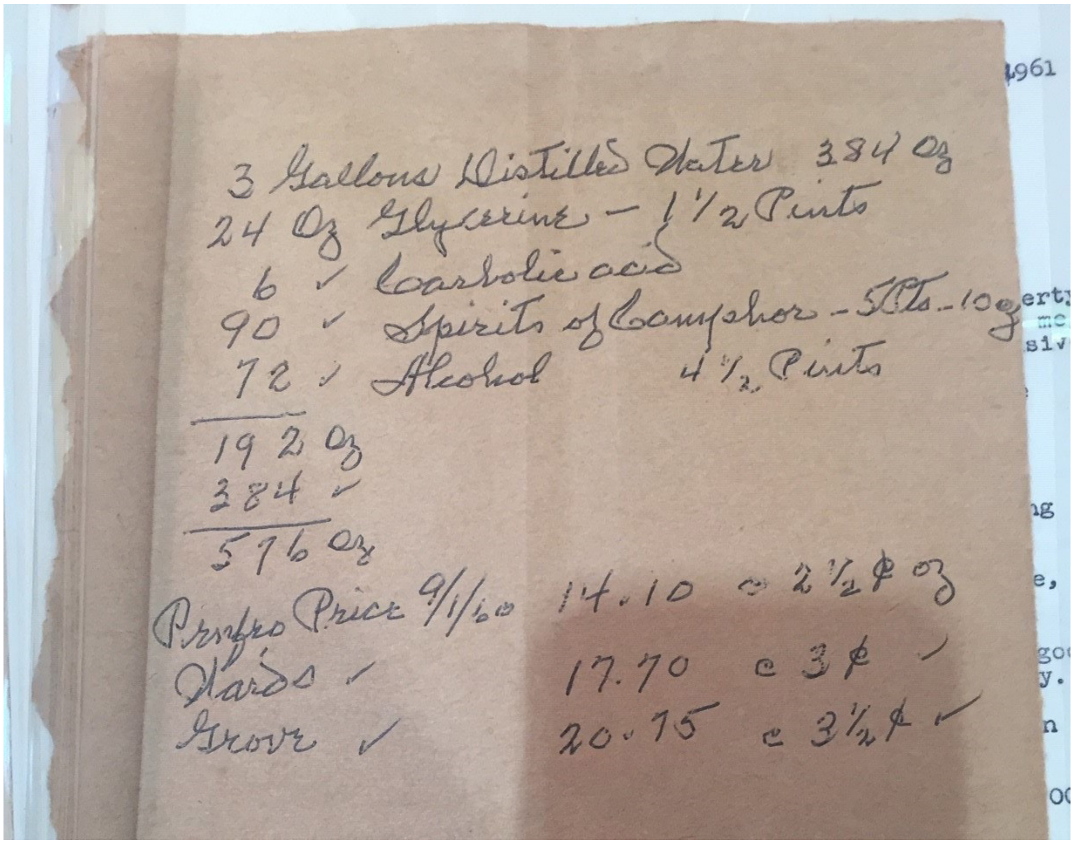

3 Gallons Distilled Water 384 Oz
24 Oz Glycerine – 1½ Pints
6 ✓ Carbolic acid
90 ✓ Spirits of Camphor – 5 Pts – 10 oz
72 ✓ Alcohol 4½ Pints
192 Oz
384 ✓
576 Oz
Penfro Price 9/1/60 14.10 @ 2½¢ oz
Wards ✓ 17.70 @ 3¢ ✓
Grove ✓ 20.15 @ 3½¢ ✓

Fig. 4. Jander's handwritten note. Austin History Center, Austin Public Library, AR.2005.024. Courtesy of D. Alonzo.

prevented the test from forming a long-chained alkylphenol, which was considered a least likely compound possibility. It is thought that the phenol may have functioned as a preservative for the mixture rather than as a critical part of the formula's preservation function. However, if Jander's recipe did produce a long-chained alkylphenol, it would be identified in subsequent analytical testing.

The two mixtures were each brushed onto six sample sheets of paper: one sample of modern Mohawk 25% cotton paper; and five samples each of varied 19th- and 20th-century blank, loose, historical endpapers present in the laboratory. The coated samples were allowed to air-dry.

Observations were as follows:

- The pH of both test mixtures was 4–4.5, measured with a pH strip.
- The treated samples had a medicinal odor similar to typical Jander treatments.
- The treated samples lacked the waxy, shiny surface typical of Jander treatments.
- The mixture made with pure camphor oil yielded large, clear globules despite vigorous stirring. This resulted in beading and streaking when the mixture was applied to the paper samples. When dry, treated samples showed dark spots.
- The mixture made with spirits of camphor yielded a fine, cloudy particulate layer, despite vigorous stirring. Beading and streaking were not evident in the application. Dark spots did not appear on treated samples when dry.

Several working conclusions from this test guided ongoing inquiry:

- Acidity was likely an issue in Jander's treatment. According to best understanding, the pH 4–4.5 mixture was brushed directly onto historical documents and allowed to dry. No washing or deacidification step was documented.
- The distinctive, medicinal odor shared between the treated test samples and historical Jander treatments informally supported the idea that camphor was part of Jander's recipe.
- The difference in surface texture between the treated test samples and historical Jander treatments reinforced the research team's conjecture that the discovered recipe was at least partially inaccurate or incomplete.

- Spirits of camphor produced a more homogenous mixture and more even application than pure camphor oil. This even application bore closer similarity to the historical Jander treatments and lent informal support to the idea that spirits of camphor were part of Jander's recipe.

After this informal test was completed, a 1948 newspaper article was discovered that described an entirely different set of ingredients. These included airplane dope, ether, concentrate of castor oil, sugar, salt, sodium bicarbonate, and paraffin (*Austin American* 1948). This new information increased the number of possible materials under investigation from 5 to 12. It also increased consideration of a cellulose nitrate or similar modified compound as Jander's final goal.

MATERIALS IN CONTEXT

Despite the seemingly unconventional nature of Jander's treatment, many ingredients associated with his formula had historical precedent and contemporaneous use in library and archives preservation. Documented preservation uses of Jander's ingredients fall into several broad categories: humectants (to improve flexibility); pest repellents; coatings, consolidants, or sizing agents; and preservatives in pastes and glues. These categories imply a focus on common concerns in aging paper: brittleness, pest activity, and fragile media and substrates. These concerns have challenged conservators through many years and many styles of practice.

The following is a brief investigation into preservation precedent for each of the known ingredients Jander may have used. The first five ingredients are listed in Jander's handwritten note; the following seven come from the 1948 *Austin American* article.

Camphor

Camphor is an aromatic crystalline compound with a sweet smell (CAMEO, "Camphor" 2016). It is made by distilling the wood of the *Cinnamomum camphora* (camphor tree) into a waxy resin or oil (Smith 2016, 392). Camphor has been made synthetically since the 1930s as uses expanded beyond traditional medicine and pest control and into the chemical, manufacturing, and photographic fields. It sublimes slowly, it is flammable, and it evolves explosive vapors with heat (CAMEO, "Camphor" 2016). Camphor is also found in pharmaceuticals, disinfectants, and explosives (Getty Art & Architecture Thesaurus Online, "Camphor (Resin)" 2004).

Camphor was used in the 19th century as an insect and rodent repellent in library collections. Powdered camphor was sprinkled on library shelves for pest control (Smith 2016, 117–18, 120). In one instance, camphor was used in the 20th century in India as a disinfectant for a books exposed to tuberculosis. Like Jander's treatments, this treatment resulted in severely browned, embrittled paper. The camphor used in India was reversed with acetone (Ubbink 2019), just like reversals of Jander's treatments.

Camphor also has a rich history as a plasticizer. It was mixed with cellulose nitrate to form the first plastic, celluloid, popular in American and European manufacturing from about 1875 to 1940 (CAMEO, "Camphor" 2016). A variant of this mixture created a preservation coating called *Zapon*, which was used as a varnish, size, and consolidant on documents in the early 20th century. In 1901, camphor was added to cellulose acetate to create the trade-named product Cellit (Smith 2016, 97–104, 392, 403).

Phenol/Carbolic Acid

Phenol, or carbolic acid, is a poisonous, caustic aromatic alcohol (Smith 2016, 392). It is a colorless or white crystalline solid with a sweet odor, created through the pyrolysis of coal tar (Getty Art & Architecture Thesaurus Online, "Carbolic Acid" 2004).

In the 19th and 20th centuries, phenol was used to prevent bacterial degradation in fish glue and to forestall mold growth in starch and flour pastes. It has high antiseptic and preservative properties even in low concentrations. It was also recommended as an insect repellent and insecticide in library collections in the 19th century (Smith 2016, 117–18, 178, 234).

Glycerine

Glycerine is a transparent, colorless, viscous liquid originally created as a by-product of soap-making (CAMEO, "Glycerol" 2016). It is a hygroscopic liquid used as a humectant, emulsifier, and plasticizer in printing inks, watercolor and gouache paints, glues, cements, and regenerated cellulose products such as rayon and cellophane (Smith 2016, 396).

Glycerine was added as a humectant to improve flexibility in fish glue, gummed papers, and mucilages in the 19th and 20th centuries. It served a similar purpose in some starch and flour pastes, including the paste used in the Emery lining process (see section 9). It acted as a thickener and drying retardant in letterpress inks. It has been included in some recipes for gelatin size and was reportedly mixed with shellac as an experimental paper preservation coating at the New York Public Library (Smith 2016, 79, 85, 86, 129, 178, 181, 266, 348).

Alcohol

Alcohol is a class of organic compounds in which one or more hydroxyl groups (-OH) are bound to a carbon atom or hydrocarbon chain (CAMEO, "Alcohol" 2016; Getty Art & Architecture Thesaurus Online, "Alcohol (General)" 2004). Jander does not specify what type of alcohol he used. Given popular availability and usage in Jander's day, likely candidates are methanol, ethanol (denatured alcohol or methylated spirits), and isopropanol (Savage 1954, 4). All have small enough chain structures that there would not be much physical difference between the final solutions mixed with them, although some chemical properties may be slightly different.

Since the 19th century, alcohol has been used as a paper-washing agent; as a solvent for removing staining agents like wax, oil, and grease; and as a softener for removing varnish from paper prints (Smith 2016, 61, 164, 267).

Water

Water has historical and current uses as a solvent and a diluent in wide-ranging applications, including paper pulp, photographic solutions, aqueous paint media, textile dyes, cement mixtures, detergents, and adhesives (CAMEO, "Water" 2016). It has been used as a cleaning agent for paper since the 19th century.

Airplane Dope

Airplane dope was a varnish or lacquer used to coat textile surfaces in airplanes in the World War I era (CAMEO, "Airplane Cloth" 2016). Varying formulations were made with cellulose nitrate, cellulose acetate, and cellulose acetate butyrate. Airplane dope tightened and stiffened fabrics to make them suitable for flight, but it required regular reapplication to address rapid cracking and delamination (Regel, Langfelt, Burden, and Ryan 2016). These issues continue to create preservation challenges for modern conservators working with historical airplanes.

The possible use of airplane dope was particularly intriguing given Jander's work with textiles and his service on an Air Force base. Cellulose nitrate and cellulose acetate have wide-ranging precedent in cultural materials and their preservation. Varied uses have included photographic stock, lamination materials, and varnishes, among many others. Mention was made in Jander's day of spray coating fragile textiles with a solution of cellulose acetate in acetone (Savage 1954, 112).

Ether

Ethers are a class of compounds with an oxygen atom linked between two carbon groups (Getty Art & Architecture Thesaurus Online, "Cellulose Ether" 2004). Jander does not specify the type of ether he may have used. Cellulose ethers form clear, hygroscopic films and are used as adhesives, poultices, consolidants, and coatings. Other types of ethers, such as diethyl ether and petroleum ether, are used as solvents for resins, oils, fats, and waxes (CAMEO, "Diethyl Ether" 2016).

Castor Oil

Castor oil is a transparent, viscous oil derived from the seeds of the castor bean. It is very slow to dry, and thick layers never dry fully. Castor oil has been used as a lamp oil, insect repellent, lubricant, paint plasticizer, an ingredient in soap, and emollient to keep leather supple (CAMEO, "Castor Oil" 2016). It has also been used in the production of synthetic resins, plastics, fibers, and varnishes (Getty Art & Architecture Thesaurus Online, "Castor Oil" 2004).

Sugar

Sugar is a carbohydrate composed of saccharose groups and formed by photosynthesis in plants (CAMEO, "Sugar" 2016). Varied uses have been documented as a humectant to enhance flexibility. In the 19th and 20th centuries, sugar was added to adhesives in animal glues, self-adhesive repair papers, and gum arabic (Smith 2016, 79, 178, 234). Sugar was also used interchangeably with glycerine in gum adhesives and letterpress inks (Smith 2016, 81, 266).

Salt

Salts are compounds formed by a pair of positive and negative ions. Many types of salt exist; Jander does not specify the type he may have used. Table salt, or sodium chloride, is certainly the best-known salt in popular applications, but it is little documented in preservation or associated practices. In the 1950s, it was identified as a cleaning aide for porcelain and a poulticing agent to contain grease stains on textile (Savage 1954, 103). It has been identified as a dry-cleaning ingredient in Absorene pink kneadable erasers (*AIC Wiki*, "BPG Surface Cleaning" 2019). It may be used in modern-day practice as a possible additive to water for steaming (*AIC Wiki*, "BPG Hinge, Tape, and Adhesive Removal" 2019).

Sodium Bicarbonate

Sodium bicarbonate, or baking soda, is a water-soluble, crystalline or granular powder. It has little historical precedent in preservation. Like salt, it may be used in modern-day practice as a possible additive to water for steaming (*AIC Wiki*, "BPG Hinge, Tape, and Adhesive Removal" 2019). It can also be used as a dry-cleaning agent for textiles (*AIC Wiki*, "Dry Cleaning" 2015).

Paraffin

Paraffin is a white, translucent, flammable mixture of saturated straight-chain hydrocarbons. It can exist as a wax or an oil. It was first made from petroleum in 1867 and later from coal after World War II (CAMEO, "Paraffin Wax" 2016). Applications relevant to preservation and associated practices include making waxed and oiled papers, leather dressings, inks, polishes, and wood sealants (Getty Art & Architecture Thesaurus Online, "Paraffin (Wax)" 2004; *AIC Wiki*, "BPG Sizing and Resizing" 2019).

In Jander's day, paraffin was described as an insecticide, a drying agent for wood, and a coating for varied museum objects, including textiles (Savage 1954, 83). Today, uses of paraffin in paintings and photographs as a coating and consolidant have mostly been discontinued due to crazing and discoloration (*AIC Wiki*, "PMG Section 1.3 Effects of Exhibition on Photographic Materials" 2009; *AIC Wiki*, "Wax as a Surface Coating" 2014). In modern-day practice, paraffin can be used in heptane as a temporary fixative for water-soluble media in aqueous treatment (*AIC Wiki*, "BPG Consolidation, Fixing, and Facing" 2019). It is also an ingredient in BEVA 371 (*AIC Wiki*, "BPG Adhesives" 2019).

Paraffin was a major component of the Emery process for document preservation. It was reportedly tested as a component in newspaper preservation at the New York Public Library around 1914 (Smith 2016, 348).

ANALYSIS OF CHEMISTRY

The examination of Jander's background, influences, materials, and techniques suggested several types of compounds that could have been created by his secret formula. According to Jander's handwritten recipe, a cellulose ether, ester gum, or alkylphenol compound initially seemed most likely. However, these possible compounds implied that Jander's recipe was incomplete, as they all required a polymer or other compounds to complete the reaction. The subsequently discovered 1948 *Austin American* article suggested that the missing ingredient might be cellulose nitrate or cellulose acetate from airplane dope. This introduced a fourth possible type of compound: a diluted cellulose nitrate solution or similar modified compound. Each possible compound type is explored next.

Cellulose Ether

Cellulose ethers are compounds that are primarily composed of cellulose, with ether groups substituted at the original -OH sites on the cellulose chain (Getty Art & Architecture Thesaurus Online, "Cellulose Ether" 2004). One of the most common types of cellulose ether is methylcellulose (fig. 5). Cellulose ethers are water soluble and can form a clear film that can be used as an adhesive, coating, poultice, or consolidant. Cellulose ethers became commercially available during the 1920s and 1930s, a time in which Jander might have developed his ideas for preservation treatments.

For Jander to make a cellulose ether, he would have had to perform etherification by treating the cellulose (not listed as one of his ingredients) with concentrated sodium hydroxide, heat, and an unknown ether. The phenol, glycerine, and camphor would most likely have acted as a preservative, thickener, and insecticide, respectively.

A cellulose ether was regarded as the least likely compound for several reasons. First, the level of degradation and damage that the treated objects exhibited did not match with observed deterioration trends in cellulose ethers. Second, several ingredients required to make a cellulose ether were

Fig. 5. Left: Powdered methylcellulose. Right: 5% methylcellulose solution.

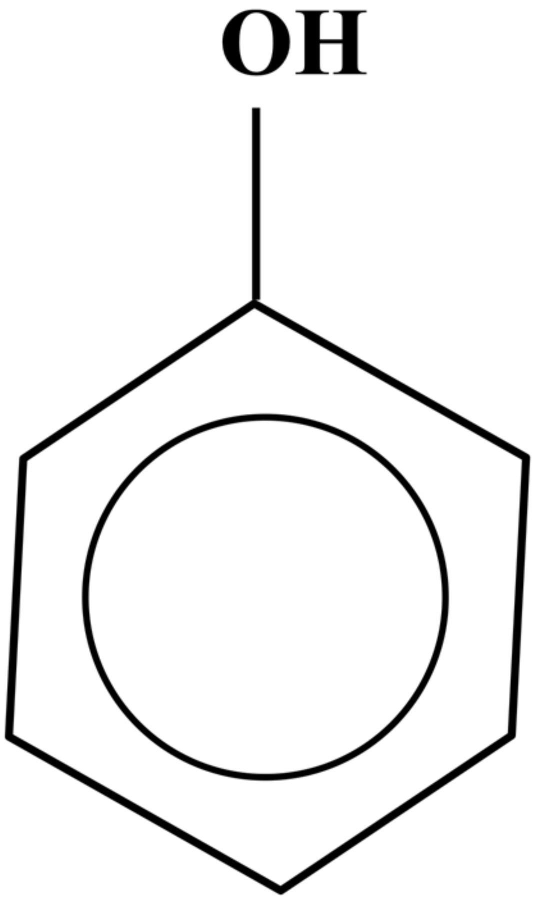


Fig. 6. Structure of phenol (carbolic acid).

missing from Jander's handwritten recipe or lacked enough specificity to produce a viable result. Although procuring these ingredients was not impossible, especially for a resourceful individual, creating them from scratch seemed outside of Jander's knowledge base. Finally, given the development of cellulose ethers in the 1920s and 1930s, it would have been more likely that Jander procured a premade cellulose ether powder and used phenol, camphor, and glycerine as additives. This would have made the presence of the ether entirely moot.

Alkylphenol Compound

Another possibility for Jander's handwritten recipe was the creation of a long-chained or cyclical alkylphenol compound, made by combining unmentioned alkenes and phenol (carbolic acid) (fig. 6).

Although unlikely, this reaction might have been able to break camphor's bicyclic ring to form a chain with a secondary cyclic tail, given the right catalyst. As a far more likely outcome, however, the camphor only would have acted as an insecticide and preservative. Perhaps Jander's end goal was something closer to a phenolic resin, but this would have required additional compounds, such as formaldehyde, to move the reaction forward. If Jander had made a phenolic resin, he might have been working toward a substance similar to the first commercial plastics, like Bakelite (fig. 7). In this case, the camphor most likely would have been a diluent and plasticizer.

This hypothesis faced several challenges. Although the deterioration of Jander's treatments plausibly matched that of some early plastics, no obvious method could be identified to move an alkylphenol reaction forward in a reasonable manner. There are simply too many chemical variables in the creation of alkylphenols to identify a likely path. In addition, although Jander could have procured an enol ether (an alkene with alkoxy substituent on one side) as his unknown ether, this type of compound was not as readily available at the time as were his other ingredients. Additionally, procuring, creating, and/or using an enol ether would have implied a more extensive chemical background than Jander's history suggests. Neither camphor nor glycerine is classified as an alkene, so in this hypothesis, they would act as preservatives or plasticizers rather than participating in the reaction. Finally, although alkylphenols are precursors to several substances, like phenolic resins, they do not act alone as any sort of adhesive or coating material. This would indicate missing ingredients or other unknown reactions to produce the final adhesion material.

Ester Gum

Ester gums provided an appealingly simple option, as they have relatively fewer variables. Ester gums are also known as glycerol esters of wood rosin, a name that describes how they are made. Wood rosin is heated in such a way that it reacts with the glycerine to form the ester gum through the process of esterification (fig. 8).

Traditionally, the wood rosin in an ester gum is pine based. However, poorer-quality ester gums can be made from other wood resin or resinous spirits, possibly like camphor (Wolbers, pers. comm., May 20, 2019). In this case, the spirits of camphor would have gone through oxidation prior to mixing to form camphoric acid (fig. 9). Given camphor's structure, this would have required nitric acid, yet another unlisted reagent.

Here, phenol would have been used as a preservative rather than an active compound in the reaction. However, without a background in materials chemistry, Jander more likely chose camphor as an insecticide and preservative, and acquired pine rosin to form the gum. Given the volatile nature of esters, an ester gum might have broken down through reaction with its environment, possibly leading to the degradation observed by archives staff. Although ester gums are not commonly seen in paper conservation, their presence and deterioration effects can be observed in enamels, paints, nitrocellulose lacquers, and tung oil mixtures (CAMEO, "Ester Gum" 2016).

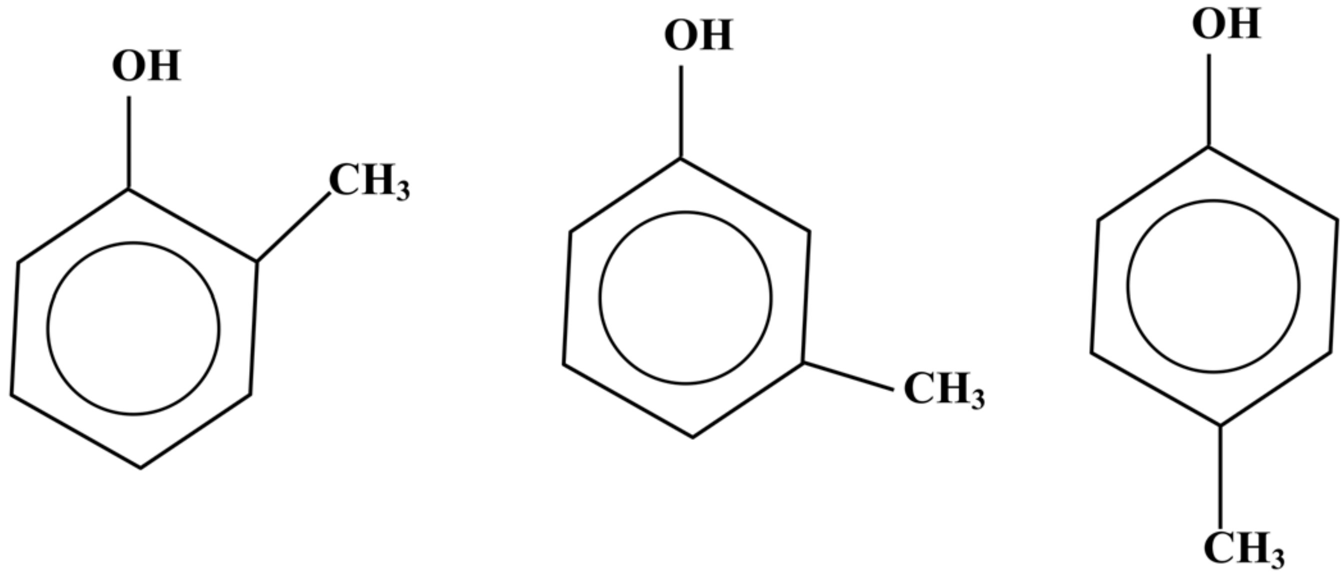


Fig. 7. Isomers of the compound cresol (o-, m-, and p,- respectively) cyclic phenol variants found in Bakelite.

Cellulose Nitrate or Similar Modified Compound

When the 1948 *Austin American* article was discovered, it introduced airplane dope as a possible ingredient. Perhaps Jander was trying to create a modified, "preservation" version of airplane dope. In this scenario, ingredients like spirits of camphor, glycerin, alcohol, water, and phenol would have been chosen for their individual purposes rather than as components of a chemical reaction.

A key ingredient in airplane dope is cellulose nitrate or cellulose acetate (fig. 10). Cellulose nitrate frequently used camphor as a plasticizer and/or diluent. Additional camphor could be mixed in without reducing its strong smell, allowing it to act as an insect deterrent. Glycerin could add increased flexibility, and phenol could act as a preservative. Water could dilute the whole solution to a desired consistency, possibly to improve application or paper saturation. Alcohol could lower the contact angle of the water and improve absorption on thicker or heavily sized papers. Alternatively, alcohol could act as a solvent along with the water. The heat provided from the exothermic reaction of alcohol and water could ease the mixing of the materials.

The hypothesizing of possible compound types created an informed framework for analytical testing. As the research team approached testing, viable options were narrowed and limited to either an ester gum or a modified cellulose nitrate/acetate compound.

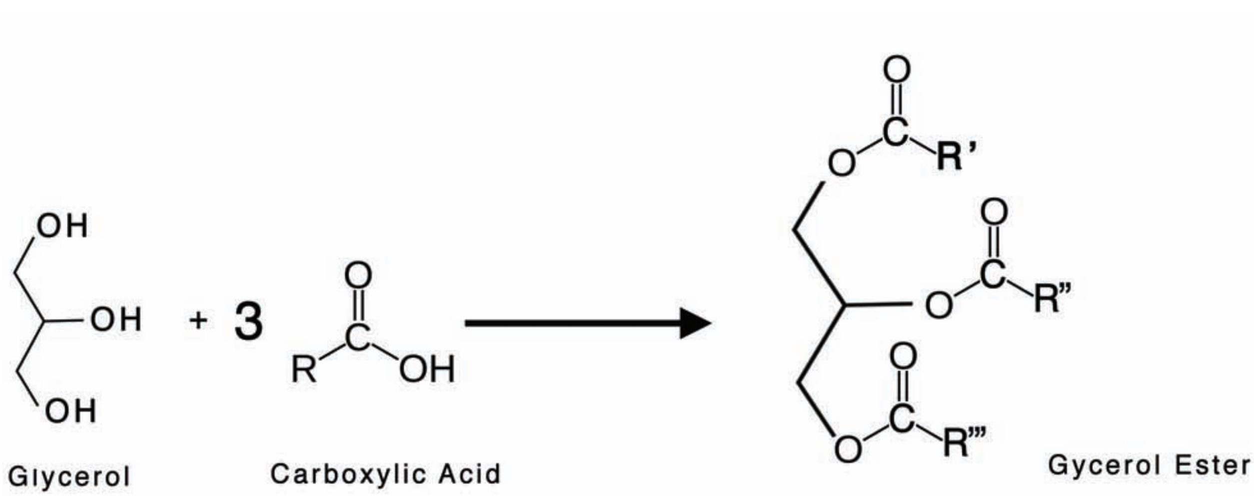


Fig. 8. Generic esterification reaction for the formation of an ester gum.

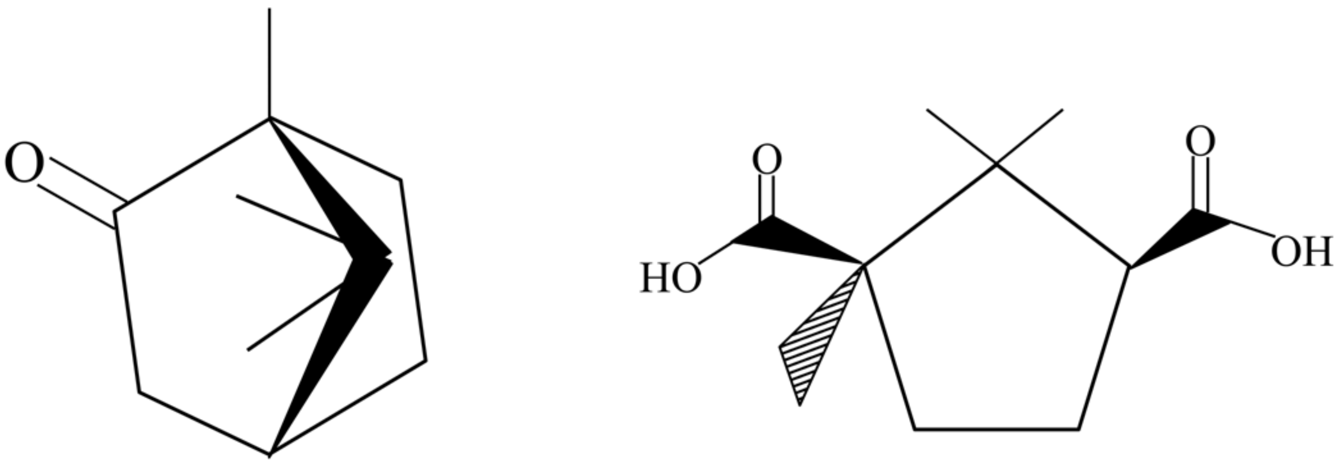


Fig. 9. Structures of camphor: R configuration (left) and camphoric acid (right).

ANALYTICAL TESTING

Analytical tests of two samples of Jander's coating were carried out using gas chromatography-mass spectrometry (GC-MS) and FTIR at the Scientific Research Laboratory at the Museum of Fine Arts, Boston. The samples were (1) a shaving of the coating and (2) nylon mesh with coating embedded in it. Both were used to analyze and confirm (or reject) the possible ingredients compiled from Jander's handwritten note and from the 1948 *Austin American* article. The GC-MS testing could also detect trace elements, which would assist in identifying other possible ingredients that Jander did not mention. Neither test would be able to show any materials that had previously evaporated, which meant that there would probably be no indicators for ether or phenol.

For the FTIR, small portions of both samples were treated with chloroform to extract any soluble materials and create a solid sample. The results for both samples were identical, indicating that the nylon did not affect the solution during application. The GC-MS testing was performed by treating the samples with Meth-Prep 2.[1]

The FTIR results (fig. 11) indicate that the solution extracted from the samples was most likely a mixture of cellulose nitrate and some kind of vegetable oil. The figure also shows a comparison of the known peaks of cellulose nitrate and linseed oils for reference. The GC-MS results (fig. 12) had numerous peaks,[2] which were expected given the variety of ingredients that Jander reported. Surprisingly, most of the peaks were attached to a pine resin. Other surprising peaks were the ones indicating that phthalates were also present in the coating.

Overall, results from the FTIR and GC-MS analyses indicate that some of Jander's reported materials were present. They also indicate that Jander neglected to mention using a natural resin or other resinous adjacent compound (beyond camphor). Assuming that all detected compounds created a single coating, the definitive ingredients used by Jander were cellulose nitrate, N-butyl phthalate, diethyl phthalate (DEP),

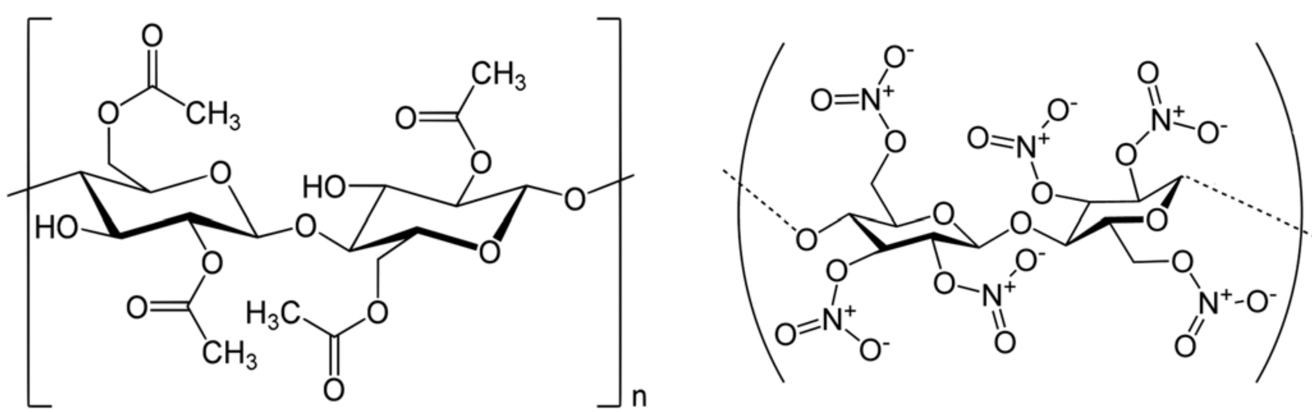


Fig. 10. Left: Cellulose acetate. Right: Cellulose nitrate.

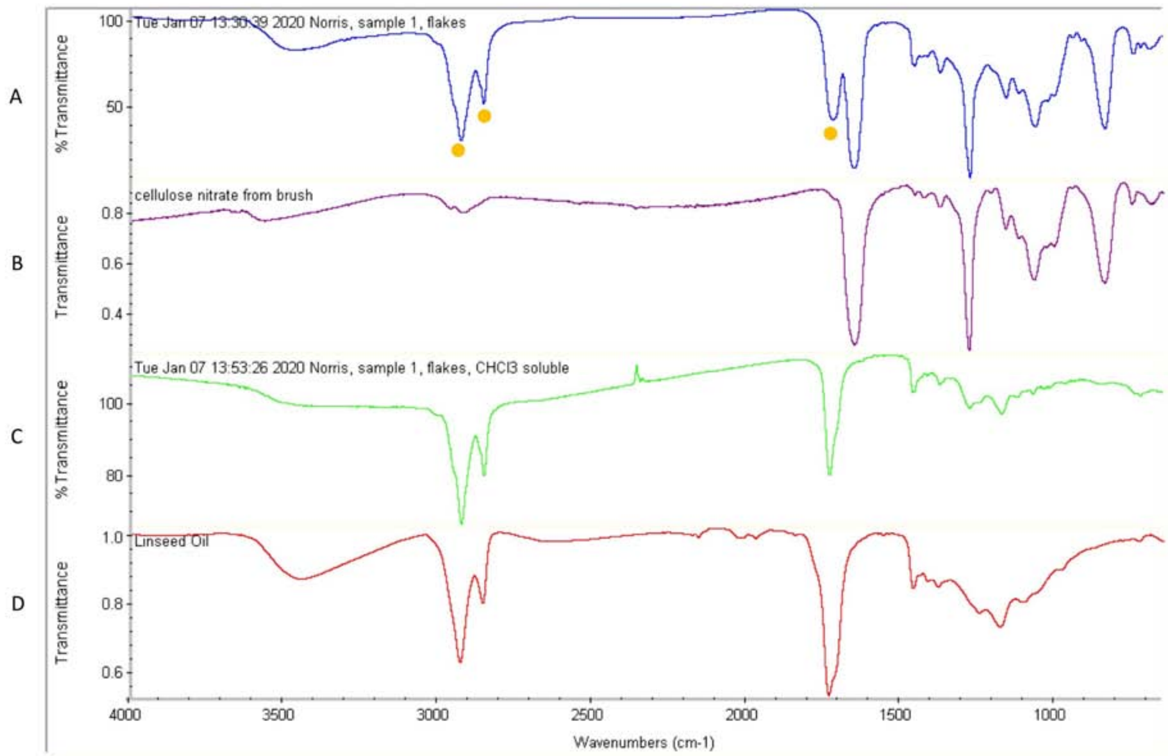


Fig. 11. Transmitted FTIR spectra from samples and references. (A) Solid Sample 1. (B) Reference sample of cellulose nitrate. Note that this spectrum contains most of the absorption features exhibited by Sample 1 below 1700 wavenumbers. (C) Chloroform extract from Solid Sample 1. The major absorption bands are those marked with filled gold circles in Spectrum A. (D) Reference spectrum of fresh linseed oil. Note that the spectrum closely matches the chloroform extract of Sample 1 (Spectrum C). Most vegetable oils have very similar FTIR spectra and cannot be easily distinguished from one another.

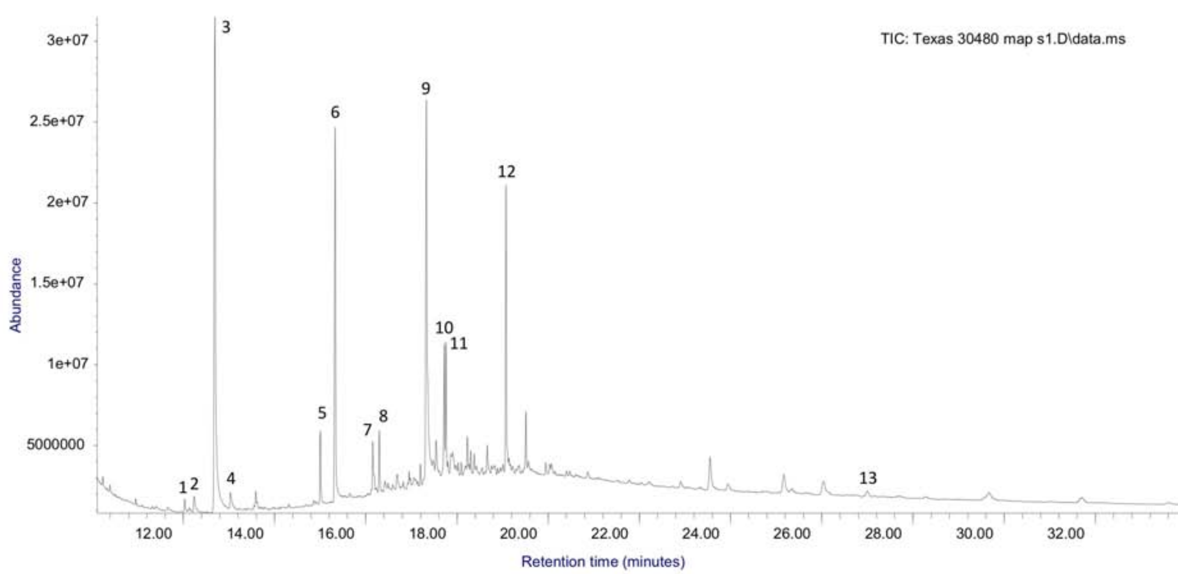


Fig. 12. Detail of chromatogram from GC-MS analysis of Sample 1. The sample was prepared with 1:1 (volume) Meth-Prep 2/toluene. Labeled peaks: (1) lauric acid, (2) 1-ethyl 2-methyl phthalate, (3) DEP, (4) sebacic acid, (5) palmitic acid, (6) dibutyl phthalate, (7) C18 unsaturated fatty acids, (8) stearic acid, (9) ricinoleic acid, (10) 6-dehydrodehroabietic acid, (11) dehydroabietic acid, (12) 7-oxodehydroabietic acid, and (13) masticadienonic acid.

castor oil (ricinoleic acid), and pine resin (Newman and Derrick 2020).

Cellulose Nitrate

Confirmation of the presence of cellulose nitrate indicates that Jander's formula produced a cellulose nitrate compound. This effectively rules out the other possible compounds: a cellulose ether, alkylphenol compound, or ester gum. This also points toward Jander's experience with airplane dope at Randolph Air Force Base in San Antonio, as described by the 1948 *Austin American* article. Perhaps Jander's varnish was an attempt to make airplane dope from scratch. Perhaps it was an attempt to modify airplane dope to achieve better consistency or other working parameters. Possibly it was even an attempt to work toward a customized version of another preservation coating or varnish, such as Zapon.

Ricinoleic Acid

Ricinoleic acid is a fatty acid found in castor oil as part of the triglyceride chain. It is present in very high concentrations of the plant's seeds and is not diluted or minimized extensively during production. Testing also showed the presence of sebacic acid (peak 4, fig. 12) which is also found in castor oil. Castor oil has a long history of use in the arts, specifically textile dying, as an antifungal, soap, and lubricant, and in the production of plastics, varnishes, and paints (Encyclopedia Britannica Online, "Castor Oil" 2020). Castor oil was identified as a possible Jander ingredient in the 1948 *Austin American* article.

Conifer Resins

Multiple conifer resins were identified in the sample of Jander's coating (peaks 1, 5, 8, and 10–12, fig. 12). Conifer resins come from the Pinaceae family, of which the pine tree is the best-known member. Pine resins have been used as a coating to improve durability and water resistance in tracing cloths for architectural drawings. Some conifer resins can have similar properties and uses as camphor, including use as an insecticide.

Camphor oil, a possible Jander ingredient, is derived from *C. camphora*, which is a member of the Lauraceae family. This family is a cousin to the Pinaceae family. Conifer resins could have been included in a "spirits of camphor" mixture, or they could have been used independently. Another possible source of the conifer resins is turpentine or "spirits of turpentine." A widely available solvent, turpentine is obtained by taking resin from live trees and distilling it (Rossol 2001, 39, 40, 89).

Plasticizers

Plasticizers identified in the sample of Jander's coating were N-butyl phthalate and DEP. Most phthalates, chemically described as esters of phthalate anhydride, are plasticizers. The polarized nature of these compounds makes them bind to polar polymer chains when heated, increasing the polymer's flexibility, transparency, and durability. The phthalate's effectiveness as a plasticizer varies depending on the type of phthalate and the type of polymer bonded together. However, because phthalates bond ionically rather than chemically with polymers, they are easily removed with heat or organic solvents. Over time, phthalate plasticizers tend to move out of polymer plastics, causing embrittlement.

Although plasticizers could have been added to Jander's formula as previously unidentified ingredients, they more likely appear as trace materials that were embedded in Jander's cellulose nitrate. In the 1920s, phthalates began replacing the earlier plasticizer camphor because they were less volatile and lacked camphor's medicinal odor (Valverde 2005). By the 1930s, camphor's use as commercial plasticizer was almost completely eliminated with the development of di-2-ethylhexyl phthalate and the rise of polyvinyl chloride (PVC) plastics (Encyclopedia Britannica Online, "PVC" 2019).

ASSOCIATED PRACTICES

Jander does not seem to have had formal preservation training or exposure to libraries and archives. Inconclusive and contradictory biographical details make it difficult to evaluate his preservation knowledge. Nevertheless, his treatment and his materials echo long-standing preservation practices of lining, consolidation, and lamination.

Before drawing final conclusions about his work, the research team sought out the historical treatment precedents that relate to Jander's materials and methods (fig. 13).

Silking

Silking, or lining with silk, was widely introduced in 1898 at the International Conference for the Conservation and Repair of Old Manuscripts in St. Gallen, Switzerland (Smith 2016, 60). The process offered better long-term stability than repairs conducted with oiled and waxed papers, which discolored and wrinkled over time. After the St. Gallen conference, the practice spread to the Library of Congress and throughout American institutions. Lightweight crepeline silk has an open weave that creates translucency and allows text to be read through the lining. Historically, silking existed alongside tissue lining; some European institutions never adopted silking, instead continuing to perform linings and repairs with Japanese tissue (Smith 2016, 93). As the role of pH in paper degradation became more thoroughly understood in the 20th century (Ellis 2014, 256, 262; Smith 2016, 172), silking was gradually replaced with lamination procedures, tissue lining, and archival plastic sleeves.

In appearance and function, Jander's nylon lining is very similar to crepeline silk. It has an open weave through which text may be read, and it reinforces fragile paper during

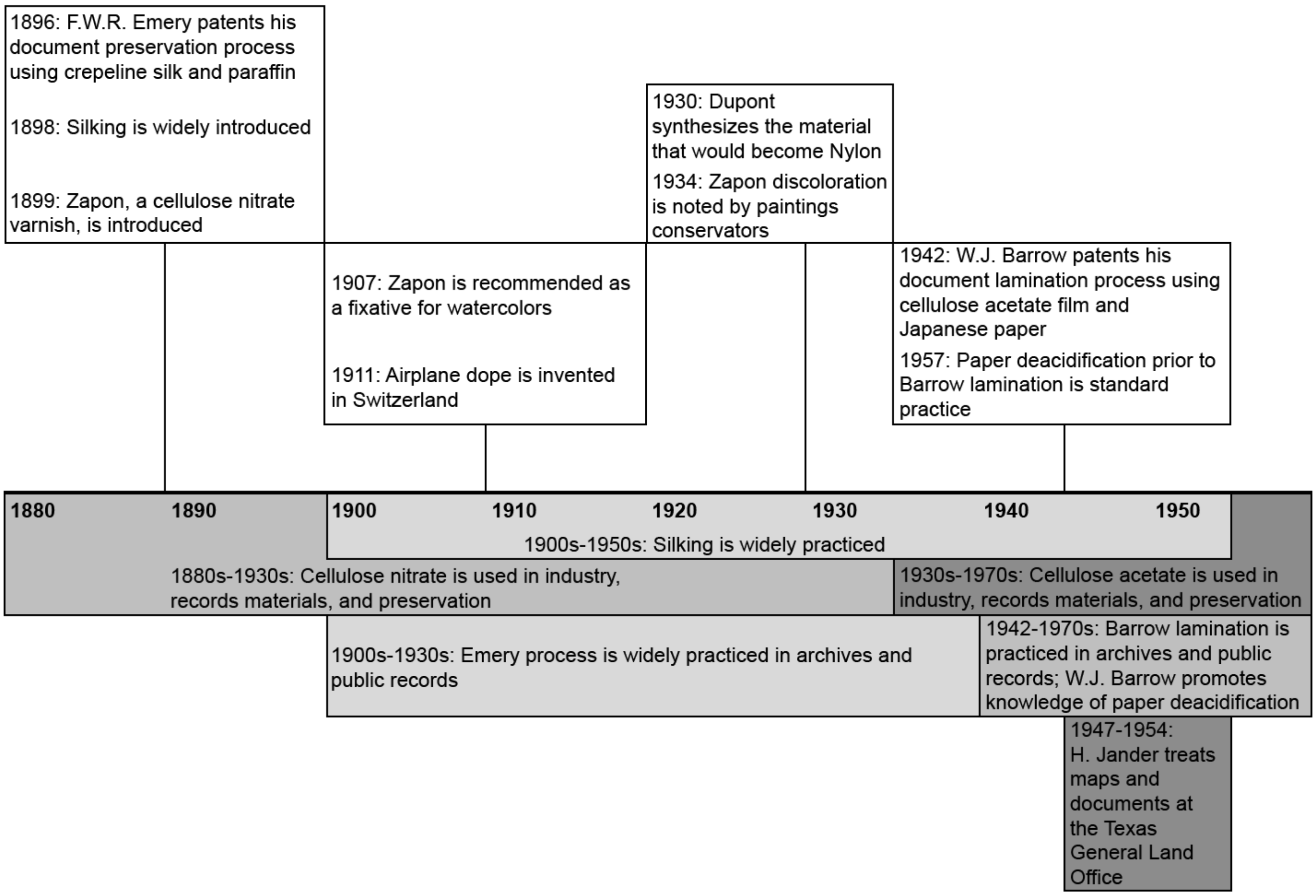


Fig. 13. A timeline of treatment practices and materials relevant to Harry Jander's work.

handling. Nylon is a synthetic, long-chain polyamide resin created for textile applications in the 1930s at DuPont. Nylon has low water absorption and twice the strength of cotton (CAMEO, "Nylon 6,6" 2016; CAMEO, "Nylon Resin" 2016). Soluble nylon was used in the mid-20th century as an adhesive, coating, and sizing agent in paper preservation (CAMEO, "Soluble Nylon" 2019). At the time of Jander's treatment, crepeline-style nylon was a relatively new material that might have seemed like an appealing and cost-saving alternative to silking, especially given Jander's background in textiles.

Zapon

Zapon was one of several synthetic varnishes used for paper preservation in the early 20th century. It was an early plastic popularized for preservation at the 1898 conference in St. Gallen, Switzerland, where silking was also widely introduced. A mixture of cellulose nitrate and camphor, Zapon was applied by immersion, brush, or spray to provide a barrier against moisture and mold and to reinforce weak paper. Concerns about Zapon emerged around 1910, given the yellowing that occurred as cellulose nitrate deteriorated. However, preservation work with Zapon continued through the 1930s (Smith 2016, 99–104).

Zapon shares with airplane dope, a possible Jander ingredient, the common underlying materials of cellulose nitrate and cellulose acetate. These plastics had wide-ranging application in the early decades of the 20th century. Zapon was more widely used in Europe and the UK than in the United States. Perhaps Jander encountered it during his time in London.

The Emery Process

The Emery process was a paper preservation technique patented by F. W. R. Emery in 1896. From approximately 1900 to the 1930s, the process was prevalent in city, county, and government agency records ranging from New England south through the Carolinas (Smith 2016, 91). It also appeared in state, public, and academic libraries. The process involved lining a document with silk or tissue, then coating the lined document with paraffin to protect against damage from water and pests (Smith 2016, 85).

There were early concerns that Emery's treated documents would discolor, much like oiled and waxed paper repairs. However, Emery's company served many American institutions that lacked skilled preservation staff until its eventual closure in 1958. The treatment's decline resulted in part from the rise of the Barrow lamination process (Smith 2016, 90, 91).

Jander does not appear to have spent significant time in the Northeast or Mid-Atlantic regions of America, but his treatment strategy of combining a translucent, crepeline-style lining with a varnish-like coating shares much in common with the Emery process. The waxy feel and sheen of Jander's applied formula also bears a strong resemblance to the paraffin coating used by Emery.

Barrow Lamination

Like the Emery process, Barrow lamination was a patented preservation process used prevalently in government, public records, and state libraries. Beginning in the late 1930s, W. J. Barrow commercialized the practice of using heat and pressure to seal documents between layers of cellulose acetate plastic and tissue. The process strengthened weak paper for easier handling and was promoted as an easily scalable, inexpensive alternative to silking (Woodward 2017). In response to concerns about yellowing paper, Barrow added a deacidification step to his process in 1939 (Smith 2016, 351). By the 1970s, many institutions turned away from Barrow lamination in favor of encapsulation with Mylar and Melinex. This provided a less invasive and more easily reversible treatment method (Smith 2016, 362).

Barrow's lamination process was introduced at the Texas General Land Office in 1958, after the conclusion of Jander's work there (Alonzo, pers. comm., January 28, 2020). One of Barrow's lasting legacies was popularizing knowledge about the role of pH in paper degradation among librarians and collections managers. Given the discoloration and embrittlement observed in the documents Jander treated, it seems likely that this understanding of pH was critically absent from Jander's work.

CONCLUSIONS AND DISCUSSION

Although the riddles of Harry Jander's life and work may never be fully solved, some insights are now within reach.

Jander's handwritten recipe, discovered in his archival papers, includes no compounds that could be definitively identified by GC-MS or FTIR. Perhaps Jander had other uses in mind for this recipe. Perhaps the handwritten note was a partial shopping list. Perhaps the ingredients were used for their historic purposes as additives to his solution and have long since evaporated away. The distinctive medicinal odor observed in Jander's historical treatments likely resulted from castor oil and conifer resins rather than spirits of camphor, as initially suspected.

Cellulose nitrate was the central ingredient in Jander's mixture. It was strongly represented in the FTIR spectra below the 1700 wavelength. This material is consistent with the sheen and body observed in remaining Jander coatings, as well as their yellowing, discoloration, and solubility in acetone. Within Jander's biography, cellulose nitrate resonates as a component of airplane dope, a substance with which he likely gained experience during his time on Air Force bases in San Antonio and Austin, Texas. It is plausible that Jander's cellulose nitrate contained within it the phthalates detected in the coating sample. These phthalates would have acted as plasticizers.

Likely goals of Jander's treatment included improving handling (via the nylon lining and cellulose nitrate varnish); improving flexibility and reducing brittleness (via the plasticizers and castor oil); minimizing future moisture damage (via the cellulose nitrate varnish and conifer resins); and possibly controlling pest activity (also via the conifer resins).

Although treatment materials and methodologies have changed greatly, Jander's treatment goals have been shared by conservators and allied practitioners across many years and many styles of practice. Historically, Jander's treatment shared much in common with the Emery process of document restoration and with Zapon varnish. Like Emery, Jander applied a mesh lining and a protective coating to his documents. But instead of coating with paraffin, like Emery, Jander used a cellulose nitrate-based varnish like the 19th- and early-20th-century paper preservation treatment Zapon. Perhaps to modernize or economize on Emery's treatment, Jander lined his work with the relatively new material nylon instead of silk.

Jander's treatment also relates to Barrow lamination, the cellulose acetate-based preservation treatment that succeeded the Emery process. Like the Emery process, Barrow lamination was presented as a simplified, economical, scalable solution for public records like those at the Texas General Land Office. Given the timing of Jander's work at the decline of the Emery process and the rise of Barrow lamination, his treatment could even be conceptualized as a transitional technology between the two processes.

A number of Jander's possible ingredients were not identified by the type of GC-MS analysis (methylation) used. These include camphor, phenol, glycerine, alcohol, water, ether, sugar, salt, sodium bicarbonate, and paraffin. In some cases, the materials could not be identified or tested by GC-MS of a solid sample. Compounds in this category include water and alcohol. Detection of salts is not advised, as it can damage testing equipment. Other ingredients can be detected by GC-MS but were not pursued for this project. These ingredients include glycerine, sugar, sodium bicarbonate, and ether. These were not further investigated given the information obtained by the FTIR spectra, concise testing methodology, and limitations in accurate extraction and identification. Future testing could be formulated for these ingredients. The remaining ingredients, including camphor, phenol, and paraffin, have been effectively ruled out. There is some chance that camphor and phenol could be methylated by a different solution, but the Meth-Prep 2 solution was chosen for this test given its proven ability to identify most cultural and historic materials.

Although Jander's processes and materials were not unreasonable within their era, modern treatment perspectives highlight serious problems in his work. Inherent in Jander's treatments are issues of acidity in paper degradation, cellulose nitrate instability, and the structural integrity of paper.

Acidity is a major focus in modern-day book and paper conservation. Low pH values create acidic conditions that underlie the browning and embrittlement often observed in paper's natural aging process. By coating paper in an acidic formula that became increasingly acidic over time, Jander intensified and hastened degradation issues. Acidity issues in paper became more popularly understood through Barrow's work in the 1950s. Perhaps due to the timing of his treatments, Jander seems to have been unaware of these concepts.

Cellulose nitrate posed a second preservation risk in Jander's treatment. This unstable plastic passes through degradation stages that include yellowing, stickiness, curling, embrittlement, powdering, and ultimately dangerous flammability. Cellulose nitrate–based roll film, such as motion picture film, poses severe flammability risks; it often requires specialized storage in a fire vault. Risks result in part from the high concentrations of self-catalyzing nitrogen oxide gasses within the densely rolled structure. Flammability risks are greatly reduced in flat materials with a lower density of cellulose nitrate (Williams 1994), such as Jander's treatments. However, caretakers of Jander's treated materials should still consider cold or frozen storage for cellulose nitrate at or below 40°F and 30%–50%RH (Adelstein 2004). Reversal of Jander's treatments might present a more thorough and economical preservation strategy.

A third, fundamental problem with Jander's treatment is the way it changes the nature of treated paper. Paper is made of strands of cellulose; the natural gaps that occur between these fibers contribute to the opacity and surface texture of the material. By filling these gaps with varnish, Jander changed the paper's refractive index, causing the increased translucency he noted. Jander saw this change as an improvement, making reproduction easier via blueprint or photostat. Modern conservation ethics argue conversely that such a fundamental structural change constitutes an unnecessarily invasive treatment. Specifically, modern treatment should be "suitable to the preservation of the aesthetic, conceptual, and physical characteristics of the cultural property" (AIC 1994).

Jander does not seem to have had direct training or experience in preservation, libraries, or archives. Despite this, he did use materials and mimicked practices that had precedent and relevance in document preservation in his era. Today, conservators practice new solutions to many of the same preservation challenges Jander tackled in the 1940s and 1950s. Ultimately, modern treatments are best distinguished from those of Jander by the conservation tenet of reversibility. Should today's best practice become tomorrow's embrittled plastic, reversibility helps ensure the ongoing preservation of cultural materials.

ACKNOWLEDGMENTS

Special thanks to Daniel Alonzo and the Texas General Land Office, Richard Newman and Michele Derrick at the Museum of Fine Arts, Boston, and Chris Stavroudis and Michael Lee for sharing their thoughts during the authors' initial research.

NOTES

1. Meth-Prep 2 is a reagent widely utilized in the cultural heritage field consisting of a 0.2-N methanolic solution of m-trifluoromethylphenyl trimethylammonium hydroxide. The purpose of this solution is to methylate oils, fats, waxes, and some components of natural resins. This GC-MS method would not be able to detect any proteins, cellulose nitrate, or cellulose acetate, if they were present.
2. Compounds in the coating were identified by their retention time in GC-MS. In some cases, this was confirmed by comparing the peaks to known peaks from the MFA's in-house spectral library or the National Institute of Standards and Technology/Wiley Mass Spectral Library (Newman and Derrick 2020).

REFERENCES

Adair, A. G. 1953. "Photographs, Papers, and Parchments Preserved for Lasting Permanency by Special Formula and Technique." *Under Texas Skies* 4 (8): 28.

Adelstein, Peter Z. 2004. *IPI Media Storage Quick Reference*. Rochester, NY: Image Permanence Institute, Rochester Institute of Technology.

AIC. 1994. Our Code of Ethics. https://www.culturalheritage.org/about-conservation/code-of-ethics.

"Airplane Cloth." 2016. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Airplane_cloth.

"Alcohol." 2016. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Alcohol.

"Alcohol (General)." 2004. Getty Art & Architecture Thesaurus Online. http://vocab.getty.edu/page/aat/300015224.

Alonzo, D., and K. Tuggey. 2019. "Janderized!: The Story of a Fraudster's Attempt at Document Conservation at the GLO Archives." *Southwestern Archivist* 42 (2): 22–25.

"Austinite Preserves Historic Papers with Secret Formula." 1948. *Austin Statesman*, August 29. 3B.

Barnes, L. 1952. "Collector Denies Ming Robe 1000 Years Old; Only 800." *Austin American*, May 4. B1.

"BPG Adhesives." 2019. *AIC Wiki*. http://www.conservation-wiki.com/wiki/BPG_Adhesives.

"BPG Consolidation, Fixing, and Facing." 2019. *AIC Wiki*. http://www.conservation-wiki.com/wiki/BPG_Consolidation,_Fixing,_and_Facing.

"BPG Hinge, Tape, and Adhesive Removal." 2019. *AIC Wiki*. http://www.conservation-wiki.com/wiki/BPG_Hinge,_Tape,_and_Adhesive_Removal.

"BPG Sizing and Resizing." 2019. *AIC Wiki*. http://www.conservation-wiki.com/wiki/BPG_Sizing_and_Resizing.

"BPG Surface Cleaning." 2019. *AIC Wiki*. http://www.conservation-wiki.com/wiki/BPG_Surface_Cleaning.

"Camphor." 2016. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Camphor.

"Camphor (Resin)." 2004. Getty Art & Architecture Thesaurus Online. http://vocab.getty.edu/page/aat/300013017.

"Carbolic Acid." 2004. Getty Art & Architecture Thesaurus Online. http://vocab.getty.edu/page/aat/300011756.

"Castor Oil." 2004. Getty Art & Architecture Thesaurus Online. http://vocab.getty.edu/page/aat/300014319.

"Castor Oil." 2016. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Castor_oil.

"Castor Oil." 2020. Encyclopedia Britannica Online. https://www.britannica.com/topic/castor-oil.

"Cellulose Ether." 2004. Getty Art & Architecture Thesaurus Online. http://vocab.getty.edu/page/aat/300014441.

"Collector, Decorator Succumbs." 1962. *Austin Statesman*, March 21. 6.

"Diethyl Ether." 2016. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Diethyl_ether.

"Dry Cleaning." 2015. *AIC Wiki*. http://www.conservation-wiki.com/wiki/Dry_cleaning.

Ellis, Margaret H. 2014. *Historical Perspectives in the Conservation of Works of Art on Paper*. Los Angeles: Getty Conservation Institute.

"Ester Gum." 2016. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Ester_gum.

"Glycerol." 2016. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Glycerol.

Jander, Harry. n.d. Untitled formula. Unpublished manuscript, Austin History Center, Austin, TX.

Moldoveanu, Serban C., and Victor David. 2018. "Derivatization Methods in GS and GC/MS." In *Gas Chromatography: Derivatization, Sample Preparation, Application*, edited by Peter Kusch. London: InTechOpen. https://www.intechopen.com/books/gas-chromatography-derivatization-sample-preparation-application/derivatization-methods-in-gc-and-gc-ms.

Newman, R., and M. Derrick. 2020. Analytical report, project number 2020-33. Unpublished manuscript, Museum of Fine Arts, Boston.

"Nylon 6,6." 2016. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Nylon_6,6.

"Nylon Resin." 2016. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Nylon_resin.

"Paraffin (Wax)." 2004. Getty Art & Architecture Thesaurus Online. http://vocab.getty.edu/page/aat/300014603.

"Paraffin Wax." 2016. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Paraffin_wax.

"PMG Section 1.3 Effects of Exhibition on Photographic Materials." 2009. *AIC Wiki*. http://www.conservation-wiki.com/wiki/PMG_Section_1.3_Effects_of_Exhibition_on_Photographic_Materials.

"PVC." 2019. Encyclopedia Britannica Online. https://www.britannica.com/science/polyvinyl-chloride.

Regel, Ben, Jannick Langfeldt, Louisa Burden, and Mary Ryan. 2016. "Doping at the Science Museum: The Conservation Challenge of Doped Fabric Aircraft in the *Flight* Gallery." *Science Museum Group Journal* 6. http://dx.doi.org/10.15180/160605.

Rossol, Monona. 2001. *The Artist's Complete Health and Safety Guide*. New York: Allworth Press.

Savage, George. 1954. *The Art and Antique Restorers' Handbook: A Dictionary of Materials and Processes Used in the Restoration and Preservation of All Kinds of Works of Art*. New York: Philosophical Library.

Smith, Christine. 2016. *Yours Respectfully, William Berwick: Paper Conservation in the United States and Western Europe, 1800–1935*. Ann Arbor, MI: Legacy Press.

"Soluble Nylon." 2019. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Soluble_nylon.

"Sugar." 2016. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Sugar.

Ubbink, K. 2019. Unconventional Uses of Conventional Treatments: Three Case Studies in Paper Conservation. Paper presented at the AIC 47th Annual Meeting, Uncasville, CT.

Valverde, María Fernanda. 2005. *Photographic Negatives: Nature and Evolution of Process.* Rochester, NY: Advanced Residency Program in Photograph Conservation, Image Permanence Institute, and George Eastman House. https://s3.cad.rit.edu/ipi-assets/publications/negatives_poster_booklet.pdf.

War Department, Army Service Forces. 1943. *Jander, Harry Garnett.* Civilian Employee Investigation Report: Loyalty and Character Report. War Department, Army Service Forces.

"Water." 2016. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. http://cameo.mfa.org/wiki/Water.

"Wax as a Surface Coating." 2014. *AIC Wiki*. http://www.conservation-wiki.com/wiki/VI._Wax_as_a_Surface_Coating.

Williams, R. Scott. 1994. *CCI Notes 15/3: Display and Storage of Museum Objects Containing Cellulose Nitrate.* Ottawa, ON, Canada: Canadian Conservation Institute.

Woodward, Eddie. 2017. "An Epidemic in the Archives: A Layman's Guide to Cellulose Acetate Lamination." *RBM: A Journal of Rare Books, Manuscripts, and Cultural Heritage* 18 (2): 108–22.

SARAH NORRIS
Assistant Professor of Practice in Library and Archives Conservation and Preservation
University of Texas at Austin, School of Information
Austin, TX
sarah.norris@ischool.utexas.edu

KATHRYN BOODLE
Associate Paper Conservator
Northeast Document Conservation Center
Andover, MA
kboodle@nedcc.org

Sustainability of Intangible Culture: How the Increasing Scarcity of Craftspeople Impacts the Traditional Remounting of a 14th-Century Japanese Buddhist Painting on Silk at the Cleveland Museum of Art

INTRODUCTION

The Cleveland Museum of Art (CMA) has one of the most admired collections of Asian art in the West. This is with thanks largely in part to the work of Sherman Lee, who was chief curator of Oriental art from 1952 and then director of the museum from 1958 to 1983. With his experience as a Monuments Man in Japan after the Second World War, and his specialty in Asian art, he was focused and positioned to strengthen the Asian art collection at the CMA. The museum now holds nearly 1000 paintings in both the Chinese and Japanese collections, plus a small but growing collection of Korean paintings. Recognizing the importance of this collection and the need for specialized care, the museum hired its first conservator of Asian paintings in 2004. It was not until November of 2011, when the author joined the museum, that a conservator of Asian paintings worked on-site in the Conservation Laboratory that had been built specifically for this specialty.

Japanese paintings' conservation techniques are based on traditional craft developed over thousands of years. The paintings are mounted into three basic formats: scroll, screen, and album. Each format has several different styles and substyles, such as hanging scrolls that can be mounted in *shin*, *gyou*, or *sou* styles (fig. 1). This can create a wide variety of choices when considering a remounting. Although the conservator will often choose to reuse the old mounting components, sometimes, if the paintings have been remounted in an inappropriate format or with inappropriate materials in the past, it becomes necessary to provide the paintings with a new mounting.

Traditional remounting of Japanese paintings is reliant on specialized materials, such as paper for linings and woven silk for borders, and traditional tools made by craftspeople who are often themselves recognized as living treasures. In the past, there was much demand for these materials, but that demand has reduced as the interest in traditional mounted artwork has waned. This article discusses the changing status of traditional art and how this has affected Japanese paintings, mounters, and traditional craftspeople. Finally, this work will present a case study of the remounting of a 14th-century Japanese Buddhist painting carried out at the CMA between 2017 and 2019 to demonstrate how the changing state of traditional craftspeople has affected the acquisition of materials.

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

CHANGING STATUS OF TRADITIONAL ART AND THE CORRESPONDING DECLINE IN DEMAND FOR SPECIALIZED MATERIALS

Traditionally, homes in Japan had a special space specifically for displaying art called the *tokonoma* (fig. 2). Families would collect a selection of hanging scrolls that would be hung depending on the season or occasion. In addition to the artwork displayed in the tokonoma, folding screens were used to divide rooms into more personal spaces, whereas decorative sliding doors divided rooms. However, this traditional architecture is disappearing as modern Japanese homes draw inspiration from Western architecture, eliminating tatami mats, raising furniture, and calling for large open spaces. Without the tokonoma to fill, fewer people are collecting traditional art formats for their homes. This decline in demand in turn leads to reduced work opportunities for mounters who would mount paintings by artists into scroll, screen, and album formats. To find employment, these mounters have turned to interior design, like applying wallpaper, which is work that requires similar skills and is more in demand. In 2001, the Mounting and Interior Design Association (全国表具経師内装組合連合会) had 4458 members,

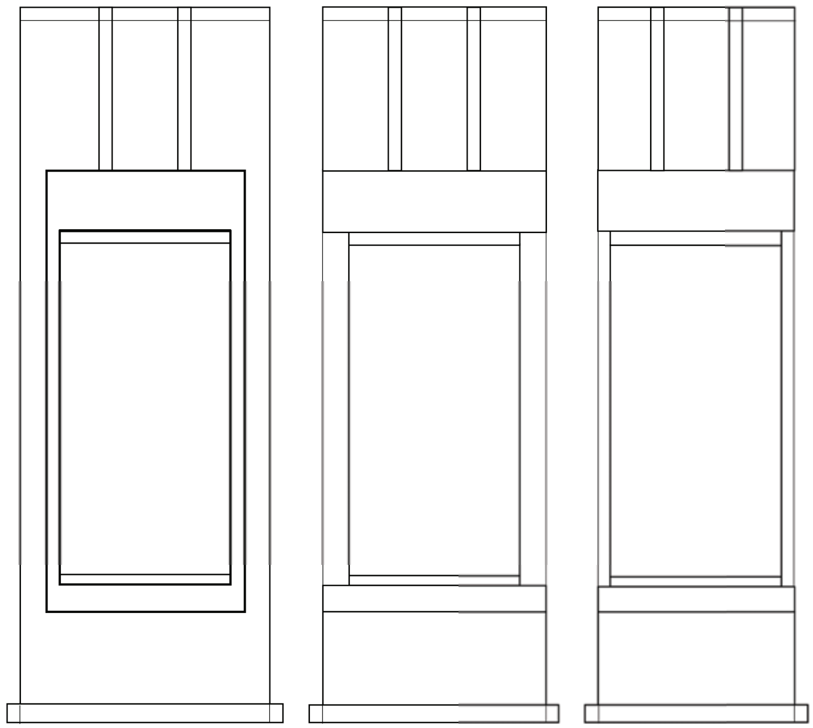


Fig. 1. Traditional hanging scroll formats, from left to right: shin style used for paintings and calligraphy related to Buddhism, gyou style used for Japanese-style paintings and calligraphy, and sou style used for tea ceremony paintings and calligraphy.

Fig. 2. Traditional Japanese tokonoma. Courtesy of Keisuke Sugiyama.

but by 2019, the membership had been reduced to 1421 members, and of those, fewer than 10%, or around 140 members, are mounters (Sugiyama 2019). In addition to the Mounting and Interior Design Association, there is a government-sponsored association of conservators that works on artwork belonging to national museums. The Association for Conservation of National Treasures (国宝修理装潢師連盟) comprises 12 studios and about 130 employees. As some of these employees may also be members of the Mounting and Interior Design Association, this means that the number of independent mounters may be even fewer than 140 people.

With the reduction in numbers of mounters, driven by the reduced importance of traditional art in the Japanese home, there is a decreasing demand for traditional materials. For example, modern materials are also replacing *washi* (Japanese handmade paper) in areas of Japanese life where it was traditionally used.[1] Thus, papermakers are now dependent upon conservators as their main client. In addition, the washi industry has been hit with the announced retirement of 80% of the farmers who grow *tororo aoi*, the root used to make *neri* which helps in the paper formation process. As the farming of tororo aoi is both backbreaking work and unprofitable, the farmers cannot ask their children to take on the business, and as they are all older than 60 they can no longer continue on their own (Shigemasa 2019). This is a similar situation through all crafts, with craftspeople passing without apprentices or children who can afford to continue the craft.

As there are fewer craftspeople and the prices of materials go up, in addition to people being less willing to invest in traditional arts for their homes, the mounters have turned to time- and cost-reducing methods to make a living. This includes using machine-made paper made with caustic soda and wood pulp, synthetic textiles for the borders instead of silks, synthetic adhesives, and dry mounting methods using heat presses. All of these changes lead to questions of longevity and aging characteristics, making them an impractical choice for those doing conservation work for museums. Instead, conservators must find ways of acquiring traditional, high-quality materials from an ever-smaller number of craftspeople while attempting to support those remaining as best as possible.

This challenging environment spans all traditional crafts and affects the wide variety of materials used for mountings. For example, hanging scroll mountings alone include cedar dowels and staves; papers and silks for filling losses; papers for linings; silks for borders; knobs made of wood, lacquer, and metal; braided silk cords; metal fittings; and paulownia wood boxes and *futomaki*. As there are many materials that can be used to demonstrate this dire situation, this article will focus on three kinds of materials: papers for linings, painting silk for filling losses, and mounting silks.

TRADITIONAL HANGING SCROLL MOUNTING MATERIALS

Papers for Linings

The paper used for first linings on paintings and border silks is *mino*. *Minogami* is composed of only the white inner bark of the mulberry tree, called *kozo* in Japanese, and can be made with wood ash, soda ash, or caustic soda depending on the intended quality of the paper. It can be dried in the sun on boards or heat dried on a metal cylinder—methods that also affect the price and the quality of the paper. The second linings are a paper called *misu*, which is composed of kozo and calcium carbonate. The final lining is *uda* paper, which is composed of kozo and kaolin or clay. Different levels of quality are also available for these papers, much like mino. Minogami is made in the Gifu region of Japan in the town of Mino by a small group of papermakers, whereas both misu and uda paper are made in the Nara region. These papers are in limited supply, with much of the paper they can make being bought up by large mounting studios in Japan that are supported by the government, making it more difficult for the smaller studios to acquire the papers they need. The remaining papermakers are also increasing the price of their paper, understandably due to the increased costs of production, the backbreaking work, and the need to make their business sustainable for their successors. Additionally, paper suppliers are running out of stock as the papermakers have focused their business by selling directly to the studios, making paper to order.

Painting Silk

Painting silk is processed differently than silk for mountings and is created by specific weavers. When filling losses in paintings on silk, the patches need to match the original painting silk with regard to the number of threads, thread thickness, and thread count. This sometimes means sending the specifications to a weaver in Japan and having the silk reproduced. Most often, conservators in the United States would work with Hironobu Textiles Corporation in Kyoto. The president of the company, Hirose-san, would ask for a microscope image of the silk with a ruler for scale from which he would be able to reproduce the silk. The reproduced silk is then aged to match the degraded state of the original painting substrate. In the past, this would be done by irradiating the silk in Japan. This is quite costly, and therefore the CMA has been experimenting with methods of aging the silk in the laboratory using combinations of UV, temperature, and humidity.

Mounting Silks

Japanese mounting silks come in a variety of different weaves, colors, and patterns. Older studios have large collections that have been added to over time, such as Usami Shokakudo Company Limited in Kyoto, where the author trained that is

Fig. 3. *Shakyamuni Triad with the Sixteen Benevolent Deities* (CMA 1941.279) mid- to late 1300s. Before treatment. Courtesy of Joan Neubecker.

now in its ninth generation. As the studio at the CMA is new, the collection has to be built up slowly as the budget allows or bought based on projects. As it is, textile suppliers in Japan are carrying more fake gold brocade and synthetic or blended textiles. They have a smaller supply of silks on hand to choose from when looking for something to suit a specific painting. Instead, the silk has to be ordered ahead of time to be woven and dyed, hopefully to the right color for the project. As it is impossible to take the painting to Japan, and having silks redyed after they have been produced is difficult if not impossible, this makes finding the right silk for a specific project quite difficult.

CASE STUDY

The aforementioned examples of the increasing scarcity of specialized mounting materials is demonstrated through a case study examining the remounting of a 14th-century Japanese Buddhist painting at the CMA between 2017 and 2019. The painting came into the CMA's collection in 1941 in a panel format and appears to not have been exhibited since. It had been titled as an *Amida Triad*, but the curator of Japanese Art, Sinéad Vilbar, realized that the iconography was actually *Shakyamuni with the Sixteen Benevolent Deities* (fig. 3). The painting was lined overall with silk, which led to delamination of the silk substrate. It also had some unfortunate inpainting to compensate for the loss of the Shakyamuni's robe (fig. 4). Where the silk was delaminating, there were areas where the original silk had clearly been lost since the last remounting. It was decided to remount the painting and in the process return it to its original hanging scroll format using the shin style of mounting (fig. 5).

Preparing the Painting Silk

The first step when treating a painting on silk is to order and prepare the painting silk to be used for filling losses. For this treatment, a custom weaver located in Kyoto, Hirose-san, was contacted by the author and sent a magnified image of the silk weave (fig. 6). When he did not respond to the initial contact, the author asked a colleague in Japan (Keisuke Sugiyama, who would be helping for short periods during this treatment) to facilitate contact with the weaver. Keisuke learned that Hirose-san was quite ill, and sadly a few months later, he passed away. As it was Hirose-san who alone wove the silk to order, and there was no one with his level of skill to step in and take his place, the Hironobu Textiles Corporation provided a list of standard weaves they could produce. From this list, the closest match to the original silk weave was chosen. After receipt of the standard weave silk, it was then necessary to age the silk. The Asian Paintings Laboratory at the CMA has started aging silks using UV light in an enclosed cabinet with slightly raised temperature, but this is a prolonged process of at least six months. Due to the delay in purchasing the silk and the timeline on the project, it was necessary to use a faster method. The silks were therefore placed in an aging chamber with a temperature of 125°C for four days (fig. 7). Once aged, the silk was lightly dyed

Fig. 4. Detail of *Shakyamuni with the Sixteen Benevolent Deities*. Before treatment. Courtesy of Joan Neubecker.

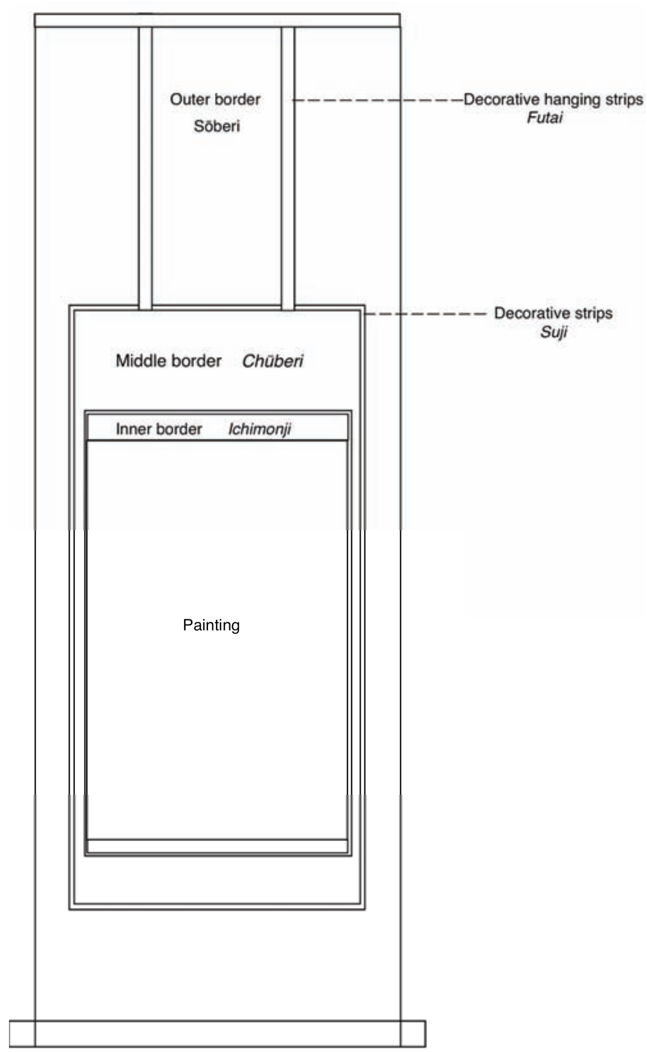


Fig. 5. Shin style of hanging scroll mounting terminology.

using *yasha*, a dye made from the cones of an alder tree. Sometimes acid dyes are used if a darker color is needed. The silk was then temporarily lined with mino paper using a thin wheat starch paste and dried on the drying board.

Treating the Painting

Once the painting silk had been prepared, the treatment began (fig. 8). The silk borders were first separated from the painting (fig. 9). Once removed, the pigment was consolidated with gelatin solutions chosen depending on whether the pigment is flaking or powdering. The surface of the painting was cleaned to remove dust and grime before wet-cleaning. The Japanese use a form of capillary washing where water is lightly sprayed over the surface and discoloration is absorbed into the blotting papers underneath (fig. 10). The blotting papers are changed two or three times depending on the amount of staining. The painting is then allowed to air-dry or is dried between felts. Once the painting is dry, the facing can be applied. However, in the case of this painting, there were areas where the original silk had been lost but there were remnants of *urazaishiki*, painting on the verso of the silk, remaining on the lining. Thus, prior to applying the facing, it was decided to fill these areas from the recto to save the urazaishiki (fig. 11). The paste used to adhere the silk fill was stronger than the old

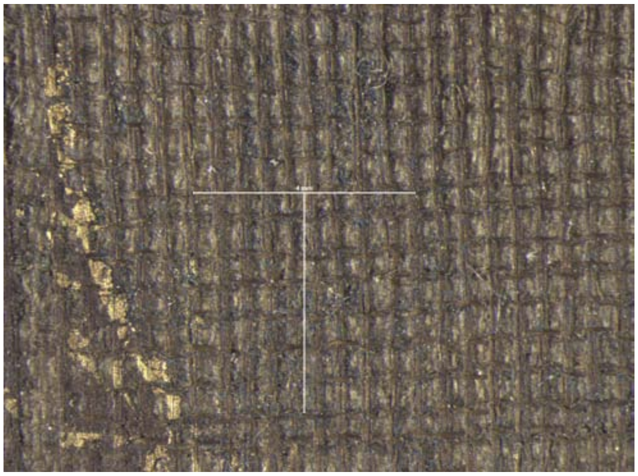


Fig. 6. Silk substrate under magnification with a 4-mm scale bar.

Fig. 8. Mechanically removing the painting and border silks from the paper covered lattice core. Courtesy of Keisuke Sugiyama.

lining paste to ensure that the pigment would stay on the fill when the lining was removed. The painting was then faced with several layers of rayon paper and thin cotton blotting paper using *funori*, an adhesive solution made from seaweed (fig. 12). The painting was dried face-in on the drying board before being transferred to a sheet of acrylic. The linings were then removed carefully using minimal moisture. Due to the first lining being silk, and it being impossible to thin the silk like a paper lining, it was necessary to work very slowly in small sections to not disturb the urazaishiki (fig. 13). Once the lining had been removed, the losses were infilled from the verso using the prepared painting silk. Working with transmitted light, the losses were traced onto the painting silk, the fill was cut out, the silk was pasted into place using funori, and finally the temporary lining paper was peeled away (figs. 14, 15). This was done for both large fills and very small fills.

Lining the Painting

With the losses patched, it was time to line the painting. In Japan, minogami made by Hasegawa would typically be used by the author for the first lining. However, when the CMA began ordering paper back in 2012, it was difficult to acquire, initially because studios making larger orders were given priority. This paper has become even more difficult to obtain because Hasegawa-san closed his studio in Mino and moved north to another prefecture and has been making less paper. Therefore, finding a replacement has been a necessary, albeit difficult, task. Although all of the papermakers in Mino make *hon-minoshi*, they have varying characteristics. After seeing samples from each papermaker, *Takegami* mino paper made by Suzuki-san was chosen as the closest match to the Hasegawa paper. The second lining is of misu, which is now only made by one papermaker in Japan. This paper is called *sekaiichi* and is made by Uekubo-san. As the paper

Fig. 7. Aging chamber used to deteriorate the new painting silk for fills. Courtesy of Keisuke Sugiyama.

Fig. 9. Cutting the painting out of the border silks. Courtesy of Keisuke Sugiyama.

Fig. 10. Capillary washing the painting using a dahlia spray and several layers of thin blotting paper. Courtesy of Keisuke Sugiyama.

supplier from which the CMA typically ordered misu did not have any in stock, it was necessary to source and order directly from the papermaker. In Japan, the craftspeople work on trust, and one often needs to be introduced to them via someone that they have worked with before. In this case, Keisuke Sugiyama once again helped with making the initial connection. Once the order could be placed directly with the papermaker, it was discovered that the price had more than doubled since the author's previous order from the paper supplier four years prior. Thus, the purchase had to be limited to the thicknesses that were most likely to be needed for the treatment.

With the papers acquired, it was possible to start the lining process. The first lining paper was toned with a combination of natural dyes and pigment. As the first lining had been slightly too pale, the second lining was dyed with ink to darken the overall tone of the lining. The painting was air-dried, then using transmitted light, the splits in the silk substrate were reinforced with thin strips of mino paper. Then with raking light, creases were reinforced (fig. 16). Finally, the painting was remoistened using a dahlia spray and attached to the drying board (fig. 17).

Toning the Infills

While on the drying board, the infills are usually toned. Toning and inpainting on silk is quite difficult, as the depth of color changes depending on the direction of viewing. Normally, the fill is toned overall, but this also has the effect of toning the lining paper through the interstices of the silk weave. This may have something to do with the variation of

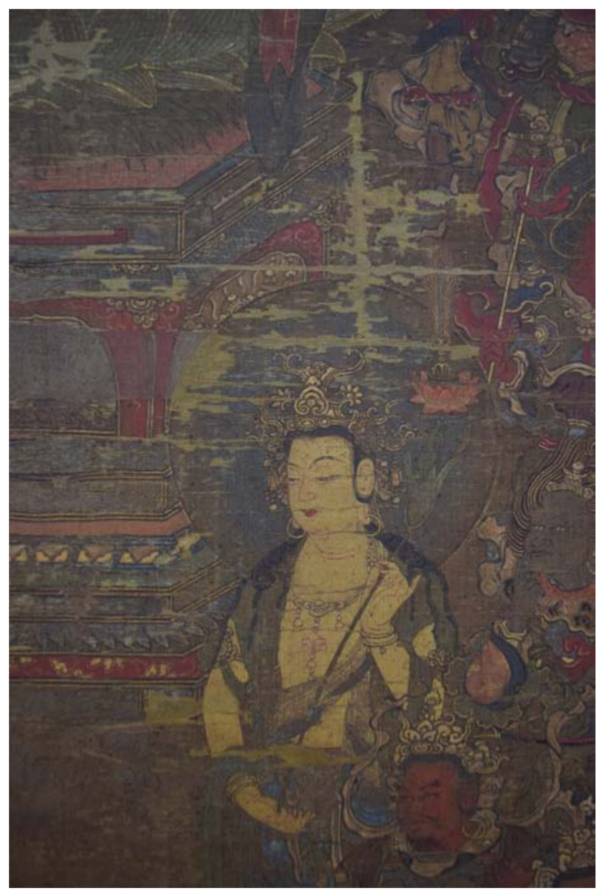


Fig. 11. Detail of *Shakyamuni Triad with the Sixteen Benevolent Deities* with losses filled from the recto with the aged and prepared painting silk.

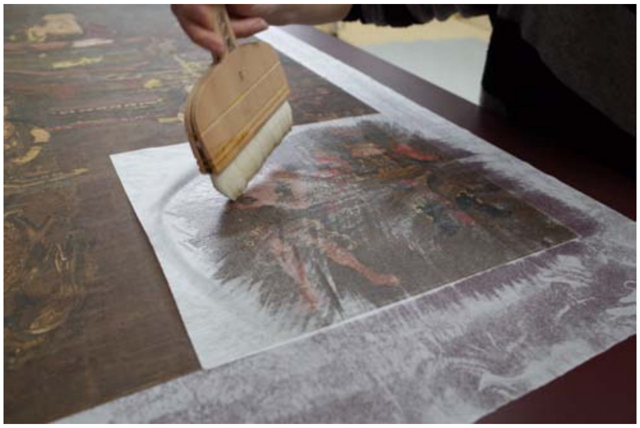


Fig. 12. Facing the painting with thin, spunbond, nonwoven rayon fabric using funori. Courtesy Keisuke of Sugiyama.

color depending on the direction of viewing. For this treatment, therefore, only the threads of the silk fill were toned, making sure that the lining paper was not touched (fig. 18). This resulted in much less variation from each angle of viewing and fills that blended with the surrounding original silk substrate. With regard to toning and inpainting, the current approach in Japan is to tone the fills to the overall color of the surrounding silk substrate without inpainting lines or color, but a great deal of the figure of Shakyamuni had been lost and the image might be hard for viewers not familiar with the iconography to read. After discussions with the curator, it was decided to slightly indicate the edges of the robe through variations in tone (fig. 19).

Acquiring the Mounting Silks

While the painting was drying, the discussion between conservator and curator began into the possible patterns and colors for the new silk borders. The old silks from the panel were much too brittle to be reused in a hanging scroll format. As the CMA's collection of silks is quite small, a replica of the newly treated painting was printed and taken to the Museum of Fine Arts (MFA), Boston, which has a collection of more than 400 different mounting silks. This enabled a decision to be made on a general color and pattern combination before traveling to Japan to acquire the silks. Once the options had been narrowed down to a choice of three colors and a few styles of pattern, the author traveled to Japan to search for similar silks. Unfortunately, none of the colors or patterns that had been discussed were available, but the silk supplier did have a loom set up with the deep blue color that was desired for the outer border silk, called the *sōberi*. They had several pattern options similar to what was deemed appropriate for the painting, so one pattern was chosen and ordered for weaving. As this was only one of three silks that were needed for the Buddhist mounting style chosen, the next

Fig. 13. Removing the silk lining.

stop was a visit to Usami Shokakudo to look through their large collection of silks. Since the author is a former student at this studio, she had the benefit of being able to purchase small amounts of silk from their collection. The perfect silk for the middle border, called the *chūberi*, was found and purchased, to be sent to the CMA by mail. This left only the inner border silk, called the *ichimonji*, to be procured. As the author could find nothing that was just right but had seen the perfect silk while looking through the MFA Boston's collection, she contacted their studio to see if it was possible to purchase the small amount needed for the ichimonji. Asian conservation studios in the United States have a strong collaborative relationship, combining forces to buy materials that are difficult or

Fig. 14. Tracing the loss onto the aged and lined painting silk using transmitted light.

Fig. 15. Traced outline of loss on lined painting silk.

expensive to acquire, and so they very kindly sent a small section of the red silk with cloud pattern that could not be found in Japan. This silk was actually one of the earliest silks to enter the MFA Boston's collection, possibly in the 1920s. It is a copy of a celebrated fabric known as Tomita Kinran and was woven by Tatsumura Heizo, who founded Tatsumura Art Textiles in Kyoto and was devoted to researching and replicating traditional textiles (fig. 20). Thus, the CMA is fortunate to have such a distinguished silk as part of the mounting of their painting. Once the roll of silk that had been ordered woven in Japan arrived, it was checked with the actual painting and then measured and cut to size.

Mounting the Painting

Much like the painting, the silks were first lined with the same thickness of mino paper (fig. 21). Then the thickness and strength of each section was hand tested, and a second layer of misu paper of various thicknesses was applied to balance each section (fig. 22). The silks were first air-dried and then remoistened and attached to the drying board to dry. After each section had dried on the drying board for a week, the painting was removed and trimmed square. The edges of the painting had been extended with painting silk to ensure that the original is never cut. The border silks are then removed and cut to size and the sections are joined using fresh wheat starch paste (fig. 23). The order of joining is ichimonji, inner decorative

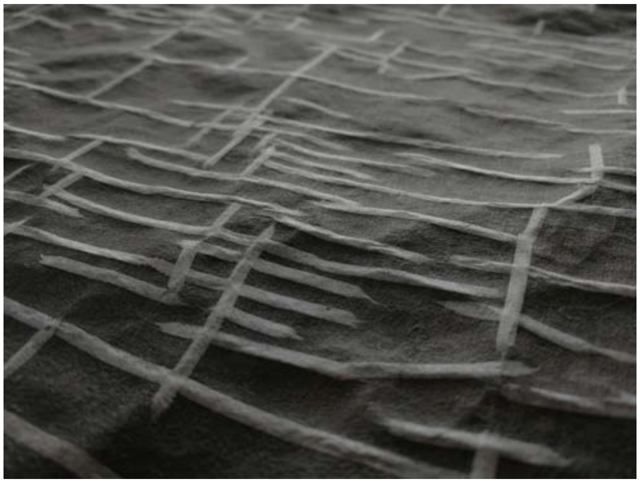


Fig. 16. Reinforcing strips on the verso of the lined painting. Courtesy of Keisuke Sugiyama.

Fig. 17. Painting drying on the drying board after infilling, lining, and crease reinforcing.

Fig. 18. Toning of infill silk.

strip (*suji*), chūberi, outer suji, and finally the sōberi (fig. 24). Because this mounting style is so detailed and difficult, it is not applied to just any painting but is reserved mostly for important Buddhist paintings. Once the sections are joined, wooden straight edges are placed to determine the final outer dimensions before folding the left and right edges over and trimming them. The placements of the pockets for the rod and stave, and that of the outer reinforcing silk for the final lining, are marked lightly with pencil on the lining papers. At this point, in many mountings, the final lining would be applied. After testing the thickness of the mount, however, it was determined that it needed to be slightly thicker. Rather than applying one thick layer, it was decided to apply a thin middle lining of misu paper before the final lining of uda. This lining is applied from

Fig. 19. Detail of Shakyamuni figure after toning of losses.

just inside the mark for the roller rod pocket to just inside the mark for the upper stave pocket, and is applied in the opposite direction from the final lining so that the final lining can be easily removed and replaced in the future without removing the middle lining in the process. The scroll is air-dried and then the final lining is applied. This is a process that involves

Fig. 20. Tomita Kinran woven by Tatsumura Heizo. Courtesy of Keisuke Sugiyama.

Fig. 21. Sara Ribbans applying the first lining to mounting silk. Courtesy of Keisuke Sugiyama.

attaching pockets of paper top and bottom, then a section of thin plain silk lined with mino paper for the top, followed by uda paper, and finishing with thin strips of the plain silk at the left and right edges of the bottom. The scroll is air-dried and

Fig. 22. Sara Ribbans applying the second lining to mounting silk. Courtesy of Keisuke Sugiyama.

Fig. 23. Sara Ribbans joining sections of border silk to the painting. Courtesy of Keisuke Sugiyama.

then remoistened and attached to the drying board, ensuring that the edges are straight and the width is the same at the top and bottom. It is left on the drying board for a total of six months, coming off after two months to have the back burnished before being reapplied to the drying board for the remaining four months. After the six months is complete, it is removed, the rod and stave are attached, the *futai* are sewn onto the top, hanging hardware is attached, and the cords are tied. This creates the finished product, seen in figure 25. The before and after photographs of the painting are seen in figure 26.

CONCLUSIONS

Although there were many challenges, the painting has been stabilized and returned to a hanging scroll format. This

Fig. 24. Detail of the mounting showing order of joining starting with the painting followed by ichimonji, suji, chūberi, suji, and sōberi. Courtesy of Keisuke Sugiyama.

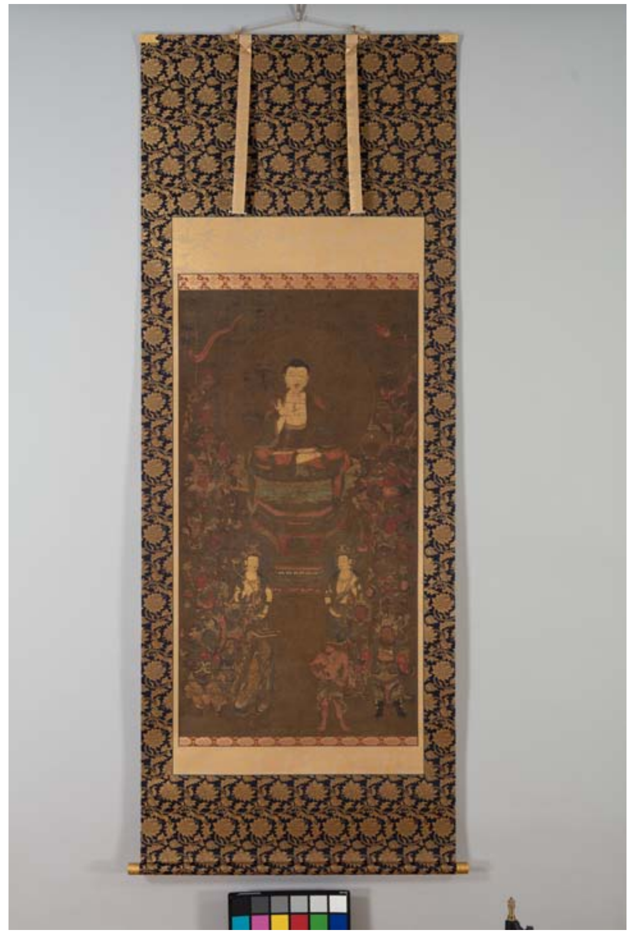


Fig. 25. After treatment of *Shakyamuni Triad with the Sixteen Benevolent Deities*. Courtesy of Joan Neubecker.

Fig. 26. Left: Before treatment. Right: After treatment. Courtesy of Joan Neubecker.

project involved a great deal of collaboration, generosity, and assistance from colleagues in both the United States and Japan. Unfortunately, there are no clear answers as to how to maintain a sustainable number of traditional craftspeople in Japan, as it will likely require government support to create an atmosphere that will encourage young people to pursue such careers. For now, Japanese painting conservators must buy as much materials as possible, recognizing that the increased costs are well worth it for the painstaking work and quality of materials produced, be as flexible as possible in adjusting to new sources and practices, and be as collaborative as possible with others within the field in recognition that everyone in the field is facing this challenge together.

ACKNOWLEDGMENTS

The author would like to thank Keisuke Sugiyama, associate professor at the Tohoku University of Art and Design, for his help during several stages of this treatment, as well as Jacki Elgar, Philip Meredith, Tanya Ueda of the Museum of Fine Arts, Boston, and Eiko and Naohide Usami of Usami Shokakudo Co. Ltd. for allowing me to look through their exceptional silk collections. The author would also like to thank Yi-Hsia Hsiao, Per Knutas, Joan Neubecker, Dave Piurek, Sinéad Vilbar, and the Cleveland Museum of Art Conservation Ambassadors for their generous support of this remounting project, as well as Robin Hanson, Sarah Scaturro, and the BPG editors for their assistance in editing this article.

NOTE

1. Washi was traditionally used not only for art but also for clothing, umbrellas, balloons, *shoji* (screen doors), wall construction, and more. These uses have been replaced by materials ranging from nylon to drywall.

REFERENCES

Shigemasa, N. 2019. 'Washi' industry hits crossroads as key suppliers call it a day. *The Asahi Shimbun*. http://www.asahi.com/ajw/articles/AJ201907020008.html.

Sugiyama, Keisuke. 2019. How to Replace the Endangered Apprenticeship? Training and Education in Japanese Conservation and Mounting. Paper presented at East Asian Paintings Conservation in the 21st Century, New York, New York.

FURTHER READINGS

Institute of Paper Conservation, International Institute for Conservation of Historic and Artistic Works, and Institute of Conservation. 1985. *The Paper Conservator: Journal of the Institute of Paper Conservation* 9 (1). London: Institute of Paper Conservation.

Institute of Paper Conservation, International Institute for Conservation of Historic and Artistic Works, and Institute of Conservation. 2010. *The Paper Conservator: Journal of the Institute of Paper Conservation* 30. London: Institute of Paper Conservation.

Masako, K. 1979. *Japanese Scroll Paintings: A Handbook of Mounting Techniques*. Washington, DC: Foundation of the American Institute for Conservation.

Uyeda, Tanya T. 2011. "How Far Do We Go? Compensation and Mounting Choices in the Treatment of Japanese Paintings." *Book and Paper Group Annual* 30: 101–11.

SARA RIBBANS
Associate Conservator of Asian Paintings
Cleveland Museum of Art
Cleveland, OH
sribbans@clevelandart.org

STEFANIA SIGNORELLO AND ELENA CARTER

Audrey Amiss, Artist and Patient: Preserving Her Legacy

INTRODUCTION

In 2014, Wellcome Collection received a unique archive collection of works created by a largely unacknowledged contemporary artist and mental health patient, Audrey Amiss. The collection consists of hundreds of sketchbooks, scrapbooks, diaries, artworks, account books, log books and record books—approximately 1500 items in total—in which Audrey meticulously recorded intimate aspects of her life over four decades.

This article explores the physical and intellectual challenges of trying to stabilise and preserve a collection comprised of a collage of complex modern materials, such as food packaging, junk mail, photographs, receipts and food residue. It is based on the talk presented by Stefania Signorello at the 2020 AIC Annual Meeting, with contributions from archivist Elena Carter, who has worked closely with the collection.

BACKGROUND

After Audrey's death in 2013, at the age of 79, her family found her flat full of paintings and sketch books, with hundreds of volumes of scrapbooks fanning out over beds (fig. 1) and stacked high on a dressing table (fig. 2). Confronted with the overwhelming amount of material accumulated and created by Audrey over the years, her family felt that something needed to be done to preserve this extraordinary body of work. A chance encounter led them to offer the material to Wellcome Collection, a free museum and library whose collections explore the intersections between health, life and art. The decision to acquire the collection was a watershed moment in Wellcome's collecting activity and paved the way for future acquisitions focusing on lived experience rather than prioritising the perspective of the medical profession.

Audrey Amiss had been a promising student at The Royal Academy School of Art when, at the age of 18 she experienced a severe mental health episode and was sectioned in a psychiatric ward. Audrey spent the rest of her life in and out of hospitals and locked wards, often medicated and detained against her will. Alongside living with mental illness, Audrey continued to develop her artistic practice, sometimes exhibiting paintings at small private galleries. During more stable periods, she was employed as a typist for the Civil Service.

Audrey's artistic style develops across the archive, from her art school training to more abstracted, collaged works. In Audrey's own words, she saw herself as an artist who was 'avant-garde and misunderstood', musing that 'there must be a great many more artists whom we have never heard of" (Wellcome Library 2020). She sketched hastily from life, often completing entire sketchbooks in a single sitting, or focusing on a particular subject, such as passers-by, plants or animals at the zoo. Her drawings are abstract, using continuous lines or simple outlines to capture movement or pick out details of significance to her.

Audrey documented her way of seeing and experiencing the world with great commitment and intensity, recording the minutiae and reality of her everyday life—from the food she ate to the people and buildings she saw and drew to the letters she wrote and sent out. Each of these activities was set out in a clearly defined series of volumes.

Audrey's account books document every penny she spent, with pasted-down receipts and frustrated annotations about being short changed in shops. Her record books bureaucratically record a summary of every letter she wrote, and to whom it was sent—quite often public figures and institutions. Her logbooks record her movements in diary-like form, detailing the state of her health and her activities over the course of the day. Her scrapbooks include pasted materials and packaging that crinkle as the pages are turned. The weight of these remnants also cause the volumes to bulge and to bow.

Audrey stuck down junk mail and food packaging that document what she ate every day, as well as other items that caught her magpie-like attention, prompting animated free association annotations and commentaries. Her works are full of material that was not made to last, from throwaway receipts to butter packaging with fatty residues that have seeped into the text of the volume itself. Despite the ephemerality of these materials, this collection offers a unique and

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

Fig. 1. Scrapbooks as found, sprawled over Audrey's beds (photograph taken by Audrey Amiss' nephew and niece in her flat shortly after her death).

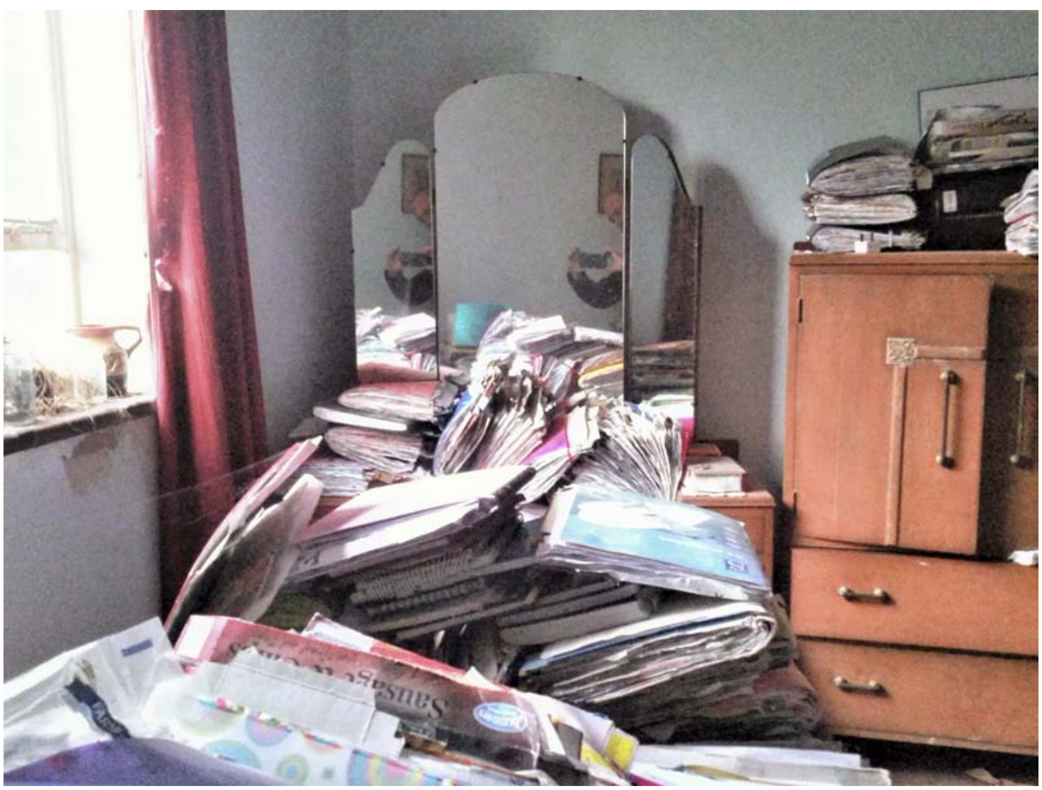


Fig. 2. Scrapbooks on Audrey's dressing table (photograph taken by Audrey Amiss' nephew and niece in her flat shortly after her death).

Fig. 3. A volume from PP/AMI/D: Audrey Amiss: photograph albums and scrapbooks. Wellcome Library.

colourful portrait of a life lived, documenting Audrey's experiences and encounters with the world as both an artist and a mental health service user. The material—and Audrey's legacy itself—will be lost if action is not taken to slow the collection's decay.

PRESERVING AUDREY'S LEGACY

This article focuses on the 234 scrapbooks Audrey compiled from the 1960s to 2013. The nature of the materials she used to assemble them, and the way they were constructed, make them not only a fascinating and unique collection but also a complex one to care for (fig. 3). They are made up of a challenging combination of multiple types of food and drink packaging—only roughly rinsed and dried by Audrey after consumption and with varying lifespans and degradation rates—and the variety of adhesives with which they were attached to the scrapbook pages, including a variety of pressure-sensitive tapes, glue sticks and extremely liquid glues.

MAIN PRESERVATION CHALLENGES

Wedging and Protruding Inserts

The volumes are severely wedged and misshapen due to the large amount of packaging, frequently bulky, secured onto their supporting leaves: paper cups and their lids, cartons, foil trays, wooden ice lolly sticks, plastic shopping bags, used tea bags and other commonly found objects (fig. 4).

For most volumes, the inserts protrude from their edges, even by up to 120–130 mm, exposing numerous vulnerable items beyond the protection of the covers.

Pressure-Sensitive Tapes and Glues

Audrey used a considerable variety of pressure-sensitive tapes to secure items in the scrapbooks. Less often, she used 'non-toxic, non-staining, acid free and washable' glue sticks, preferring liquid glues in the very early scrapbooks, which unfortunately caused significant mold growth. In later scrapbooks Audrey noted when one specific roll of tape had ended

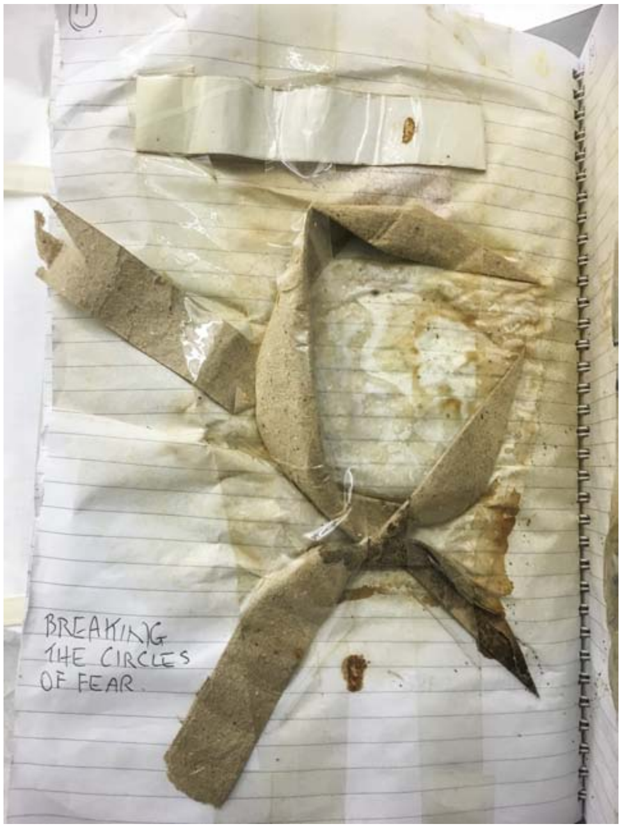


Fig. 4. Everyday found object stuck into a volume with pressure-sensitive tape.

and another had started, where she purchased them and how much they cost, attaching their empty packaging to the leaves.

She meticulously recorded the use of a wide range of tapes: wide brown packing; 'original easy-tear and antistatic', 'original golden', and 'extra sticky and easy-tear' from Sellotape; 'clear tape' from the Post Office (Royal Mail); and 'gift wrap tape refill' from the newsagent WHSmith, among others. From visual examination, it is evident that the antistatic tape, in which the layers of glue are transferring to, and sinking into, the paper, making it look translucent, is degrading the fastest.

Food Residues

Dried-out remains of food lie loose within the leaves and have become powdered over time. Sticky and slimy residues have leaked out of packaging, causing mold and a potential pest issue. Some pages are extensively stained by sugars, flour and butter, whereas others retain the pungent odour of smoked haddock and kippers (fig. 5).

Some types of foods, unexpectedly, look greasy (i.e., flour), and some others look very powdery (i.e., chocolate). Due to the wide variety of food residue, there is potential for professionals to research how the composition of beyond their sell-by date food ingredients have aged on the paper over time in contact with the environment.

Inks

In many areas where Audrey applied pressure-sensitive tape over her handwritten annotations, the inks have

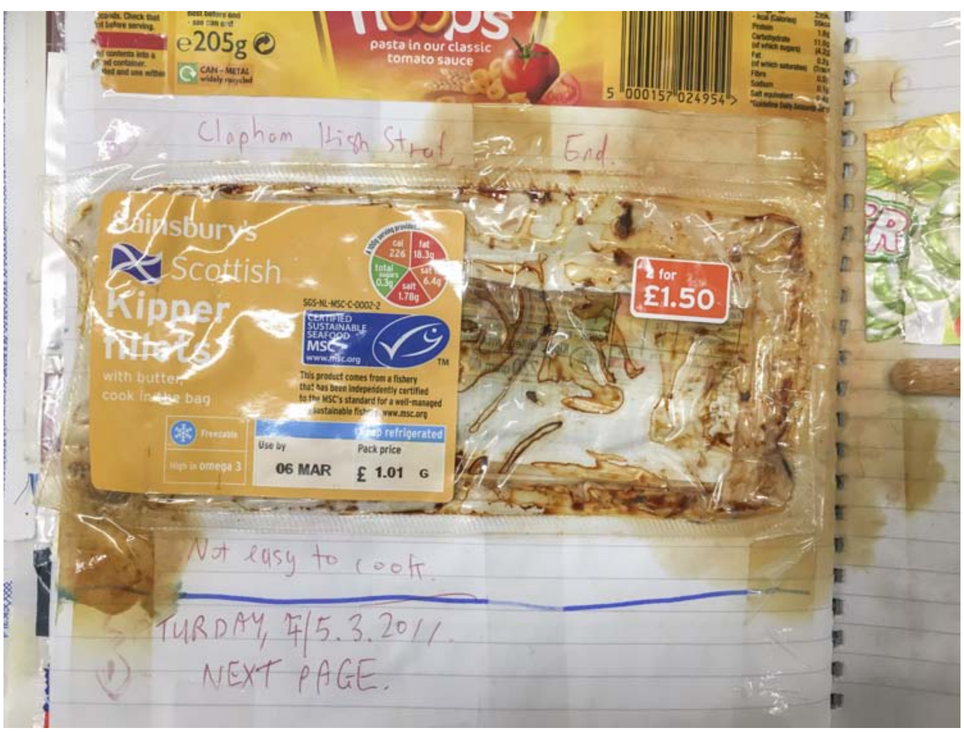


Fig. 5. Kipper fillet packaging adhered to one of the leaves.

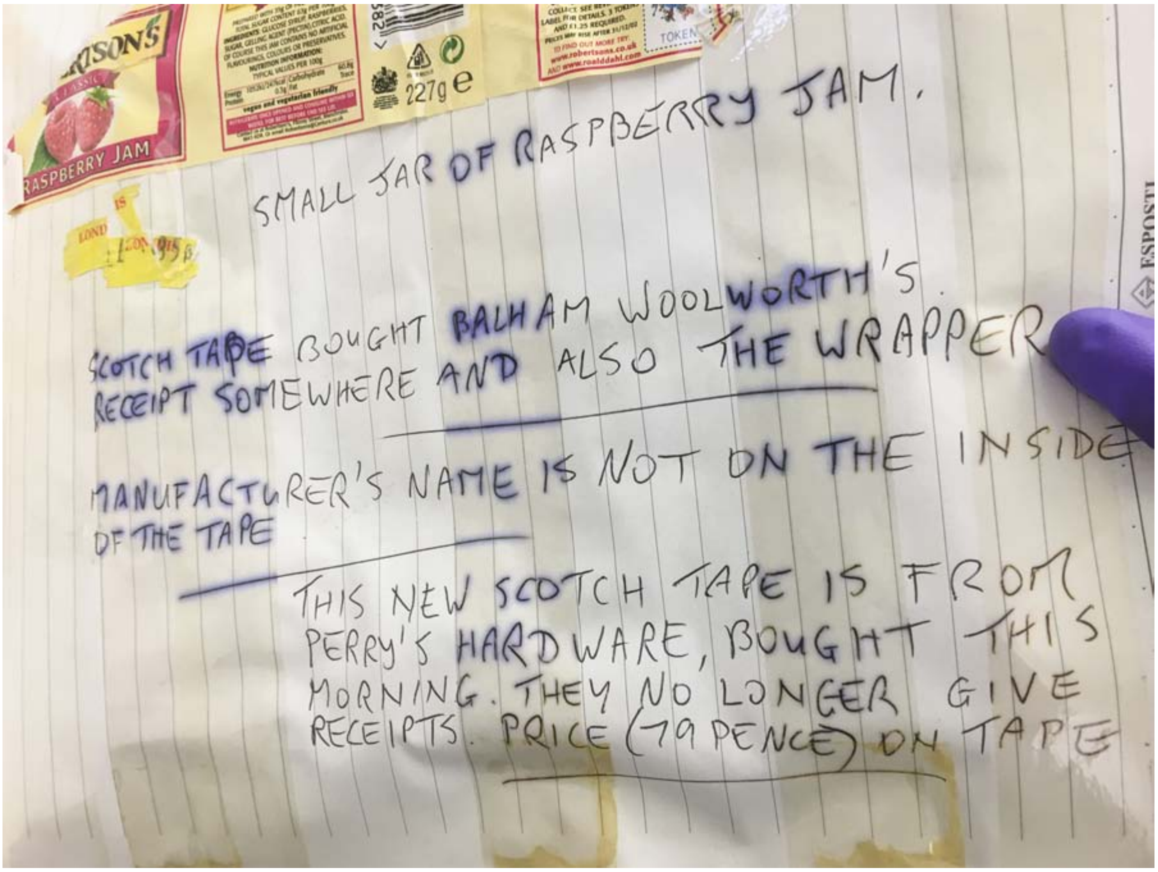


Fig. 6. Detail showing ink bleeding underneath pressure-sensitive tape.

bled significantly (fig. 6). A large percentage of her recorded observations, written after she had secured the inserts in place, consist of barely visible ballpoint pen indentations of faint red ink over the self-adhesive tapes (fig. 7).

Till Receipts

Till receipts, ostensibly for every single item she purchased over the course of four decades, feature heavily in her account books (PP/AMI/E: Audrey Amiss: Account Books. Wellcome Library) and, to a lesser but still significant degree, in her scrapbooks. The poor-quality paper of the receipts and their highly unstable inks, liable to fade or to black out, make them a very vulnerable component of the volumes. The exposure of the receipts to the off-gassing of some of the plastic items in the scrapbooks could further threaten their stability over time.

Mold

The presence of mold, both within the packaging and between the supporting leaves of the scrapbooks and the items secured onto them, generally presents access difficulties and makes the collection even more difficult to care for.

Evaporation of Plasticisers and Emission of Volatile Organic Compounds

The wide variety of plastics contained within the scrapbooks is susceptible not only to external factors like moisture, heat, light and pollution but also to internal factors like the migration of plasticisers and the off-gassing of the plastics. Extending their life span is one of the most important considerations in the care of this collection, together with preserving the carriers of the pressure-sensitive tape.

SURVEYING THE COLLECTION AND CONTAINING RISKS

When surveying a relatively large collection, conservators typically spend a maximum of three to five minutes per item. But because of the unpredictability of the findings within Audrey's scrapbooks, it was considered necessary to examine every single page.

It was also of paramount importance to confirm the suspected presence of mold in the volumes so that they would not be made available to users of the library at Wellcome Collection until treated.

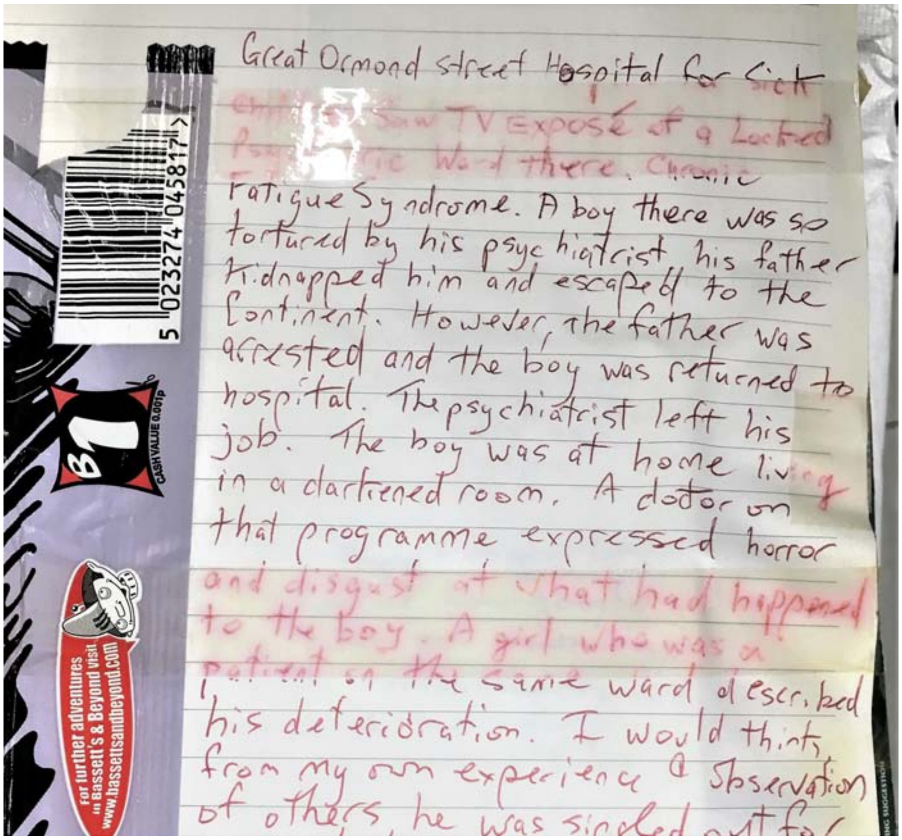


Fig. 7. Detail of red ink over tape.

The survey thus became a unique, intimate, powerful and emotionally engaging experience. Poring through the pages, seeing, smelling and touching these items brought the material to life in a visceral, immediate and evocative way. Often Audrey's words would give clues to the types of materials used and their age, as well as describing her sensory experiences of the items pasted down. Reading Audrey's notations allowed the authors to understand the material in context so that the items secured into the volumes were not treated in isolation but instead understood as part of the rich tapestry of Audrey's creative process.

While recording data on the condition of the volumes in a spreadsheet, it was necessary to deal with the most urgent preservation issues. Minimising the amount of handling and additional time-consuming 'preservation and conservation stages' the volumes would have to go through was deemed the most sensible approach. The main tasks involved the following:

- Ensuring that the volumes were stored flat on the shelves
- Clearly labelling them with warnings about the presence of mold, loose food residues and items at risk of loss—such as a pen and a coin lying loose between the page of a couple of volumes
- Separating inserts stuck against each other from adjacent pages, using a spatula, when possible
- Highlighting in the spreadsheets the presence of detached or detaching items due to the failing of the pressure-sensitive tape, as useful information for prioritising future work on those volumes
- Restricting access to items containing mold, alerting staff of the reasons for the restriction
- Scheduling items at high risk of new pest infestations, due to the significant presence of frass and food remains, for regular pest checks
- Containing those scrapbooks with loose frass and food residues by wrapping in large sheets of Tyvek
- Wrapping scrapbooks with protruding items in Tyvek to ensure extra protection of their edges inside their boxes
- Identifying items that should be prioritised for digitisation, initially sampling five of them to flag and iron out any issues that may arise from the nature of the scrapbooks' shape and contents.

One of the most urgent challenges is the preservation of adhesives and pressure-sensitive tape. It is crucial that it retains its tackiness for as long as possible, because the drying out of the adhesives will eventually cause the contents of the volumes to become detached.

ACCESS TO THE ITEMS

All of the scrapbook volumes have now been catalogued, although the Audrey Amiss archive collection will not be made accessible until the entire collection of materials has been catalogued in full. Some materials will need to be restricted due to sensitive content or for preservation reasons. Conservation work on the restricted and treatable moldy items will follow, allowing access to a larger part of the collection.

The wrapping of the volumes in large Tyvek sheets (with the smoother and less porous side against the item) will offer containment not only while in storage but also in the library's rare materials room. Handling guidelines and training will be provided for desk supervisors, and the volumes are likely to be set up with their Tyvek sheets onto book supports placed on a dedicated tailor-made tray. The regular pest checks of the stores will be easier against the smooth and white background of the Tyvek.

ACCESS TO DIGITAL CONTENT: PLANNING THE DIGITISATION OF THE COLLECTION

Ideally, the whole collection should be digitised before further deterioration of the pressure-sensitive tape takes place. Incorporating hundreds of complex items to photograph into the Wellcome Collection's digitisation programme, however, presents a challenge.

Hence, priority for digitisation will be given to the volumes with the following:

- Pressure-sensitive tape that is starting to fail, that is carrying notes and that is causing bleeding of the inks
- Large quantities of till receipts
- Mold, food residues and frass
- Plastics showing signs of deterioration, if any, even though currently, surprisingly enough, they are in rather good condition.

Unlike usual conservation preparation for digitisation, mechanical cleaning and removal of debris will not be undertaken prior to photography. This is due to the intrinsically unique reasons the scrapbooks are in their current condition. Dust, food residues, frass, flies and mold (fig. 8) will be left as found, as they show the way in which Audrey worked and how she experienced life. Preparation, therefore, will be limited to releasing the packaging that is stuck together so that an image of each opening can be captured.

The process of digitisation is likely to be slow and labour intensive; the photography studio will need to be prepared, personal protective equipment will need to be worn and checks will need to be carried out to ensure the environment is safe and that other materials from the collections are not at risk of contamination. Digitisation of the volumes will take place using state-of-the-art Hasselblad medium format imaging equipment, ensuring that high-quality imaging standards are met, resulting in colour-accurate reproductions. Once the volumes have been digitised, they will be sealed in low-oxygen enclosures to delay the degradation of pressure-sensitive tapes and plastics. It is hoped that the digital representation of the three-dimensional nature of these volumes can be achieved in the future in a cost- and time-effective way.

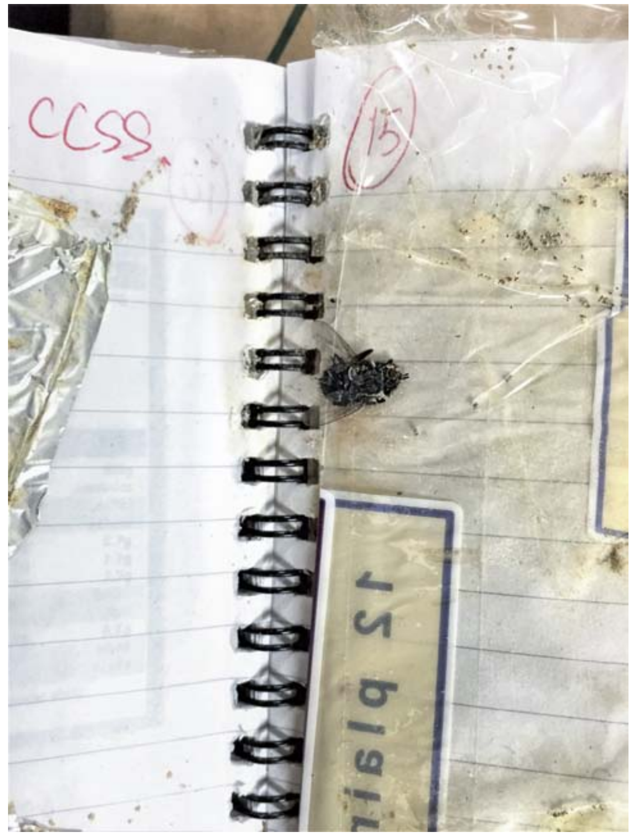


Fig. 8. Detail of a fly trapped within see-through packaging.

Once digitised and sealed, the physical scrapbooks will be made accessible to users only on special request and then resealed immediately afterwards.

STORAGE

For the long term, cost-effective storage solutions have been explored to slow down the degradation of the scrapbooks and thus preserve Audrey's legacy—at least until they are all digitised. This will be attempted by means of anoxic storage. The scrapbooks are kept in a controlled environment, protecting them from environmental fluctuations and reducing to the bare minimum their time away from cold storage for viewing.

The equipment needed for anoxic storage, including a free-standing heat sealer (necessary for large volumes such as these rather than a handheld one), nitrogen gas generators and an oxygen headspace analyser, is currently being purchased.

Anoxic enclosure trials of two scrapbooks were carried out with a colleague from the Natural History Museum, and a demonstration of yearly checks of anoxic enclosures—made nearly 10 years before—was hosted by another colleague at the British Museum. Their kind support, together with consultation by a former senior polymer scientist at the Victoria and Albert Museum, provided answers about how anoxia would work in practice and how it would prolong the useful life of Audrey's scrapbooks. It also enabled invaluable cross-disciplinary networking across four major UK institutions.

CONCLUSION

Balancing the needs, and accepting compromise solutions to contain costs, of such a fascinating and complex collection with its intrinsically short life span and risks for the neighbouring core collection, has proved to be a captivating and enriching experience.

In this first phase of the project, the authors have been working towards making the collection available to the public, and dealing with the risks that might negatively affect collection stores and reading rooms, making sure that the scrapbooks are made safe for handling and restricting access to those volumes that are not.

Once the highest-priority issues have been dealt with, including the digitisation of all volumes, this collection offers great potential for research into the preservation and identification of plastics; the potential effect of off-gassing of the plastics and pressure sensitive tapes on the scrapbooks prior to, and after, their placement in anoxic enclosures; the length of time for which it is possible to prevent the degradation of the material, thus maintaining the current appearance of each different type of plastic in a low-oxygen environment; the development of a prototype of a possible anoxic storage solution that allows at least partial viewing of the volumes without having to break their sealed enclosure; and digitally enhancing the three-dimensional experience of people viewing the volumes.

Archivists and conservators rarely get the chance to acquaint themselves in such depth with a collection and its creator. From an archival perspective, cataloguing the collection has reiterated the fallacy of archival neutrality, as to frame and describe the works has required a deeper understanding of Audrey and who she was. Trying to balance archival 'neutrality' and standardisation against the outpourings of a truly unique mind has been an intellectual challenge. The complexities inherent in preserving and describing such a dynamic and multifaceted collection mirror the complexities and contradictions of Audrey's own life. Audrey was an artist, a patient, a family member who was hard to care for, and a woman who lived mostly in solitude and had difficult encounters with the outside world but seemed to also crave recognition and understanding. Audrey was compelled to document her daily experiences and encounters, convinced that the world was mad and not her. As caretakers of Audrey's legacy, our responsibility is to present that complexity in its fullness, and to hope that its continued preservation will allow others the privilege of encountering and listening to Audrey for themselves.

ACKNOWLEDGMENTS

The authors thank Audrey's family, who entrusted Wellcome Collection with Audrey's legacy, and without whom the collection would have been lost to history. The authors also thank Fabiana Portoni, preventive conservator at the British Museum, and Lu Allington-Jones, senior conservator at the Natural History Museum, both in London, UK. Their support, and their extremely helpful suggestions, have been invaluable, as have been the recommendations made by Brenda Keneghan, former senior polymer scientist at the Victoria and Albert Museum, London. A big thank-you also goes to Bridget Mitchell, owner and director of Arca Preservation, Norfolk, UK, and to Mark Furness, senior conservator at The John Rylands Library in Manchester, UK. With them, the authors explored possible designs for high-tech storage solutions for a very small group of volumes, and our investigations may be further developed at a future stage of the project. Finally, special thanks go to the wonderful current and former colleagues in the library who have helped the authors with the page-by-page condition survey, measuring, wrapping volumes in Tyvek, tying, labelling and moving around the scrapbooks from tables to trolleys and shelves … widely demonstrating their gift of multitasking and can-do attitude!

REFERENCE

Wellcome Library. Audrey Amiss Archive. Retrieved November 4, 2020. Available at http://archives.wellcomelibrary.org/.

STEFANIA SIGNORELLO
Conservator
Wellcome Collection
London, UK
s.signorello@wellcome.org

ELENA CARTER
Collections Development Archivist
Wellcome Collection
London, UK
e.carter@wellcome.org

MELISSA TEDONE AND ROSIE GRAYBURN

Arsenic and Old Bookcloth: The Safe Handling, Treatment, and Storage of Victorian-Era Cloth Case Bindings

INTRODUCTION

The Winterthur Poison Book Project seeks to identify potentially toxic pigments used to color 19th-century bookcloth, and to provide recommendations for mitigating the risks associated with their handling and care. This article focuses on one toxic pigment in particular: arsenic-based emerald green (copper acetoarsenite).

Successful bookcloths were a closely guarded trade secret during the 19th century, and our current understanding of their materiality and manufacture is still incomplete. The Poison Book Project builds on William Tomlinson's work elucidating late-19-century bookcloth manufacturing techniques and Andrea Krupp's inventory of early-19th-century bookcloth patterns (Krupp 2008). Tomlinson's research demonstrates that late-19th-century bookcloths were colored by applying a surface treatment rather than dyeing cloth fibers directly. Bleached cloth was padded, meaning a colored starch slurry was scraped into the interstices of the weave, imparting color while also making the cloth more impervious to adhesive squeeze-through during the bookbinding process. Bookcloths were then backfilled with a material composed of colorant mixed with starch and other fillers (Tomlinson and Masters 1996). The backfill material sits on the surface of the cloth, and serves the function of both colorant and coating. This technique results in brilliantly hued bookcloths, but their surface can be vulnerable to mechanical abrasion.

The 19th-century craze for brilliantly hued arsenic-based greens is well documented (Whorton 2010). Arsenic-based pigments could be found in everything from apparel—such as gowns, hats, and shoes—to children's toys and wallpaper. This passion for emerald green required some degree of cognitive dissonance on the part of Victorian consumers, who also purchased and used arsenic-based green pigment as a rat poison and agricultural insecticide.

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

There are many common names for arsenic-based green pigments, and these were often used interchangeably by the contemporary public. Some historical sources also mistakenly conflate Scheele's green (copper arsenite) and Mitis green (copper arsenate) with the various other names for emerald green, such as Schweinfurt green, Paris green, Vienna green, and King's green; however, Scheele's green and Mitis green are distinct compounds. Paris green was a commercial name commonly used when emerald green was sold as a pesticide. *Emerald green* was the name used to describe the compound *copper acetoarsenite* by the German chemists who first synthesized it, and these two terms will be used interchangeably here.

Emerald green is a bright, brilliant green first synthesized around 1800, and commercially produced in Schweinfurt, Germany, in 1814 (CAMEO 2020). Its toxicity was realized soon after, but it continued to be sold as both a pigment and a pesticide. Its popularity as a green colorant in everyday consumer products persisted in Victorian England and the United States throughout the 19th century. Emerald green is more lightfast than the yellowish-hued Scheele's green, but is still susceptible to sulfurous air pollution, which causes the compound to oxidize and darken.

In early 2019, during the course of exhibit-related treatment of the volume *Rustic Adornments for Homes of Taste* (Hibberd 1857), the suspiciously bright green hue and friability of the colorant prompted pigment analysis in the Winterthur Scientific Research and Analysis Laboratory. The bookcloth colorant on *Rustic Adornments* was confirmed to be copper acetoarsenite, or emerald green. The presence of a friable toxic pigment on the exterior of a book in Winterthur Library's collection caused concern for the safety of library staff and patrons alike, the more so because many Victorian-era, cloth case bindings are housed in Winterthur's circulating collection. This concern prompted an analytical survey of the collections to better understand how many of the library's case bindings might be covered in potentially toxic bookcloth.

METHODOLOGY AND RESULTS

The analytical survey was limited to English-language cloth case bindings published during the Victorian era (1837–1900), because by the turn of the 20th century, brightly colored, lightfast, coal tar dyes superseded many of the textile colorants that were popular in the 19th century. Using portable XRF (pXRF) for elemental identification, interns at Winterthur began by analyzing 200 books in a range of bright colors, including reds, yellows, greens, and blues. Where toxic elements were present, the elemental analysis was followed with Raman spectroscopy to confirm the molecular structure of the compound. The bookcloth covering the front board of each tested book was photographed for reference, and in anticipation of a future database. This initial survey revealed copper acetoarsenite to be the pigment of most immediate concern, so after the first 200 books, testing continued on books bound in green bookcloth only to work through the collection more efficiently. More detailed experimental parameters can be found in the appendix.

All green case bindings in both the circulating and rare book collections at Winterthur Library have been analyzed with pXRF and Raman spectroscopy. Thanks to special access provided by Head of Conservation Jennifer Rosner and her colleagues, green case bindings in the American and British publishers' binding collections at the Library Company of Philadelphia have also been analyzed with pXRF. In total, nearly 500 volumes have been tested across the two institutions, approximately 350 of which are covered in green cloth. Of those, 38 tested positive for the presence of arsenic and copper.

Arsenical cloth case bindings range in size from large quartos to petite duodecimos. The current data set is still too small to see any trend in publishers, but there are other helpful commonalities. The majority of emerald green bindings have publication dates in the 1850s (fig. 1). A few were published in the 1840s, but this does not necessarily indicate that emerald green bookcloth was being manufactured and used in the 1840s, because remaindered books may have been bound later. The latest publication date identified so far is 1860. A time-effective strategy for those considering searching for emerald green books in their own collections might therefore start in the 1850s and work out in either chronological direction.

Emerald green bindings tend to be highly decorated American or British imprints, with gold titling, gold and blind blocking, and often gilt edges. The bookcloth over the boards remains vividly green, with no sign of insect damage. The condition of emerald green spine cloth shows more variation in color, likely from exposure to oxidizing air pollution as the book sits on the shelf.

Winterthur's *Rustic Adornments for Homes of Taste* displays a binding ticket for Westley and Co., a prolific London bindery in the mid-19th century. According to a contemporary article in *Penny Magazine* (1845), "A Description of Westleys & Clark's Bookbinding Establishment" (the predecessor to Westley and Co.), bookcloth was purchased in rolls, and stored in a cloth warehouse, where it was cut down into pieces of several yards each before being handed over to the cloth case makers. Gas

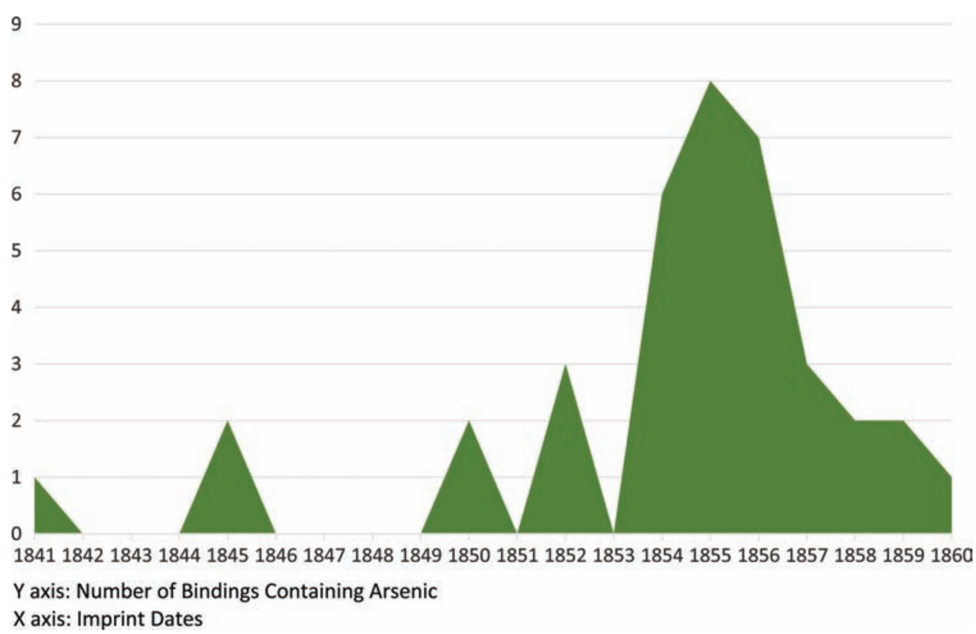


Fig. 1. Histogram showing number of arsenical green bindings (determined by XRF) by imprint date.

jet powered embossing machines impressed patterns on the precut pieces of bookcloth to hide the weave, raising questions about the effect of heat and steam on arsenic-pigmented cloth and the workers who used it. The article also notes that gilding was reserved for a "higher class of bound book," which speaks to the consumer demographic for these bindings (*Penny Magazine* 1845).

The qualitative survey results revealed that arsenical emerald green was not uncommon in mid-19th-century bookcloth, but quantitative analysis was needed to better understand the risks associated with emerald green bookcloth. A destructive sample, in triplicate, of 1-cm^2 bookcloth taken from underneath the pastedown was sent to the University of Delaware Soil Testing Laboratory for quantitative elemental analysis using the inductively coupled plasma–optical emission spectrometer (ICP-OES) (see the appendix for experimental details). The Soil Testing Laboratory also analyzed a "pick-up test" of dry cotton swabs rolled lightly across the surface of the bookcloth intended to simulate common handling.

The quantitative analysis indicated that the octavo-sized book *Rustic Adornments for Homes of Taste* contains several times the lethal toxic dose of arsenic for an average-sized adult, as little as 2 mg/kg of body weight (Gehle 2010). The cotton swab pick-up test resulted in a significant, measurable amount of arsenic offset from the dry bookcloth. A second pick-up test using nitrile gloves was also conducted, but the Soil Laboratory protocol was unable to digest the nitrile and therefore provided no results. There are limitations to the interpretation of these results. This singular binding may not be representative of all emerald green bookcloth. Not all emerald green bookcloth may be this friable. It is also impossible to determine how much pigment this binding may already have shed over its nearly 200-year history.

HEALTH AND SAFETY IMPLICATIONS

Conversations about this research with experts from various fields associated with health and safety have provided a broader context for interpreting the degree of risk present. Forensic toxicology, epidemiology, and industrial hygiene are related disciplines that consider risk from differing perspectives. According to forensic toxicologist Dr. Justin Brower (Skype call with the authors, March 22, 2020), there is no record of any person dying from exposure to arsenical bookcloth. From the perspective of pathology, he considers arsenical bindings to be low risk; however, he also acknowledged that institutions may need to act with an abundance of caution because of issues surrounding legal liability. Epidemiologist Dr. David Goldsmith (pers. comm., October 30, 2019) focused less on fatality as the primary risk factor, drawing attention instead to the potential for materials that people interact with in their daily lives to trigger serious, long-term health issues. Goldsmith suggested research into arsenical bookcloth should be communicated not only to conservators and librarians but also to epidemiologists, because potential problems from long-term, low-grade exposure to arsenic could be a public health concern. Safe handling and storage protocols for arsenical bindings at Winterthur Library are based on consultation with Industrial Hygienist and University of Delaware director of Environmental Health and Safety Michael Gladle. From Gladle's perspective (phone conversation with the authors, December 13, 2019), there are no safe exposure limits for copper acetoarsenite, so limiting direct contact, inhalation, and ingestion of bookcloth pigment insofar as possible is essential.

Emerald green bindings present a risk to library staff and users which should be taken seriously. Although every institution must work out its own logistics for meeting the goals of safe storage, handling, and treatment, the approaches being explored at Winterthur Library may provide a useful model. First, steps have been taken to restrict circulation of arsenical bindings. Users will not be allowed to check out emerald green books and bring them home. Whenever possible, researchers will be encouraged to use a digitized surrogate instead of the original. Researchers with a compelling reason to handle original emerald green bindings will do so in the controlled environment of the Winterthur Library Rare Book Reading Room, under the supervision of trained library staff. All library staff will be trained in safe handling practices, and a written policy will be posted for easy reference in staff areas of the library, including in the stacks at the location where the arsenical bindings will be stored.

Other precautions in place at Winterthur recommend that individuals wear nitrile gloves when handling arsenical bindings; take care to avoid ingestion or inhalation of pigment dust; and avoid touching the face, eating, or smoking until hands can be thoroughly washed, even if gloves have been worn to handle bindings. Arsenical bindings will be used only on hard surfaces that can be wiped down with a damp, disposable cloth. A nonpermeable "placemat" of polyethylene or polyester will be draped over book wedges, cushions, or futons during use. Additional guidelines for researcher use of arsenical bindings and the potential use of waivers are still under discussion among conservation, library staff, legal counsel, and other stakeholders at Winterthur.

The Covid-19 pandemic shutdown in 2020 interrupted practical conservation treatment of the emerald green binding *Rustic Adornments for Homes of Taste* at Winterthur. When treatment resumes, the treatment protocol will adhere to recommendations from University of Delaware Environmental Health and Safety. In addition to wearing nitrile gloves and observing the good hygiene practices already described, conservators should carefully consider the environment in which they plan to treat books bound in arsenical bookcloth. Moisture introduced by adhesives could cause the arsenic to migrate and offset in greater concentration. Moisture could also trigger the release of highly toxic arsine gas. Therefore, best practice indicates working under a certified chemical fume hood. A second choice would be to work in a ductless particulate hood with a combination HEPA/charcoal filter. A respirator with organic solvent and particulate filters should be considered only as a last resort.

Conservation and library staff at Winterthur agreed that enclosures for arsenical bindings should be used to prevent casual touching and contain any pigment shedding. First, standard enclosures already in use were considered: the CoLibri book jacket system and corrugated clamshell boxes. CoLibri jackets are made of polyethylene, an effective choice of material as a barrier for emerald green pigment. However, CoLibri jackets have a large gap that exposes the head and tail of the spine, as well as a portion of the board edges, where colorant is most vulnerable. Paperboard boxes were also evaluated and rejected, as they could collect and then release shed pigment unpredictably during handling.

Ultimately, staff consensus settled on the humble, but perfectly serviceable, polyethylene zip-top baggie. The manual logistics of sliding materials in and out of the baggie encourages extra attention and care. The transparency of the polyethylene allows easy monitoring of pigment shedding, and the baggies are easy to label. Bagged books can continue to be shelved upright, and have a tight zip-top seal that keeps pigment in and water out in the case of a water disaster. The baggie differs enough from other standard enclosures at Winterthur Library to signal that something is notable about these contents; however, if desired, a bagged book could additionally be boxed.

Recommendations from University of Delaware Environmental Health and Safety suggest storing arsenical books together in one area with clear shelf signage, in addition to individual labels on each enclosed item. Winterthur Library already has a tradition of shelving certain collections items together based on physical attributes. For example, folia and miniatures collections are housed in designated shelving areas rather than being interspersed throughout the rest of the collection. A letter code at the end of the call number alerts library staff and users to the item's special location. Rehousing arsenical books together in one storage area easily fits into this pre-existing practice. A clearly labeled shelf in the Rare Book Vault has been designated for Winterthur's 10 arsenical case bindings, which further minimizes risk to salvage staff in case of a collection emergency.

NEXT STEPS

A primary goal of this project is to assist libraries and collectors without access to analytical equipment to identify potentially arsenical bookcloth in their own collections, a purpose which has led to the development of an emerald green color swatch bookmark freely available upon request. The bookmark is not a perfect tool; it can only give a visual indication that a book *might* be bound in arsenical bookcloth. However, all 38 bindings that have tested positive for arsenic have presented a remarkably consistent vivid green hue. Combined with other contextual clues, such as publication date, the bookmark may help narrow down the likelihood whether green case bindings are covered with arsenical bookcloth. Emerald green color swatch bookmarks are currently available from Winterthur Library.[1]

Ongoing analysis, archival research, and outreach to libraries, private book collectors, and book dealers continues for this project. Next steps include a peer-reviewed publication of the formal methodology and findings to date, and expansion of the arsenical bindings data set through local and international partnerships, beginning with University of Delaware Special Collections and the British Library. Expanding the data set in the UK is critically important, because England was the main manufacturing source of bookcloth used by 19th-century binderies in North America, as well as in the British Isles. The project also continues to collect data about other pigments of concern, including chromium-based, mercury-based, and lead-based pigments.

To share identification and safety tips broadly, Poison Book Project information will be maintained on the Winterthur Wiki.[2] Although a wiki page is gray literature, this format does allow nimble updates to public-facing information about the project as it evolves. At the time of this article's publication, the list of confirmed arsenical bindings has been posted as a static table, but plans are under way to create and grow a searchable, publicly accessible database of potentially toxic bookbindings.

Although this project focuses on the specific risks associated with arsenic-based pigment, generalized lessons can also be drawn from this work. First, allied disciplines related to health and safety have differing perspectives and risk tolerances, so consulting experts from multiple adjacent fields provides breadth of context for decision making. Second, a cookie-cutter approach to the logistics of storing, handling, and serving potentially toxic materials to library patrons will not work for every institution; involving stakeholders in a conversation about desired outcomes based on core safety guidelines can achieve a tailored solution that works. Finally, libraries need more materials research to identify hidden hazards in their collections. Research partnerships and inter-institutional knowledge sharing is vital for protecting library staff and users, as well as collection materials themselves.

ACKNOWLEDGMENTS

The authors thank Winterthur Library director Emily Guthrie and staff for their support of and contributions to this project; Winterthur interns Layla Huff, Sara Leonowitz, Meghan Abercrombie, and Philip De Paola for collecting and interpreting analytical data; and the Library Company of Philadelphia and Head of Conservation Jennifer Rosner for access to their collections for analysis. Special thanks to Suzy Morgan, library conservator at Arizona State University Library, for the idea to print color swatch bookmarks. The authors also thank Michael Gladle, Dr. Justin Brower, and Dr. David Goldsmith for discussing the merits and health and safety implications of the project. The authors appreciate Preventive Conservator Nicole Monjeau, Book Conservator Amy Baldwin, and Conservation Scientist Paul Garside of the British Library, and Associate Librarian for Special Collections Alexander Johnston of the University of Delaware, for their commitment to continued analysis of their respective collections. The authors gratefully acknowledge funding support from the ICON Fred Bearman Research Grant, the University of Delaware Art Conservation Department, and the Winterthur Do More 24 Delaware campaign coordinated by the United Way.

APPENDIX

1. Qualitative Testing

pXRF was used to collect elemental information from bookcloths. Analysis was performed with a handheld Bruker Tracer III-SD XRF spectrometer using a rhodium tube (40-kV high voltage, 9.6-μA anode current, 25-μm Ti/305-μm Al) for 30-second live time irradiation. A zero background plate (design courtesy of the Institute for the Preservation of Cultural Heritage, Yale University) was placed behind the cover to mask elements within the textblock. Spectra were interpreted using the PXRF1 software.

A total of 406 books from the Winterthur collection were analyzed. The Library Company of Philadelphia shelves its Americana collection chronologically according to imprint date. Volumes were selected for testing by a visual scan of the shelves in the appropriate date range (1830s–1900). Approximately 80 books bound in green bookcloth or with green paper onlays were tested using pXRF. Spectra and bibliographical data were saved for each volume.

When arsenic and copper were found together on Winterthur volumes, Raman spectroscopy was used to confirm copper acetoarsenite. The books were analyzed with a Renishaw Invia Raman spectrometer (785-nm diode laser) in conjunction with WiRE 3.4 software with extended scan from 200 to 2200 cm^{-1}, 50× objective lens, exposure time of 15 seconds/scan for three accumulations, and 1% laser power. Spectra were compared against an emerald green reference spectrum from the Raman Spectroscopic Library of Natural and Synthetic Pigments, University College London.

2. Quantitative Testing

The University of Delaware Soil Testing Lab performed destructive quantitative analysis on 1 cm^2 bookcloth samples from one Winterthur Library volume bound in emerald green bookcloth. A pick-up test was also performed on the cover of the same volume, by rolling dry cotton swabs across the surface with even pressure.

Triplicate samples were weighed and were placed in 10 mL of concentrated nitric acid. Samples were then digested by EPA Method 3051A using a CEM MARS5 microwave digestion system. The digest was then diluted to 50 mL using deionized water. Digests were analyzed for arsenic using a Thermo 7600 ICAP 7600 Duo View inductively coupled plasma–optical emission spectrometer (ICP-OES).

NOTES

1. Please email a postal address to reference@winterthur.org to request an emerald green color swatch bookmark; make sure to put "Emerald Green Bookmark" in the subject line.
2. The Poison Book Project site on the Winterthur Wiki can be found at http://wiki.winterthur.org/wiki/Poison_Book_Project.

REFERENCES

"A Description of Westleys & Clark's Bookbinding Establishment." 1845. *Penny Magazine*. London: Friar's Street, Doctors' Commons. https://play.google.com/books/reader?id=-tKSNWNZEvcC&pg=GBS.PP8.

"Emerald Green." CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. Accessed January 28, 2020. http://cameo.mfa.org/wiki/Emerald_green.

Gehle, Kim. "Arsenic Toxicity." Environmental Health and Medicine, Centers for Disease Control and Prevention, Agency for Toxic Substances & Disease Registry. Last modified January 15, 2010. https://www.atsdr.cdc.gov/csem/csem.html.

Hibberd, Shirley. 1857. *Rustic Adornments for Homes of Taste*. London: Groombridge & Sons.

Krupp, Andrea. 2008. *Bookcloth in England and America, 1823–1850.* New Castle, DE: Oak Knoll Press.

Tomlinson, William, and Richard Masters. 1996. *Bookcloth 1823–1980: A Study of Early Use and the Rise of Manufacture, Winterbottom's Dominance of the Trade in Britain and America, Production Methods and Costs and the Identification of Qualities and Designs.* Stockport, Cheshire, England: Dorothy Tomlinson.

Whorton, James C. 2010. *The Arsenic Century: How Victorian Britain Was Poisoned at Home, Work, and Play.* Oxford: Oxford University Press.

FURTHER READING

Ball, Douglas. 1985. *Victorian Publishers' Bindings.* London: Library Association.

FitzHugh, Elisabeth West, ed. 2019. *Artists' Pigments: A Handbook of Their History and Characteristics*, vol. 3. Washington, DC: National Gallery of Art. https://www.nga.gov/research/publications/pdf-library/artists-pigments-vol-3.html.

Hawksley, Lucinda. 2016. *Bitten by Witch Fever: Wallpaper & Arsenic in the Victorian Home.* London: Thames & Hudson Ltd.

Lundblad, Kristina. 2015. *Bound to Be Modern: Publishers' Cloth Bindings and the Material Culture of the Book, 1840–1914*. Translated by Alan Crozier. New Castle, DE: Oak Knoll Press.

Miller, Julia. 2014. *Books Will Speak Plain: A Handbook for Identifying and Describing Historical Bindings.* Ann Arbor, MI: Legacy Press.

MELISSA TEDONE
Lab Head for Book & Library Materials Conservation
Affiliated Associate Professor, Winterthur/University of Delaware Program in Art Conservation
Winterthur Museum, Garden, and Library
Winterthur, DE
mtedon@winterthur.org

ROSIE GRAYBURN
Lab Head for Scientific Research and Analysis
Affiliated Associate Professor, Winterthur/University of Delaware Program in Art Conservation
Winterthur Museum, Garden, and Library
Winterthur, DE
rgrayb@winterthur.org

RENÉE WOLCOTT

Restoration, Rebinding, Conservation: Changes in Collections Care over 275 Years at the APS Library

INTRODUCTION

The American Philosophical Society (APS) has maintained a research library since its founding in 1743. In the institution's 275-year history, the library's approach to collections care has changed as the conservation field has evolved, from binding loose documents and pamphlets in the 1700s to item-level treatment in today's fully staffed and well-equipped conservation laboratory. In the years between, the APS forged relationships with many contract binders and restorers beyond its walls and established its own in-house conservation facility. The APS Archives reveal the library's long-standing concern with stabilizing its collections, and provide details concerning the individuals hired to perform the work, including Philadelphia binder Jane Aitken in the early 19th century; Library of Congress manuscript restorer William Berwick in the early 20th century; Carol Rugh (later Carolyn Horton), who was hired as the first APS on-site conservator in 1935; and Willman Spawn, the society's first full-time conservator. Not all of these restorers and conservators left records of their work, but the collections themselves reflect the changing materials and methods in use over the years, from Western-paper fills and silk lamination to indiscriminate rebinding to today's historically sensitive item-level treatment. This long, varied history of collections care also means that today's conservators must sometimes reverse earlier treatments that no longer serve the needs of the books and documents they were designed to protect. This constant engagement with and reassessment of conservation work from the past is common in smaller research libraries, particularly as scientific conservation techniques have been slower to catch on in the complex interplay among binders, restorers, and program-trained book conservators. The society's approach to the evolving history of conservation treatment may serve as a guide for other institutions in like circumstances.[1]

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

EARLY HISTORY OF THE APS COLLECTIONS AND THEIR CARE

Benjamin Franklin founded the APS in 1743 for the "pursuit of useful knowledge," bringing together a small group of men who studied the latest developments in science and agriculture to promote the welfare of the American colonies. These men read and collected books and papers on the latest scientific discoveries, exchanged botanical and mineralogical specimens, and established ties with scholars in other parts of the world. In December 1768, the APS merged with another small society with similar aims, the American Society held at Philadelphia for Promoting Useful Knowledge. The books, papers, and specimens of both societies were brought together, and by 1770 one of the main goals of the enlarged society was to maintain a Cabinet—a research library and museum—worthy of international acclaim. The committees of the expanded society, and its growing library, focused on geography, mathematics, natural philosophy, and astronomy; medicine and anatomy; natural history and chemistry; trade and commerce; mechanics and architecture; and husbandry and American improvements. In the last decades of the 18th century, the society's Cabinet contained donated and purchased reference books, papers submitted to the society, and meeting minutes, as well as natural history specimens, medals, and architectural and mechanical models.

The APS Minutes from this period reveal the society's concern with the security and preservation of its growing collections. The society purchased a new bookcase for its library in 1773, when its members met in rented space in Carpenters' Hall, and more cases were added as the collections continued to expand. David Rittenhouse was appointed the first APS Librarian in 1775, charged with overseeing the society's collections and monitoring its lending practices. From 1783 to 1790, while the society struggled to purchase land and erect a building after the Revolutionary War, Rittenhouse stored the APS Library and Museum collections in his own home. Printed ownership labels were pasted into the books and pamphlets during this period. The collections moved into the

Fig. 1. Philosophical Hall, which contained the APS meeting rooms and library, after its construction in 1790. APS Archives, unprocessed collection, M42.34.25. Courtesy of the American Philosophical Society.

newly constructed Philosophical Hall in early 1790 (fig. 1). In 1792, the society established regulations for the management of the library, including cataloging guidelines, lending restrictions, and fines for overdue books. The society's curators were to use the proceeds from any fines for the "augmenting of their Library, & keeping the same in proper preservation" (Minutes 1787–1793, 222).

According to the APS Minutes, society members first called for the library collections to be cataloged in 1790, when the books were moved to their new home, but the process took years to complete. In early 1793, all of the loaned books were recalled from borrowers for the purposes of creating the catalog. When Charles Willson Peale rented part of the society's hall for his museum in 1794, he was named Librarian of the Society and given the responsibility of caring for both the collections and the building. Along with two other APS members, he presented a draft of the library catalog in 1796. Discussions for printing the catalog were under way in 1797, and the society moved on to cataloging its "cabinet of minerals" and "mathematical and philosophical apparatus" (Minutes 1793–1798, 170). The library catalog project appears to have stalled, however, perhaps because books kept disappearing. Although unauthorized borrowing or outright theft are not addressed directly in the APS Minutes (1793–1798), a committee was directed "to take proper measures to secure the property in the Society Room" in November 1798 (233), and locks were installed on the bookcases before the next meeting. New bookcases with glazing were installed the following year to assist with the cataloging process. The catalog was finally completed in December 1799, and the books were grouped by size and numbered sequentially. This catalog was revised from 1807 to 1814; in 1819 (by which time the collection had again outgrown its bookcases); from 1822 to 1824; and in 1838, when the society also purchased a stamp for marking the books. Lists of book donations—and the ever-increasing costs for insuring the library collections—reflect the growing size and importance of the APS holdings during this period.

Binding as Collections Care

As part of the process for preparing the first catalog of the library collections, the society ordered in March 1797 "that the pamphlets belonging to the Society be arranged and uniformly bound" (Minutes 1793–1798, 160), and in November 1799 that all of the unbound books in the society's possession be bound. Binding loose papers provided protection against both mishandling and loss, and it appears to have become a standard procedure. On October 15, 1802, the APS Minutes (1799–1804) note that an incoming donation of quartos from another learned society "being unbound [will] be bound" (129). A year later, APS members were not permitted to borrow the latest or "loose" journals, suggesting that the library's usual practice was to bind sets of journals on a regular basis (Minutes 1799–1804, 170).

Starting in 1821, the APS Librarian (John Vaughan, fig. 2) was given an appropriation for binding each year, starting at $50 and growing to $200 annually by 1843. The binders used for this routine work cannot be identified from the APS Minutes alone, although they show that the APS paid Samuel Taylor, Robert Aitken, Jane Aitken, and "Mr. Gaskill" for binding society publications between 1771 and 1837. Spawn's research on early American bindings established that Robert Aitken bound many additional volumes for the APS (Baker 2004), perhaps including most of the incoming books, until his death in 1802. Further research into the Librarians' correspondence and Spawn's papers (which now await processing at the APS) may reveal a list of Robert Aitken's bindings and the identities of later binders.

Fig. 2. John Vaughan, a Philadelphia wine merchant, served as APS Librarian from 1803 until his death in 1841. The first printed catalog of the APS Library was produced under his aegis, and he also donated many valuable books. Thomas Sully's 1823 portrait depicts Vaughan holding an APS book with a torn parchment binding propped on a copy of the library's catalog. Thomas Sully, *Portrait of John Vaughan*, 1823. Oil on canvas. 40.25 × 35 in. Courtesy of the American Philosophical Society.

Earlier references to binding deal with printed materials; however, the society also bound many of its manuscript collections, including its own archival records, as well as donated letters and other historical documents. On November 17, 1837, the APS secretaries were instructed "to cause the Records and Documents, connected with the History and Transactions of the Society, to be properly arranged and bound" and installed in appropriate cases (Minutes 1834–1839, 174). This directive was carried out by March 5, 1841, when the papers had been bound into "18 quarto and 2 folio volumes" (Minutes 1840–1842, 122). The APS Minutes of July 17, 1840, note that "[Charles Pemberton] Fox had deposited in their archives a collection of papers and original letters of Dr. Franklin" (57). The following month, the society appointed a committee "to arrange the Franklin papers deposited with the Society, and to report a plan for the better preservation of the Manuscripts of the Society" (Minutes 1840–1842, 62). As Berwick's later correspondence reveals, the loose Franklin letters were subsequently oversewn and bound. On October 21, 1842, Librarian George Ord "called the attention of the Society to the condition of the bound manuscripts in the Library, some of which are without indices, and parts of others have been cut out of the volumes which once contained them, and have been removed" (Minutes 1840–1842, 294). A committee was appointed "to consider the Manuscripts in the possession or custody of the Society . . . [and to report] . . . what action may be proper for their secure preservation, and for facilitating their usefulness" (Minutes 1840–1842, 295). This approach also appears to have involved binding or rebinding, although the APS Minutes do not specify what was done; the committee was disbanded in August 1845.

Other Early Preservation Efforts

Although care for the library collections appears to have focused on binding during the 18th and 19th centuries, the society was also interested in preserving its instruments, natural history specimens, and artworks from harm, and in repairing them when they were damaged. On April 4, 1783, the curators presented a "report on the state of the natural curiosities in the Museum," and the society "ordered that the curators take immediate measures for preserving the same from further decay" (Minutes 1774–1778, n.p.). Based on these records and the letters of Peale, it is safe to assume that any skins and taxidermied specimens then in the APS collections have been treated with arsenic, mercury, or other toxic materials during that time. In early 1802, the society considered several options for repairing and maintaining its timepiece. On June 18, 1802, the curators were "requested to put the Lens [of the telescope] in good order & have the globes varnished with spirit varnish and properly covered" (Minutes 1799–1804, 126). On June 17, 1836, the society turned its attention to repairing its "transit instruments," which had been used to observe the transit of Venus across the face of the sun (Minutes 1834–1839, 109). Franklin's portrait was "cleaned and repaired" for the sum of $28 in 1842 (Minutes 1842–1846, 30). All of this information is valuable for today's conservators, who may be called upon to re-treat instruments, specimens, or paintings that were first restored more than 150 years ago. At other institutions as well, the archives may fill in some of the blanks concerning restoration work undertaken before the age of modern conservation documentation.

The APS Archives also provide tantalizing clues concerning the early study of preservation and the development of new materials and technologies. The society actively collected information related to preservation and conducted its own research on the matter. On March 20, 1789, the APS Minutes recorded the donation of a dissertation in French on protecting paper from the ravages of insects. On February 16, 1798, a committee of three was appointed "to devise the best method of preserving fossil bones" as they were raised from the ground (Minutes 1793–1798, 210). On January 17, 1806, an Italian pamphlet was criticized for containing "nothing of importance, except a mode of preserving books from worms, which simply consists in mixing oil of turpentine with the paste used in binding—which, in drying, the writer says, forms a vitreous substance with the paste" (Minutes 1805–1814, 37). The APS Minutes (1815–1825) also reflect its members' interest in mulberry paper from American trees, the development of machine-made paper in 1819 such as Josiah and Thomas Gilpin's "endless sheet" (98), methods for shaping caoutchouc, early Daguerreotypes and other photographic techniques, the first metal-nib pens, and experiments to develop a sediment-free ink for such pens.

RESTORATION AND CONSERVATION IN THE 20TH CENTURY

Although further research in the APS Archives—its manuscript minutes, librarians' correspondence files, and staff records—will no doubt cast further light on preservation in the second half of the 19th century, those records are not available in digital form and could not be accessed while preparing this article. The author hopes to return to the subject when regular on-site work resumes. In the meantime, this narrative must skip forward approximately 50 years to 1900, when the APS hired expert paper restorer Berwick to again address its collections pertaining to Franklin, Thomas Jefferson, Nathanael Greene, and other luminaries of the early republic.

It is worth noting that the APS Library remained in Philosophical Hall throughout this interim, but that its collections were rapidly outgrowing the space. A blind third floor with a clerestory was added on top of Philosophical Hall in 1890 purely to house the books and manuscripts. This extra floor spoiled the Federal style of the building and was derogatively likened to an ugly top hat, but it remained in place until construction of Independence National Historic Park in 1949 (figs. 3, 4).

William Berwick, Paper Restorer, 1900–1920

William Berwick's professional career and cultural milieu have been expertly covered in the magnum opus *Yours Respectfully, William Berwick: Paper Conservation in the United States and Western Europe, 1800 to 1935* by Christine Smith (2016), and the following paragraphs owe much to her labors. Berwick was born in London on February 28, 1848, and apparently apprenticed as a bookbinder. He emigrated to Canada in or around 1866, and as a young man worked as a binder in Hamilton, Toronto, and Montreal. While in Montreal, he married Mary Gillespie, and by the time they immigrated to Lansing, Michigan, around 1882, they had two daughters, Mae and Edith. In Lansing, Berwick worked as a binder and restorer, repairing and mounting maps for the

Fig. 3. Philosophical Hall after its 1890 renovation, which added a blind third floor with a clerestory to house the APS Library collections. Print Collection, graphics:9588. Courtesy of the American Philosophical Society.

state land office. When his firm went out of business, he took the civil service examination, and in 1897 he applied successfully for a binding job at the US Government Printing Office. He made his prior restoration experience known, and in 1899 he was assigned to the Division of Manuscripts in the Library of Congress on his birthday, at the age of 51. He directed manuscript preservation at the Library of Congress until he died unexpectedly at his bench in 1920.

In addition to his full-time work at the Library of Congress, Berwick took on vast quantities of contractual work for other employers, including the APS, the New York State Library, and the State Historical Society of Wisconsin. His correspondence with I. Minis Hays, the ophthalmologist and APS member who served as Society Librarian from 1897 to 1922, reveals that Berwick often dedicated evenings, weekends, holidays, and vacations to his private work, possibly (as Smith notes) because his pay from the Government Printing Office was so low.[1] Berwick's constant concern—still familiar to modern conservators—was maintaining a steady supply of high-quality materials for his work. Many of his letters to Hays focus on procuring silk crepeline, tracing cloth of the proper color and thickness, and antique papers to be used for fills and false margins. In one early letter to Hays, he wrote, "Often I come across more flyleaves in a book than

Fig. 4. The library on the third floor of Philosophical Hall in 1947, when many of the library's holdings had already been moved to the Drexel Building across the street. APS Archives, Negative no. 9. Courtesy of the American Philosophical Society.

are wanted & so remove them, if you have any old books that can be treated thus I shall be glad if you will attend to it for me" (Berwick, October 31, 1900). Hays apparently followed through on this request at least once, as Berwick notes in a letter dated August 2, 1904:

> The few sheets you took out of the vols when I saw you last are gems in their line & it seems to me to be a crime to allow such paper to remain on shelves, so any time you may have to spare may be put to good use by removing some more & letting me have them. It seems to me that making paper as they did in those days is a lost art.

One wonders which books in the APS collections had their endleaves or blank pages sacrificed for Berwick's labors!

Berwick began work on the society's manuscripts in May 1900 and continued until his death in 1920. He started with the William Penn manuscripts and went on to treat other important APS collections, including the papers of revolutionary Richard Henry Lee, the early laws and provincial council minutes of Pennsylvania, the military correspondence of George Weedon, and Jefferson's muddy, tattered, moldy "Indian vocabularies" of indigenous languages. The only printed work his letters refer to is a "Mercury newspaper," most likely Andrew Bradford's *American Weekly Mercury*, the first newspaper printed in the Mid-Atlantic states, which ran from 1719 to 1749. Berwick's most monumental task, which engaged him for 13 years, was conserving the Benjamin Franklin Papers, Mss.B.F85. This collection contained 13,284 items in 57 bound volumes (which expanded to roughly 114 volumes after Berwick's treatment), and the expert restorer was rightly proud when he had finished.

The manuscripts had all been previously bound, and Berwick's treatment began with disbinding and separating the leaves, a task made more challenging by the poor condition of the documents and the time-saving practices of earlier binders. At least in the cases of the Franklin and Greene papers, the binder or binders hired by the APS had sawn deeply into the spine edges of the letters, then oversewn them as groups of single sheets. This both damaged the writing and allowed glue to penetrate between the letters when the spine was lined and covered, as Berwick noted in his letters to Hays on October 31, 1900, and in August 1915, respectively:

> I have received the vol. of the Franklin papers & agree with you that they are in a very bad condition & will require time,

> very great care & patience to take apart. Letters that are bound in this way are always more difficult to take apart than a folded sheet for in this the glue only touches the outside of the fold, but in single sheets like those sent the glue finds its way in between each sheet & also onto the thread overcasting. I will however take great pains to preserve the mss.
>
> This Vol [5] of Greene letters is the worst bound Vol as yet, the binder ? has taken considerable pains to have deep saw marks & then let the glue run in, in many cases at least an inch making the task of taking it apart very difficult & then at the expense of many mutilated leaves.
>
> It is shameful the way these valuable documents have been treated. What surprises me is how your readers have managed to read the writing close to the back.

Berwick also pointed out that the former binders had often inserted leaves backward, with their fore edges bound into the gutter. He corrected these errors before returning the manuscripts. He was well aware that the treated documents were slated to be bound once more after their return to the APS, and was eager to prevent further errors and damage after his extensive labor. His letters to Hays often offer advice for having the books rebound, stored, and handled, particularly when oversize folded manuscripts or maps needed to be bound in.

Berwick's conservation work to prepare the manuscripts for rebinding included removal of surface dirt (apparently using both dry and aqueous methods), flattening creases and resizing paper, removing former mends and adhesives, adding new Western paper fills and false margins (fig. 5), and lining with paper and/or silk crepeline. The finished manuscripts were hinged to ledger paper with thin tracing cloth or bond paper. Berwick sometimes removed seals and replaced them in their original positions when the paper treatment was finished, and inserted shields to prevent thick seals from damaging adjacent leaves. Occasionally, he also split manuscripts through their thickness, particularly when oversize double-sided sheets would have to be folded prior to rebinding, which would interrupt the flow of the text. In many cases, Berwick described his methods when returning the letters or asked Hays for guidance when more than one solution to a treatment problem presented itself. He also returned the books' detached covers. Berwick does not appear to have used before- and after-treatment photography except for public relations purposes, and he did not provide the detailed written reports that today's conservation ethics require, so the specific materials and techniques he employed cannot be determined. His letters and the treated documents, however, reveal a conscientious, highly skilled practitioner who took great pains to preserve historic texts without damage to ink or paper.

Indeed, Berwick's mastery of silk gauze or crepeline to line and protect manuscripts appears to have been unequaled

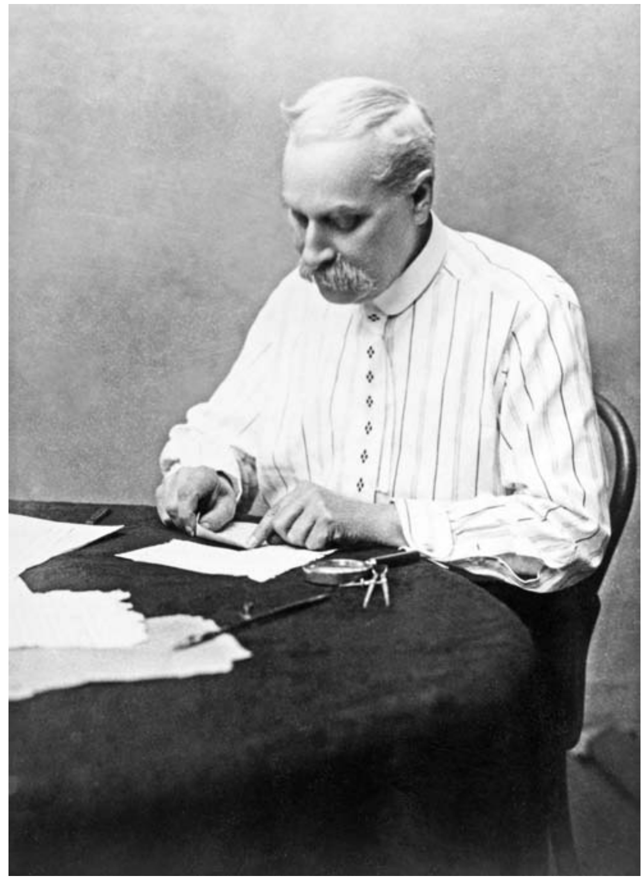
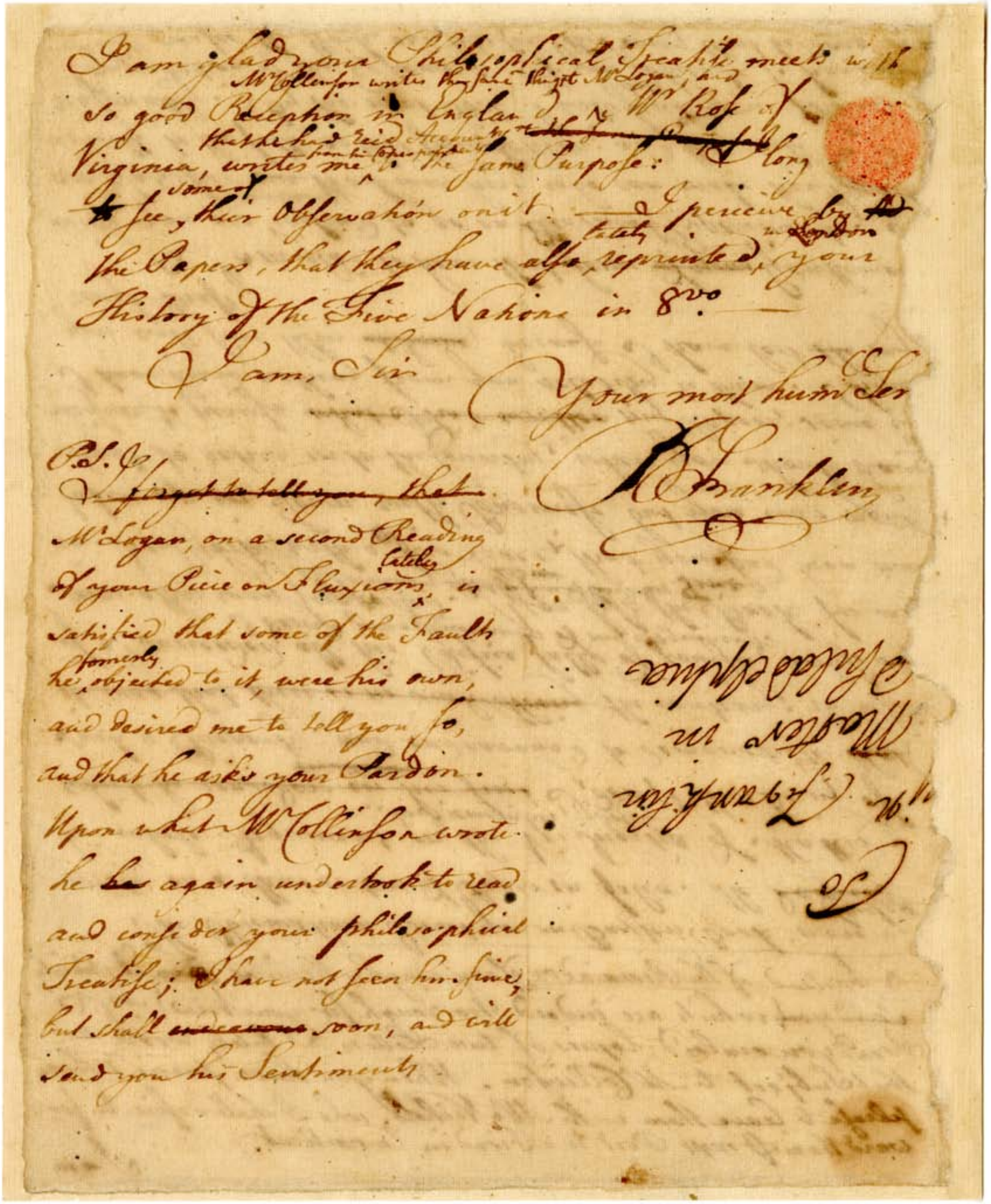


Fig. 5. William Berwick at work, ca. 1916. Courtesy of the William Berwick Family Collection.

in the United States. In her book, Smith describes the evolution of fine silk as a conservation material, concluding that it likely developed from the adhesive-coated silk netting known as court plaster, which was used both cosmetically and medically in the 18th and 19th centuries. Carlo Marrè, a restorer employed by the Vatican Library, perfected the use of silk crepeline on the manuscripts there, and his methods were publicized by Prefect Franz Ehrle in an 1898 article and conference on manuscripts and iron gall ink. Herbert Friedenwald, then superintendent of the Department of Manuscripts at the Library of Congress, wrote to Ehrle while establishing the library's first restoration program and apparently introduced the Vatican method of silking to his employees. On October 27, 1900, Berwick wrote to Hays:

> Crepeline is wonderful stuff for this work & the more I use of it the better I like it. It seems to me that Dr. H. Freidenwald [sic] (whose resignation I very much regret) should be given due credit for his unremitting search for the best material to repair mss. & was, I believe, the first to introduce it into this country & for which all lovers of ancient mss should be grateful.


I am glad your Philosophical Treatise meets with so good Reception in England. Mr Collinson writes the same thing; Mr Logan, and Mr Ross of Virginia, writes me to the same Purpose: long to see their Observations on it. — I perceive by the Papers, that they have also reprinted lately in London your History of the Five Nations in 8vo.

I am, Sir

Your most humble Servant

B Franklin

P.S. I forgot to tell you, that Mr Logan, on a second Reading of your Piece on Fluxions lately, is satisfied that some of the Faults he formerly objected to it, were his own, and desired me to tell you so, and that he asks your Pardon. Upon what Mr Collinson wrote he again undertook to read and consider your philosophical Treatise; I have not seen him since, but shall soon, and will send you his Sentiments.

Fig. 6. William Berwick filled the losses in this letter, provided it with handling margins, and laminated it with silk sometime between 1900 and 1913. Benjamin Franklin to Cadwallader Colden, 1747 August 6, Mss.B.F85. Courtesy of the American Philosophical Society.

Today, Berwick's silked documents at the APS remain flat, strong, undarkened, and highly legible (fig. 6). The paper handling margins and fills, which he shaped and beveled to fit each ragged edge or loss, continue to protect the original documents from harm while making each manuscript an aesthetic whole. Although the manuscripts were again disbound, unmounted, and placed into folders during the 20th century, they often retain their tracing-cloth hinges. Berwick's repairs continue to allow the documents to be read and handled by APS researchers more than 100 years after they were made. Further study of the manuscripts may reveal more about his treatment methods.

Following Berwick's unexpected death in 1920, APS Librarian I. Minis Hays made inquiries about hiring another paper restorer, but it is unclear whether he found anyone. Again, studying the Librarians' Correspondence records in the APS Archives may yield further information.

Carol Rugh (Carolyn Horton), Book and Paper Conservator, 1935–1939

In 1935, the APS Library hired its first in-house, part-time conservator, Carol Price Rugh, who became Carolyn Horton upon her remarriage. Although the latter name is now famous within the conservation community, the former will be used in this article when referencing work performed at the APS. According to Betsy Palmer Eldridge's overview of Horton's career and accomplishments, she studied bookbinding at the Women's Academy of Applied Art in Vienna from 1929 to 1930, then apprenticed with German binder and restorer Albert Oldach in Philadelphia for five years. At the APS, archival records show that she was paid $1 to $1.50 an hour to mend documents and repair books. With additional income from private binding and conservation work, Horton was able to support herself and her sister through the Great Depression. When she left the APS Library in 1939, Horton went on to become the first book conservator at Yale University, then a binder and conservator in private practice and an expert responder after the Florence Flood in 1966. She is now recognized as a pioneer of modern book and paper conservation (Eldridge 2002).

In her work for the APS from 1935 to 1939, Rugh worked in the library's recently acquired space in the Drexel Building, a towering bank headquarters built across the street from Philosophical Hall in the late 1880s (fig. 7). One of the benefits of moving the society's special collections to the Drexel Building in 1934 may have been the availability of fireproof vaults. In 1929, the published Minutes of the Meetings of the APS reflect a growing concern not only with the overcrowded conditions in Philosophical Hall but with the lack of protection from fire and theft:

> The Library Committee wishes to call the attention of the Society as a whole to the inadequate protection from fire or theft of its priceless collection of Manuscripts and Books and to urge that the Society take action at as early a date as possible, to provide more adequate protection for these treasures, the loss of which would be irreparable. (*Proceedings of the American Philosophical Society* 1929, xii)

Securing the library's collections evidently involved both locating a safer space for its materials and hiring a restorer to assess and repair them.

Rugh treated both manuscripts and printed materials, loose documents, and bound volumes. Her work appears to have been guided by Laura E. Hanson, the first APS Librarian to possess a library degree and the first who was not required to be an APS member.[2] To date, the author has only been able to review Rugh's treatment records from 1935, which she

Fig. 7. The APS Library as housed in the Drexel Building, from an undated photograph. Prints Collection, graphics:9594. Courtesy of the American Philosophical Society.

evidently shared with the APS Library Committee in a report in October of that year and later gave to Spawn to deposit in the APS Archives. Without access to further documentation, it is unclear how her work was selected. In her report, however, she notes, "As each piece of work was begun the value and probable use of the book was discussed with the librarian. The most elaborate restoring has been done only on priceless items" (Rugh 1935, 81).

Although Rugh's work began in May 1935 with treatment of specific treasures from the library's collection—including APS archival documents, copies of early American almanacs, and recently acquired letters from Franklin—by July she had embarked on a survey of the society's special collections to establish condition problems and treatment needs throughout the library, an approach more aligned with preventive conservation. Her survey included the Mason Collection (likely a book donation from William Smith Mason) and the book collections in the library's new fireproof rare book and manuscript vaults. Her resulting notes for the Library Committee broke down needed repairs into manuscript mending (simple and complex), books that needed regluing and recasing or rebacking, books that needed resewing and/or rebinding, and books whose vellum covers required special attention. She also distinguished detached or broken leather bindings from cloth or paper bindings in similar condition. Further research may reveal how her work was guided by her findings and through input from the APS Librarian and Library Committee.

Rugh relied on many of the materials and techniques that Berwick had used—including silk chiffon, tracing cloth, and carefully selected Western papers—but she also adopted new methods under development in the fledgling field of library conservation. Librarians were deeply concerned about the corrosion of iron gall ink by the end of the 19th century; in the early 20th century, they became equally concerned with the rapid deterioration of leather and modern papers. The British Museum established a formula for cleaning and dressing leather that well-meaning conservators—Rugh among them—applied religiously for decades. In June 1935, Rugh's treatment notes refer to 1818 books that were "washed, oiled & polished according to the British Museum formula & technique" and 568 labels that were "oiled and polished" (Rugh 1935, 11). She evidently considered leather dressing part of routine maintenance, as she wrote to the APS Committee on the Library in May 1941 (when her offer was rejected) and in February 1942, offering to oil the bindings again for six cents per volume.

In addition to dressing the society's leather bindings, Rugh performed a variety of more extensive book conservation treatments. Rugh's 1935 treatment notes for specific books (designated by their call numbers and often a short title) indicate that she rebacked decayed leather bindings with buckram or "new American chrome tanned calf" (Rugh 1935, 71), and rebacked damaged cloth or paper bindings with cloth, before mounting the original spines on top. She also soaked the original paper and leather coverings off damaged or rotten book boards and applied them to new boards. Rather than relying on uncertain supplies of antique Western paper, she often used modern Arches paper, both to make new pamphlet covers and to create false margins, which she tinted to match the hue of the original paper. She also used Korean paper for guarding, hinging, and mending. She often specified the use of "Japan vellum," or thick, translucent Japanese paper, for guarding and strip mending the edges of leaves. Although most of this information is gleaned from the treatment notebook she kept for reporting to the Library Committee, the abbreviated treatment records she pasted into the backs of books are also pithy but informative (fig. 8). They reinforce the surprising discovery that she performed certain leather repairs and rebacks with chrome-tanned leather—difficult to pare and tool but extremely durable—evidently in an effort to stave off leather decay.

Like modern conservators, Rugh often addressed the problem of oversize maps folded into books, likely with input from the APS Librarian. In her 1935 treatment of a 1613 German edition of Johann Theodor de Bry's "Small Voyages" with a modern binding, she removed all of the maps, cut them along their folds, and mounted them on cloth (other treatment notes specify "muslin") to prevent wear of the paper at the folds. Three of the maps were then resewn into the book, and the book was recased. The last map in the book, which served as a general reference for the whole work, was provided with its own case of black library buckram.

Rugh also treated damaged wax seals—a conservation challenge unique to manuscripts collections. In a summary detailing her restoration work from November 1, 1936, to

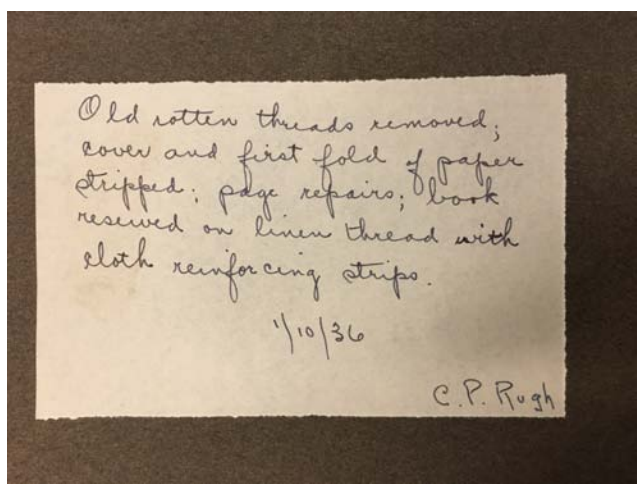


Fig. 8. Carol Rugh's treatment slip for William Poyntell's 1803 thermometrical journal, a pamphlet stitched into a folio of marbled paper. In this case, Rugh pasted her treatment slip into the wrapper she created for the journal. Mss.551.5.P86, American Philosophical Society.

April 30, 1937, she noted that "140 seals were pieced together and restored. Moulds of 34 of these were taken and are being cast in wax" (Rugh 1937, 1). One hopes that further research may determine which seals have been recreated and how the pieced-together seals were restored.

In many ways, Rugh had a modern conservator's sense of what was right: she provided thoughtful estimates, documented her work, and used the best materials available to her. Her October 1935 report to the Library Committee listed the materials she was likely to need for the work covered in her condition survey, budgeting $100 for leather, "buckram, end papers, Japan vellum, repair paper, blotting paper, wax paper, glue, vellum, etc." and $80 for chiffon, "if no rebacking is to be done" (Rugh 1935, 79). She valued her first 5.5 months of labor at $550 and her materials at $89.71 (equivalent to $10,350 and $1,690 in 2020). In explaining these costs, she wrote:

> Since labor is always by far the greatest expense in all such work, the entire effort has been to make the work as lasting as possible. A special effort has been made to use only the very best materials available, so that the work will not have to be done over in the years to come. All paper used has been imported hand-made all rag paper. Glue and paste have been of the best quality. All chemicals have been of U.S.P. [United States Pharmacopeia] quality.

In restoring, the aim has been honest workmanship with no attempt to conceal the fact that work has been done. (Rugh 1935, 81)

Helen A. Price, Book Conservator, 1942–1949

After Rugh's departure for Yale in 1939 and Hanson's retirement in 1941, the October 21, 1942, Committee on the Library Minutes address the desire for a new book restorer:

> The assistant librarian spoke of the need for the repair of old books which it is thought inadvisable to send to a commercial binder, and said that it is possible to secure the services of Mrs. Helen A. Price to do this work in our own building at the rate of $1.00 an hour, plus the cost of materials. Dr. Moore recommended Mrs. Price and said that she had done some work of a similar nature for the Academy of Natural Sciences. The Committee agreed that the work should be done, and voted an appropriation of $500 with which to start. (Committee on the Library Minutes 1942, 5)

This note is valuable both for its reference to the use of commercial binders and for its recognition that not all books should receive commercial or library bindings. The distinguishing factors for the books thought to need special treatment remain tantalizingly vague, given the preponderance of rebound books and manuscripts in the society's collections. Some of the library's earliest printed books, including William Cowley's 1758 *Illustration and Mensuration of Solid Geometry* and a copy of Benjamin Rush's 1794 *An Account of the Bilious Remitting Yellow Fever*, were evidently sent to a library binder during the 20th century, and any original bindings they may have had are now lost. The primacy of the text and a disregard for the material culture of historic bindings are clearly illustrated in this period of the society's history, although certain of the library's treasures—often its earliest manuscripts or printed books, or the remnants of Franklin's own library—received the attention of skilled conservators.

Following her mention in the Committee on the Library Minutes, Price was evidently hired part-time by new APS Librarian William E. Linglebach, a historian who led the APS Library until 1958. Price's typed or handwritten slips may be found on treated books scattered throughout the library's collection. According to Spawn, Price also worked as restorer for the Philadelphia Register of Wills and left him a supply of silk chiffon (badly gnawed by cockroaches) for conservation work (Baker 2004). Little more is now known about Price's training or previous experience, or about the specifics of her in-house treatment for the APS. It is hoped that further research in the APS Archives will reveal more about her identity and practices.

Willman Spawn, Book Conservator and Binding Historian, 1948–1985

Willman Spawn, who studied bookbinding in the Works Progress Administration bindery at the Smithsonian as a teenager and later trained with Berwick protege Augusta Hitchcock at the Massachusetts Historical Society, became the society's third part-time conservator in 1948 (Baker 2004). In his 2004 FAIC oral history interview, he told Julie Baker:

> The work that the APS had me do initially was basically silking of manuscripts and repair[ing of] manuscripts in the collection. It wasn't until after I came [full time?] that we did any binding work, and after that it was mainly repair on some of the rare books, some of the books from Franklin's library and such . . . I would say the first year I worked on nothing but Franklin items, and one or two Jefferson things. Later on, we got into some of the large maps and things that needed to be conserved. (Baker 2004, 2, 3)

When Spawn was first hired at 10 hours per week (Baker 2004), the APS Library was still housed in the Drexel Building, but Spawn soon assisted with two collections moves as 19th-century buildings made way for a re-envisioned Old City and today's Independence National Historic Park. In 1952, the Drexel Building was slated for demolition, and the APS moved quickly to draft plans for a new Library Hall on the same site. In keeping with the bicentennial fervor then sweeping the city, the hall's exterior would reproduce the 1790 Library Company building previously erected there. In the interim, Spawn helped transfer the APS collections to the United States Fidelity and Guaranty Company Building.

The old-on-the-outside, new-on-the-inside Library Hall was completed in 1959, and Spawn moved the collections once again in 1960. APS Librarian Richard H. Shryock described the new space in the *Proceedings of the American Philosophical Society* and included floor plans of the building, which featured stacks with room for growth, air conditioning, and a small "restoration laboratory" on the second floor. He wrote, "The air-conditioning will minister to the comfort of the staff and simultaneously to the more effective preservation of books and manuscripts" (Shryock 1960, 356). Shortly thereafter, he promoted Spawn to full-time conservator (fig. 9).

The author has not found any written or photographic documentation dating to Spawn's era, but given his concern with retaining the records of the conservators who went before him—including Berwick and Rugh—it seems unlikely that he did not keep treatment records himself. Further research in the APS Archives, which have not been processed since 1930, may reveal a treasure trove of conservation information. Books that Spawn allegedly bound or rebacked—he did not attach slips summarizing his treatment as Rugh and Price had done—reveal that he continued on the path his predecessors had established. He silked manuscripts using rice starch paste (Baker 2004), applied guards of bond paper, rebacked in leather, or provided new cloth or paper case bindings to replace earlier bindings that no longer served to protect their contents. His oral history reveals that he also split manuscripts to adhere a new paper core between the separated layers to strengthen them (Baker 2004). Fortunately for the society's collections, none of its conservators or contractors experimented with cellulose acetate lamination, which was extremely popular from the 1930s to the 1980s (Woodward 2017).

The Report of the Committee on Library for 1964 provides some insight into the society's preservation activities during Spawn's tenure. Over the course of the year, "in order to facilitate future use of the collections, some 1,200 volumes were bound, 140 rare books were restored, and 126 slipcases were made for rare books and pamphlets" (*Proceedings of the American Philosophical Society* 1965, 189). In his oral history, Spawn expressed frustration that books continued to be sent out for binding (either to commercial binders or trained artisans like Fritz and Trudi Eberhardt) without his input. Yet Spawn seems to have been held in high esteem within the organization, perhaps because of his demand as a teacher within the wider conservation community and because of his own academic prowess. The same report also states:

Fig. 9. Willman Spawn working in the Library Hall conservation laboratory in an undated photograph. APS Archives, graphics:9621. Courtesy of the American Philosophical Society.

> Mr. Spawn, Restorer of Manuscripts, spent several weeks during the Spring in giving instruction to trainees at the Toronto Public Library and the University of Toronto. During the summer, aided by a grant from the Society's Penrose Fund, he was on leave in order to continue research on eighteenth-century American bookbinders. He worked primarily at Boston, Worcester, Providence, and Newport. At the Newport Historical Society he arranged an exhibit and spoke on Francis Skinner, 1708–1785, a binder in that city for more than fifty years. (*Proceedings of the American Philosophical Society* 1965, 187)

As the report suggests, Spawn became a recognized authority on early American binders through studying their tool marks in extant leather bindings. The impressions of hand stamps or rolls on bindings known to be produced by specific individuals—such as Robert Aitken or Skinner—allowed Spawn to attribute previously anonymous bindings with the same tool marks to their historical binders. He urged other conservators and restorers to retain original bindings whenever possible so that their historical evidence would not be lost, and the reuse and retention of existing binding material is now a critical tenet of book conservation.

Many libraries across the country—including Case Western Reserve Library, Temple University Law Library, the Wilmington Public Library, and the Free Library of Philadelphia—also benefited from Spawn's expertise and generosity in responding to leaks and other water disasters. In his oral history, he described sandwiching wet documents between waxed paper and felts so they would dry rapidly, without developing mold. When time was of the essence, he experimented with refrigerating and vacuum freeze-drying wet library collections, a response that has since become a disaster-response standard (Baker 2004).

Spawn also taught staff at local institutions to make "the Spawn wrapper" or "Spawn box," a book housing he invented to prepare the APS Library for its many moves. The wrapper is quick to make and requires no adhesive, but its operation can be mysterious to the uninitiated. It is now found in many library collections throughout the Delaware Valley. According to Spawn's oral history, he was concerned about acid migration and advocated for the use of pH-neutral housings and book boards at the APS (Baker 2004). Shortly before his retirement in 1985, Spawn feverishly built thousands of his wrappers to protect the Library's nonrare printed books during their move to the former Farmers' and Mechanics' Bank Building at 427 Chestnut Street (later renamed Benjamin Franklin Hall).

After his retirement, Spawn served as Honorary Curator of Bookbindings at Bryn Mawr College and continued his research on bookbindings until his death in 2010. Bryn Mawr has since donated his papers to the society, where they currently await processing. One hopes that their contents may eventually contribute further details about 18th-century bindings and mid-century conservation practices to the literature on those subjects.

Fritz and Trudi Eberhardt, Bookbinders and Restorers, 1960s–1970s

Although Spawn preferred to retain original bindings, he could not do all of the book repair required by a growing special collections library. As it had in the past, the APS continued to send many of its damaged books out for repair and rebinding through the late 20th century. In 1965, the APS Committee on Library discussed sending the books in Franklin's library to Harold W. Tribolet of R. R. Donnelley and Sons, Chicago, or to Joseph Ruzicka of Baltimore (*Proceedings of the American Philosophical Society* 1965). It is unclear whether the committee's recommendations were pursued, but many rare books were certainly sent out for repair and returned without their original bindings. Hedi Kyle's 1993 review of conservation practices at the society lists surviving commercial binding records for "MacDonald in New York, Storm in Arizona, and Wessely in England" and notes that "the practice of sending serials out to library binderies continues and results in approximately 400 hardbound volumes per year" (Kyle 1993, 1).

In the 1960s and 1970s, two of the society's contract binders were Fritz and Trudi Eberhardt. The couple apprenticed as bookbinders in their native Germany, and Fritz also attended the Academy for Graphic Arts in Leipzig and the Offenbach School of Fine Arts for binding and calligraphy, becoming a master binder. After World War II, Fritz escaped Soviet Eastern Europe on foot, despite one leg that had been lamed by childhood polio. He later met Trudi, and the two married in Sweden, eventually emigrating to Philadelphia in 1954. Their characteristic leather bindings—with rounded spines, crisp raised bands, gold-tooled titles, and flattened endcaps—can be found at the APS and in many other local institutions.

These bindings offended Spawn's sensibilities when applied to early American books, but he apparently had no say in whether or which rare books were sent out for repair. In his oral history, he complained (likely of Fritz Eberhardt),

> that he had restored a book in a good Scottish binding of Robert Aitken's that had been perfectly [planned] and efficiently done in 1779 in Philadelphia by Robert Aitken, and it looked like a German binding with gold tooling. It was so inappropriate that it really bothered me, and it made me realize that any binding that I saw in the APS collection, that the only way I could protect it was to make a very nice box for it and keep it out of sight. Because if the book was preserved in a box, it wouldn't be sent out for restoration. I am grateful for the books that I saved in the collection by putting [them] in a case. (Baker 2004, 9–10)

Although the Eberhardts are primarily remembered as contract binders, they evidently performed a fair amount of book restoration as well. In a 1993 oral history, Fritz recalled their early days in Philadelphia, repairing and binding pamphlets for Edwin Wolf II, Library Company Librarian:

> We had—our workload doing pamphlets, the rebinding, maltreated and raped pamphlets, abused pamphlets [that we put] into their own little hard cover with a title on. Washing them, cleaning them, mending them and all that. And they went, at the beginning, for $3.00 a piece, finished . . . We took them in lots of one hundred. (Metzler 2002, 51)

In the same interview, Trudi reported, "There was a lot of paper repair in the beginning. That's very technical work" (Metzler 2002, 52). The Eberhardts had not been trained in restoration when they emigrated, but they found that American clients were far more willing to pay a living wage for the restoration of historical documents than for well-made new bindings. Trudi stated:

> We, of course, both learned bookbinding and not restoration because that wasn't done at that time. And when we came to this country, there was more and more need for it. For restoration. And so a lot of things we figured out for ourselves but then we figured out we should go back to Germany sometime and see what they're doing. Because . . . [after] the World War, there were lots of libraries who needed restoration. (Metzler 2002, 73)

In 1972, the couple returned to Munich, Göttingen, and Wolfenbüttal, and, according to Trudi, "visited several different institutions that had restoration workshops. And they were very accommodating. They showed us everything we wanted to see and we learned . . . quite a lot there" (Metzler 2002, 73).

By the time the Eberhardts studied restoration in Germany, they had been living and working in rural Harleysville, Pennsylvania, for a decade. The majority of the Eberhardts' work for the APS likely occurred during this period. As Trudi said:

> At the time, we mostly worked for the rare book collection of universities. And they didn't just come from around here. We worked for Wyoming, for the University of Connecticut, then Arizona for a while, Rice University. And so on and so forth. They came from all over. So it was very good that we could just stay at home, do the work, pack it up, and send it out. (Metzler 2002, 81)

The Eberhardts also trained binders who were serious about learning traditional hand skills, including Don Rash, who studied with them for several years (Metzler 2002). Rash later taught the author to bind books following the Eberhardt model, albeit over a far shorter time span. Thus, in a roundabout way, the Eberhardts' work continues to influence the collections at the APS. Further research in the APS Archives may reveal the extent of their original contributions to the APS Library.

Hedi Kyle, Book Artist and Conservator, 1986–2003

Hedi Kyle became head of conservation at the APS after Spawn's retirement (fig. 10). Like the Eberhardts, she had trained as an artist in Germany before immigrating to the United States in the early 1960s. In the 1970s, she studied with bookbinder and early book conservator Laura Young in New York, and from 1979 to 1985 she served as head conservator at the New York Botanical Garden. Shortly after she was hired at the APS in 1986, she renovated and enlarged the conservation laboratory in Library Hall. She also created the first APS Library Disaster Plan with conservator Gail Harriman.

Kyle's 1993 overview of conservation changes at the APS suggests that the lion's share of her work involved rehousing the collections, and she often taught workshops on the construction of boxes, wrappers, and folders. The book housings produced by herself and her trainees were always thoughtfully constructed and sometimes gorgeously decorated, incorporating bright bookcloth, paste papers, or dyed Tyvek. In addition to rehousing books, Kyle and her assistants performed full treatments on flat paper and bound documents, including aqueous washing and sun bleaching. For two decades, Kyle also mentored graduate book arts students at the University of the Arts, many of whom—notably Denise Carbone—later served as interns or staff in the APS conservation laboratory. Kyle's most enduring legacies since her retirement in 2003 have been as a book artist and teacher. Her iconic book designs continue to draw inspiration from historic bindings and her conservation experience.

Kyle and her staff certainly kept records of their work during treatment, for they routinely reported the total number of items and pages treated to the APS Library Committee. These reports rarely include the details of what treatment involved, however, and the surviving documentation is scarce. The conservators and interns may have retained their own records rather than placing them in a physical or digital archive at the library, although some handwritten and digital records have been found. Rough treatment notes occasionally accompany partially treated materials, and they range from interns' handwritten notes and diagrams to a variety of preprinted condition and treatment forms. The detailed checklist book treatment form used in the 2000s provided spaces for recording binding and sewing structures, condition problems, and repair methods and materials. Full written and photographic documentation does not appear to have been the norm for even the most complex book treatments, and final treatment reports were not routinely included with repaired library books. Those that have been found range from full printed reports with photographs to handwritten

Fig. 10. Hedi Kyle assists a student with a folded paper structure in an undated photograph. APS Archives, graphics:9785. Courtesy of the American Philosophical Society.

slips. It is hoped that further research in the APS Archives will uncover more information about the book treatments undertaken during this period.

CONSERVATION AT THE APS LIBRARY AND MUSEUM TODAY

Today, the APS employs three conservators with master's degrees in art conservation: Anne Downey, Anisha Gupta, and the author. Their specialized graduate education and training allow them to apply more knowledge of materials science, chemical principles, and recent developments in library conservation to the treatment work than has likely been employed at the APS in the past. Downey, head of conservation, has a degree in paper conservation from Buffalo State. Gupta and the author both graduated from the Winterthur-University of Delaware program, specializing in paper and photograph conservation and in book conservation, respectively.

Shortly after Downey joined the APS in 2003, she oversaw the design of a new, larger conservation laboratory in Franklin Hall, with bench space for four workers. Although it has the disadvantage of being separated from the rare book and manuscript collections by a busy city street, it provides space for treatments that could not be accommodated within Library Hall. The laboratory contains a wet treatment area, a humidity cabinet, mobile drying racks, a fume hood, chemical storage, and a separate room for UV examination and mold remediation. Last year, part of the space was revamped to include a tethered-capture digital photography system, which has made photographic documentation far more efficient.

Documentation is now far more standardized than ever before. New file-naming and organizational protocols ensure that today's treatment records will remain accessible to future conservators. All treatments are logged by call number, title, and date, with—at minimum—brief statements of initial condition and the treatment performed. Any treatments that go beyond minor, routine repairs also require full written and photographic documentation. Any hard-copy treatment records are scanned to PDF and retained. The contents of treatment records are also entered into Mimsy XG, a collections-management database that the library shares with the museum. Gradually legacy conservation records will be entered as well.

Hands-on rehousing and repair of collections material remain a high priority for the APS Library and Museum, with 40–60% of each conservator's time spent at the bench. Conservators continue to create specialized enclosures for unusual library collections; however, their focus is now on item-level conservation treatment and preventive care. The society orders most of its custom book boxes from one of the many vendors with programmable board-cutting machines. Two fantastic volunteers handle the measurement and housing of new accessions. Almost every year, the APS conservation laboratory also accepts either a conservation graduate student or a preprogram candidate into the paid Willman Spawn Conservation Internship, with a focus on treatment and overall collections care.

GENERATIONS OF RE-TREATMENT AT THE APS LIBRARY AND MUSEUM

Given the long history of the APS, it is not unusual for today's conservators to confront books, manuscripts, and other documents that have been treated before. Their need for treatment may stem from exhibition, researcher or staff use, or special significance to donors. The library recently established an "adopt-a-book" program, for example, that has sponsored conservation treatment for several decrepit volumes, some with great historic value and some that are interesting purely for their structure. (The author's enthusiastic description of a mold-eaten English scaleboard binding has borne fruit.) The two biggest drivers for re-treatment, however, are exhibition and regular use.

In 2019, the APS Library and APS Museum (one entity until their collections were separated in 2000) were reintegrated to form the APS Library and Museum. Even before reintegration, the society served not only reading room researchers but the museum-going public, and the conservators' more interventive treatments have often stemmed from exhibit preparation. Until the current pandemic disrupted normal operations, the APS Museum mounted an exhibition in Philosophical Hall each year, generally from April 15 to December 31. Although the museum exhibitions typically include three-dimensional objects and paintings, as well as printed books and archival documents, APS Library holdings predominate. At the start of each exhibition cycle, the conservators assess the physical and chemical stability of library materials proposed for exhibition and treat them when necessary, even when that means undoing a previous conservator's work.

Use in the library—whether by visiting researchers or APS staff—is another factor that drives conservation treatment of books and manuscripts. Items that require stabilization for safe handling range widely, from overstuffed scrapbooks assembled with pressure-sensitive tape to oversize folded maps. Some of the most frequently handled objects are the most iconic books and documents in the library's possession, which see constant use on tours for donors and other library visitors. In many cases, these "treasures" have received repeated conservation interventions over their long history with the library. Treatment for the bound volumes among these treasures—books that once belonged to figures like Franklin and Peale—often goes beyond stabilization and into restoration. Today's librarians often desire such books to look intact and "well cared for," leading to the repair of minor visible damage that does not affect the book's function. Informed discussion about the pros and cons of such an approach is a necessary part of establishing a treatment plan.

The following case studies describe treatments carried out in the past two decades on library materials that had been treated at least once before. Their former restorers and conservators include Berwick, Rugh, Spawn, and Carbone. In each case, these men and women were doing the best they could with the information, skills, and materials they possessed. In some cases, these methods and materials did not age well and were removed because they were causing physical or chemical damage. In other cases, former treatments introduced errors such as mispagination, or caused discoloration and staining in paper. In still others, the former repairs had nothing to do with the reasons for re-treatment, and their retention or removal was merely a by-product of treatment designed to address a completely separate condition issue.

David Rittenhouse, Diaries, 1784–1785 and 1792–1805, Mss.B.R51d

In addition to serving as one of the earliest APS Librarians, David Rittenhouse was a Philadelphia instrument maker, astronomer, and surveyor, as well as treasurer of Pennsylvania and the first director of the US Mint. A self-taught mathematical genius, Rittenhouse built clocks, orreries, and telescopes; observed the 1769 transit of Venus across the sun from his own private observatory; and assisted with the 1784–1785 survey extending the Mason-Dixon line to the southwest corner of Pennsylvania.

The APS holds two of Rittenhouse's diaries. The first covers the period from 1784 to 1785, and includes both meteorological observations and notes from his surveying trip in western Pennsylvania. The second contains meteorological observations from 1792 to 1805; these were carried on by family members for nine years after Rittenhouse's death. Recently, it was discovered that the two diaries display the work of three generations of book conservators at the APS. Both volumes were displayed open in the APS Museum's 2007 *Undaunted* exhibition, which seems to have been the catalyst for their most recent treatment.

The later and larger of the two books retains its original binding, but with substantial alterations (fig. 11). Rugh mended the book block in 1936. She also consolidated the leather, sewed new endbands, and rebacked the book with chrome-tanned calf. In 2007, Carbone treated the book again, mending additional edge tears, reinforcing the leather edges, and setting down the lifting front label. Both conservators documented their work with handwritten slips and minimal information about the materials used (fig. 12).

The original binding of the first diary was allegedly rebacked by Spawn in the 1950s (fig. 13). Carbone removed this binding

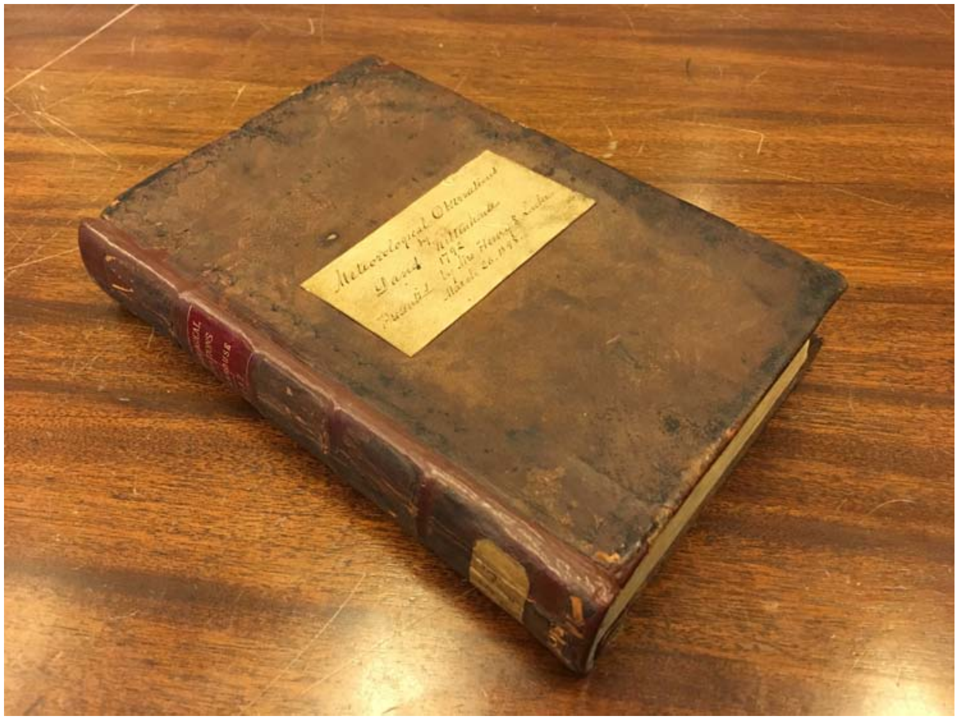


Fig. 11. David Rittenhouse diary, 1792–1805, Mss.B.R51d vol. 2., American Philosophical Society. Carol Rugh rebacked this volume in chrome-tanned calf in 1936. Denise Carbone performed additional mending in 2007.

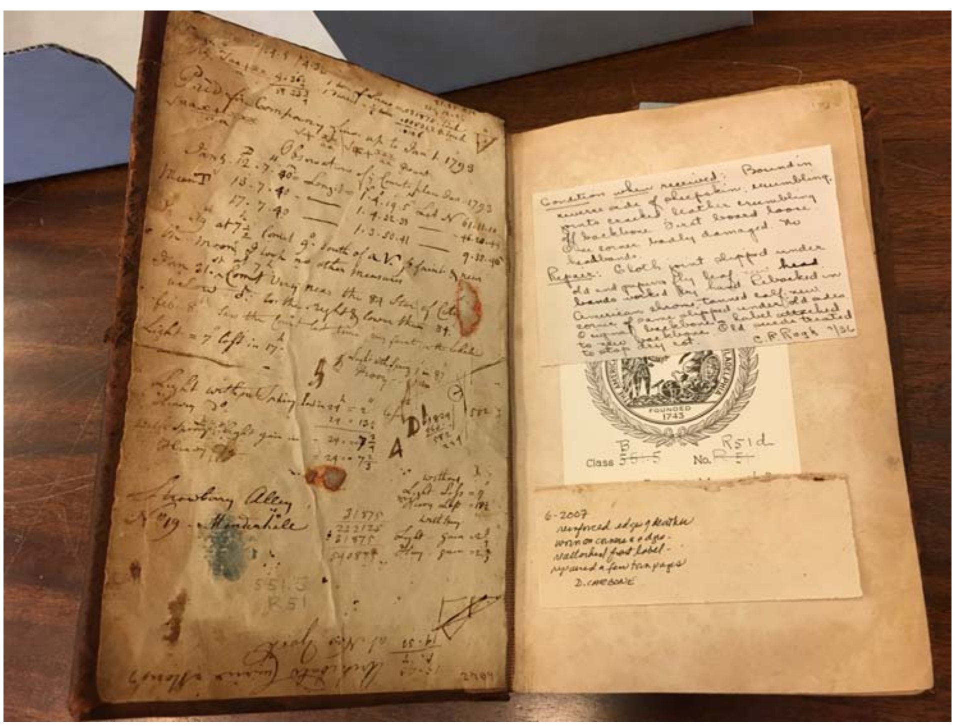


Fig. 12. David Rittenhouse diary, 1792–1805, Mss.B.R51d vol. 2., American Philosophical Society. Carol Rugh's and Denise Carbone's pithy handwritten treatment slips (from July 1936 and June 2007, respectively) are adhered to the front flyleaf of the volume.

Fig. 13. David Rittenhouse diary, 1784–1785, Mss.B.R51d vol. 1, American Philosophical Society. Willman Spawn allegedly rebacked the original binding for this volume in the 1950s.

in 2007, perhaps because it opened poorly. Condition notes from the museum's item list say that the binding was "bad," with leaves "cracking and falling out." After exhibition, the binding was not reattached, but it was retained and provided with an interior support of corrugated alkaline paperboard. The handwritten slip left with this support does not provide any context for the treatment beyond the date and Spawn's prior involvement with the binding (fig. 14).

The first diary is now sewn into a contemporary variant of the laced-case binding executed in heavy brown paper (fig. 15). Nonadhesive paper bindings like these were frequently employed during Kyle's and Carbone's tenures at the society, and they provide incontrovertible visual evidence that the object has been treated. They also generally open very flat, which would have been helpful during exhibition. Although the current conservation staff would likely pursue a different approach to treating this diary, reusing as much original material as possible, the laced-case binding is not causing harm and is not scheduled for replacement. The question may be revisited in the future if returning the book to its original context becomes a priority.

Vocabulary of the Delaware Indians, Mss.497.V85 no.17

Thomas Jefferson, who served as president of both the United States and the APS, was convinced that a comparative study of American indigenous languages would reveal their common roots and suggest how recently each tribe had diverged from a common, ancestral tongue. To support his theory, he collected lists of Native vocabulary words. Around 1791, he had large vocabulary forms printed with English words, and asked friends and military officers across the young United States to fill in the forms with the words' indigenous equivalents. Each

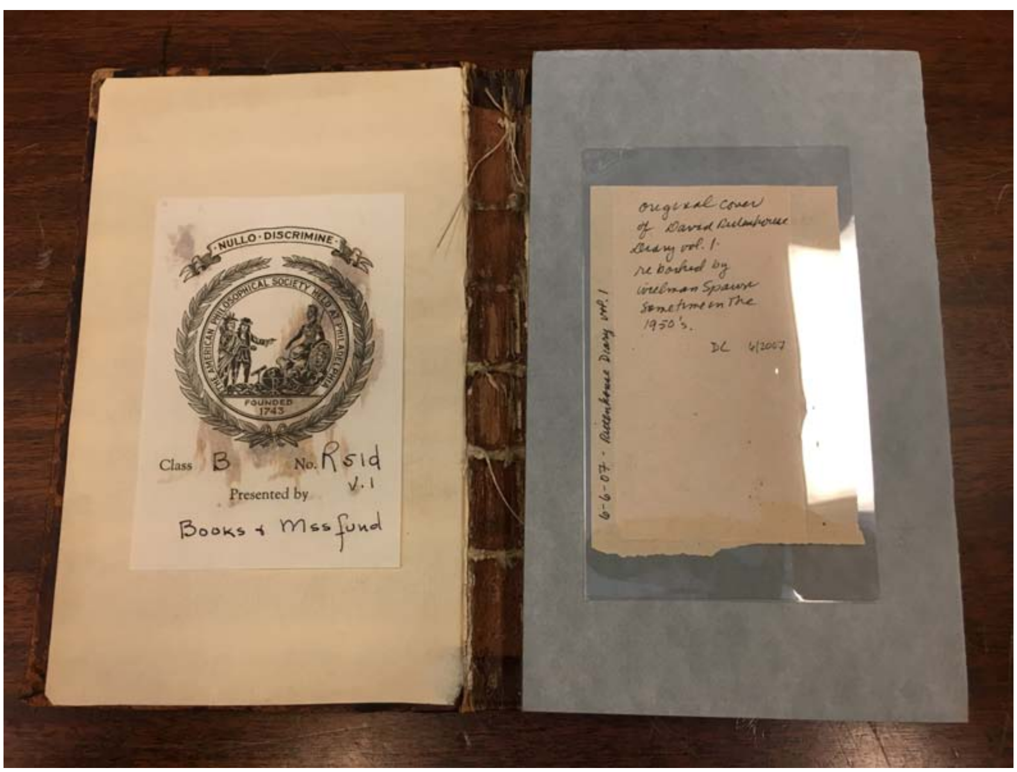


Fig. 14. David Rittenhouse diary, 1784–1785, Mss.B.R51d vol. 1, American Philosophical Society. Denise Carbone removed the volume's rebacked original binding in 2007, probably because it opened too poorly for exhibition, and provided it with an internal support of alkaline corrugated board.

Fig. 15. David Rittenhouse diary, 1784–1785, Mss.B.R51d vol. 1, American Philosophical Society. Denise Carbone rebound the volume in a contemporary paper variation of the laced-case structure. The unlined spine allows for unrestricted opening.

large printed sheet contained about 280 English words on each side, beginning with "fire," "water," "air," and "earth," and moving on to days and seasons, the weather, body parts, types of people, and different birds and animals.

Jefferson had collected hundreds of these vocabulary sheets by the time he left office as President of the United States in 1809, and he had also created lists comparing the words from different languages to one another. He packed the one-of-a-kind manuscripts in a trunk for shipment to Monticello, but en route, thieves mistook the trunk for a different sort of treasure and rifled its contents. Disappointed to find only documents, they flung the comparative vocabulary lists into the James River. The few surviving sheets, gathered by the APS Historical and Literary Committee in 1816 for publication, remained stained by mud and mold. Many of them were in tatters (fig. 16). Given their historical importance and lamentable condition, APS Librarian I. Minis Hays shipped them to Berwick for restoration in late 1913, after he had finished work on the Benjamin Franklin Papers. Berwick also treated the few surviving printed vocabulary forms.

The printed vocabulary lists were quite large, roughly 19.5 × 13.5 in., with identical printed matter on both sides of each sheet. Generally only one side of each sheet was filled out, typically in iron gall ink, leaving a blank form on the other. Berwick treated three completed vocabulary forms, for the Delaware, Miami, and Nanticoke tribes. Prior to his involvement, the sheets appear to have been folded vertically down the center and stitched through the fold. In 1913, however, the society's intention seems to have been to bind the miscellaneous contents of the American Indian Vocabularies Collection (now Mss.497.V85) into one book, incorporating both the small and oversize manuscripts. Berwick addressed this challenge in his October 24, 1913, letter to Hays:

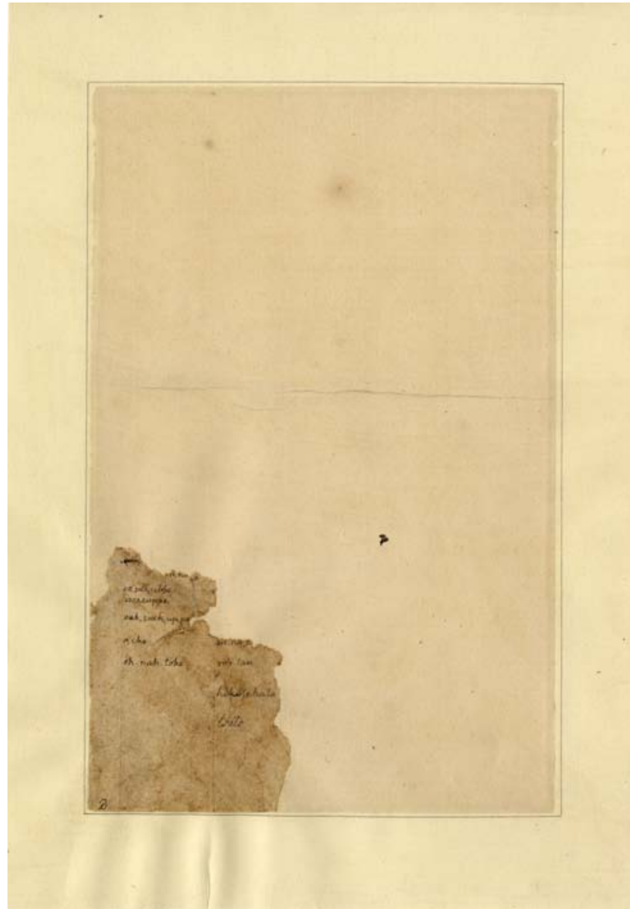


Fig. 16. This fragment is from one of the many sheets on which Thomas Jefferson compared the Native words collected from his vocabulary forms. The comparative vocabularies suffered extremely when thieves threw them into the James River. According to his letter to I. Minis Hays on January 24, 1914, William Berwick split this fragment to avoid covering any of Jefferson's handwriting with fills. The split halves were then mounted on blank paper the size of the original document, provided with a frame, and silked. Thomas Jefferson, Comparative vocabularies of several Indian languages, 1802–1808, Mss.497.J35. Courtesy of the American Philosophical Society.

> I have examined the Miami & Delaware language sheets. It seems a pity to take them out of the rest of the collection & bind them on larger sheets. It would not do to mount them as in Dummy A inclosed [sic]—but would there be any objection to mounting them like Dummy B? The fold would be at the front instead of the back of the ledger paper but the reading matter would not be interfered with as in Dummy A in which the fold would break the reading matter in half on the back side.

Although the "dummies" Berwick refers to have disappeared, it can be inferred that both mock-ups featured a vocabulary list cut in half horizontally and mounted within false margins of ledger paper. In each case, the mounted list was rotated 90° and folded to create a folio. In Dummy A, the fold (with the new cut edges of the manuscript adjacent to it) was bound into the gutter or "back" of the book. In Dummy B, the fold was placed at the fore edge of the book rather than in the gutter. Opening the fore-edge fold in option B would allow the list to be read in its entirety on both the front and the back, which would be impossible with option A.

Hays's feedback to Berwick's question is unknown, but Berwick apparently decided that even option B was too unwieldy for long-term preservation of the vocabulary lists. He worked on the vocabularies during his 1913 Christmas and New Year's holidays, and shipped the completed documents to Hays by American Express on January 5, 1914. In his accompanying letter, Berwick wrote:

> The fault in doing the large vocabularies like the dummy I sent you was that to leave the writing intact it was necessary to hinge them at the end, & in turning over these large sheets the danger of tearing them would be great. The only way to avoid this & at the same time to make them handier to read was to split the paper, when of course the inner side of the (now) two sheets would be blank. This has been done. Each sheet was then lined & crepelined as usual . . . Splitting paper which can easily be replaced if spoiled is comparatively easy but with an old document only one of its kind & covered with writing is rather more hazardous, but I had no doubt of the result of the operation, although quite tedious.

Berwick did not reveal his technique for splitting the paper, but his treatment portfolio—which he kept for marketing rather than documentation purposes—includes several samples of split paper documents (figs. 17a, 17b). Examining the samples, which have not yet been processed, may reveal some of the details of his treatment process. According to Brückle and Dambrogio (2000), paper splitting historically involved facing both sides of the paper with a viscous adhesive and overhanging support sheets, then peeling the halves apart while the center of the paper remained damp. The separated halves might be lined separately, as in Berwick's treatment of the printed vocabulary sheets, or rejoined over a strengthening core paper (see fig. 16). Today, manual paper splitting often employs thick gelatin to attach the facing papers and a starch-based adhesive or cellulose derivative to secure any core paper. The facing papers can be removed with warm water, which will not dissolve the inner adhesive layer.

Berwick apparently cut the sheets for the Delaware and Nanticoke Indians in half horizontally along a previous fold. He then split the halves, lined the resulting thinner sheets with ledger paper, and silked them. The two halves of each sheet were then provided with a cloth hinge for binding in the format he had originally suggested for Dummy A, with the hinge in the gutter of the book (figs. 18a, 18b). The blank form from the back of the Delaware vocabulary was mounted in the same way (fig. 19). The split Miami vocabulary sheet

Fig. 17. William Berwick's treatment portfolio, which his descendants donated to the APS in 2006, includes these samples of split music sheets. (a) The sheet has been split in preparation for further repair, and Berwick has signed one of the split sheets on its interior surface. (b) The halves of a similar sheet have been laminated to either side of a new paper core. Berwick's signature on the interior can be seen in transmitted light. Unprocessed William Berwick Family Collection. Courtesy of the American Philosophical Society.

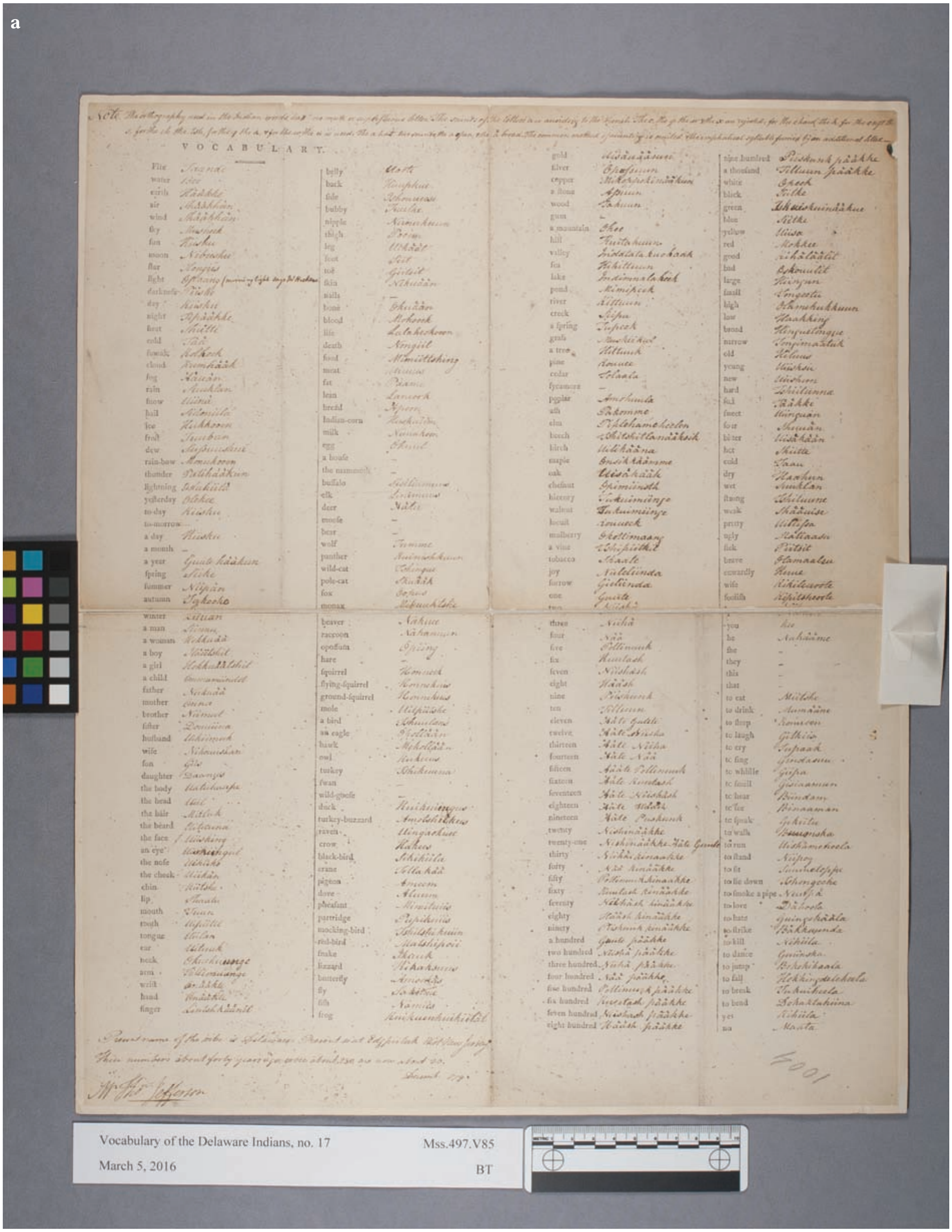


Fig. 18. Vocabulary of the Delaware Indians (a) and Vocabulary of the Nanticoke Indians (b) before treatment in 2015–2016. William Berwick split, mounted, and silked the top and bottom halves of these vocabulary forms. The two halves were then hinged together with linen tape or tracing cloth for sewing. Mss.497.V85, American Philosophical Society Historical and Literary Committee, American Indian Vocabulary Collection. Courtesy of Anne Downey.

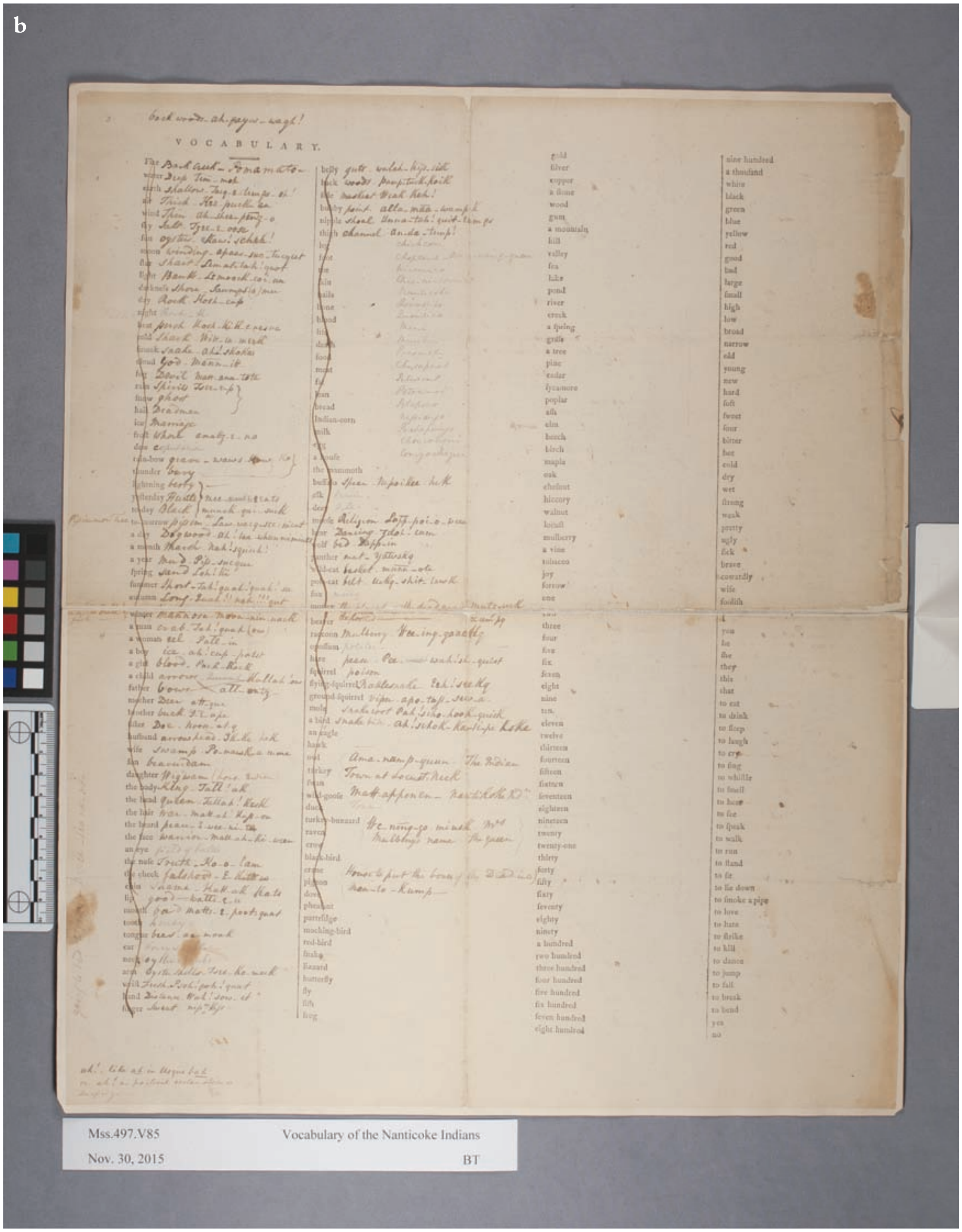
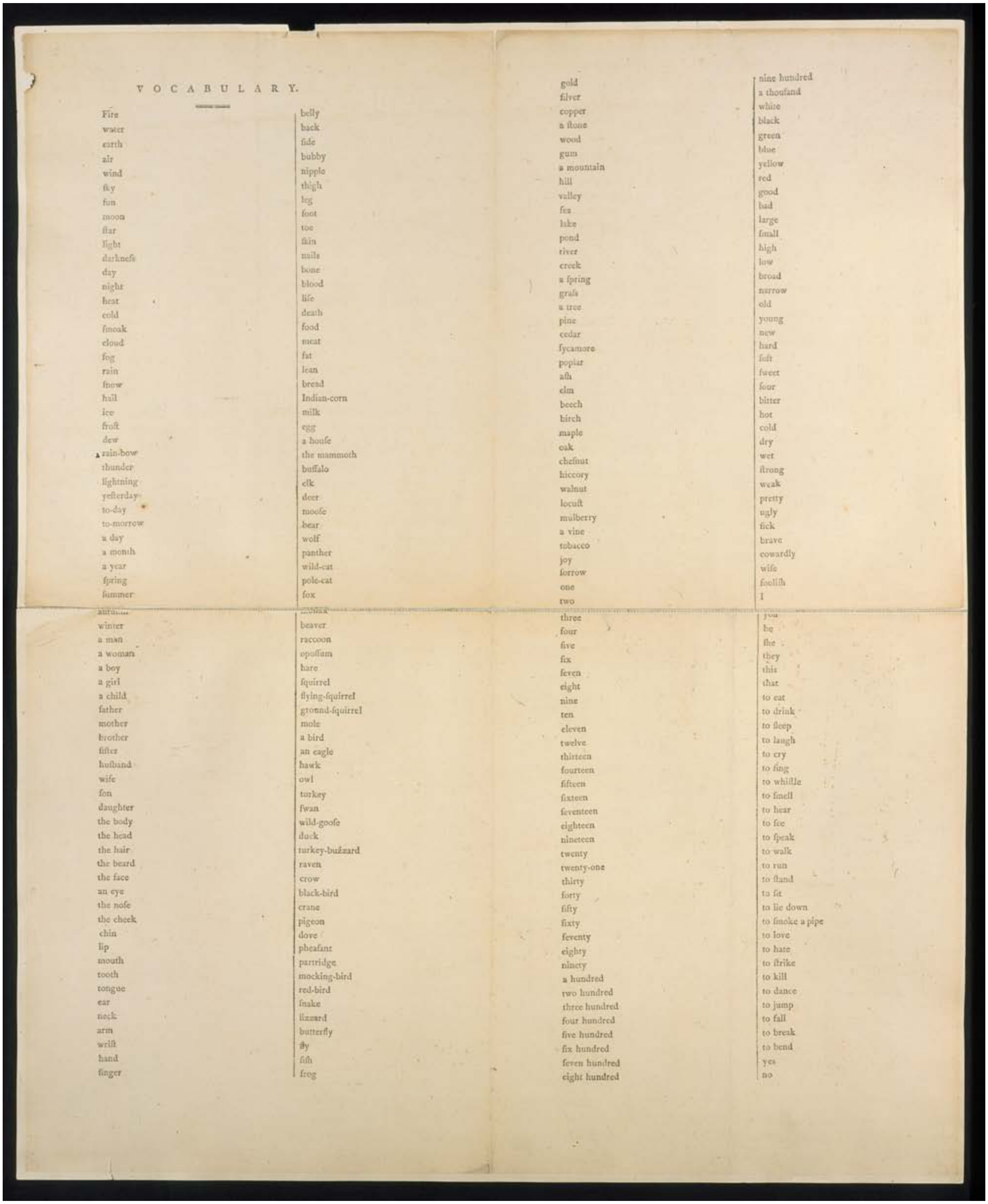


Fig. 18. (Continued)

was mounted on four pieces of ledger paper rather than two, perhaps because it had already split along its central vertical fold. Berwick provided each of the four quarters of the sheet with an additional false margin of antique paper along its horizontal cut edge, apparently to match the leaf size of the rest of the volume more closely (fig. 20). The mounted quarters were likely sewn into the book through hinges attached to their left edges, which have since been removed. It is not clear whether the blank backs of the Miami and Nanticoke vocabularies were retained.

None of this history had been discovered when the Delaware vocabulary form (see fig. 18a) was treated prior



VOCABULARY.

Fire
water
earth
air
wind
ſky
ſun
moon
ſtar
light
darkneſs
day
night
heat
cold
ſmoak
cloud
fog
rain
ſnow
hail
ice
froſt
dew
rain-bow
thunder
lightning
yeſterday
to-day
to-morrow
a day
a month
a year
ſpring
ſummer
autumn
winter
a man
a woman
a boy
a girl
a child
father
mother
brother
ſiſter
huſband
wife
ſon
daughter
the body
the head
the hair
the beard
the face
an eye
the noſe
the cheek
chin
lip
mouth
tooth
tongue
ear
neck
arm
wriſt
hand
finger

belly
back
ſide
bubby
nipple
thigh
leg
foot
toe
ſkin
nails
bone
blood
life
death
food
meat
fat
lean
bread
Indian-corn
milk
egg
a houſe
the mammoth
buffalo
elk
deer
mooſe
bear
wolf
panther
wild-cat
pole-cat
fox
[illegible]
beaver
raccoon
opoſſum
hare
ſquirrel
flying-ſquirrel
ground-ſquirrel
mole
a bird
an eagle
hawk
owl
turkey
ſwan
wild-gooſe
duck
turkey-buzzard
raven
crow
black-bird
crane
pigeon
dove
pheaſant
partridge
mocking-bird
red-bird
ſnake
lizzard
butterfly
fly
fiſh
frog

gold
ſilver
copper
a ſtone
wood
gum
a mountain
hill
valley
ſea
lake
pond
river
creek
a ſpring
graſs
a tree
pine
cedar
ſycamore
poplar
aſh
elm
beech
birch
maple
oak
cheſnut
hiccory
walnut
locuſt
mulberry
a vine
tobacco
joy
ſorrow
one
two
three
four
five
ſix
ſeven
eight
nine
ten
eleven
twelve
thirteen
fourteen
fifteen
ſixteen
ſeventeen
eighteen
nineteen
twenty
twenty-one
thirty
forty
fifty
ſixty
ſeventy
eighty
ninety
a hundred
two hundred
three hundred
four hundred
five hundred
ſix hundred
ſeven hundred
eight hundred

nine hundred
a thouſand
white
black
green
blue
yellow
red
good
bad
large
ſmall
high
low
broad
narrow
old
young
new
hard
ſoft
ſweet
ſour
bitter
hot
cold
dry
wet
ſtrong
weak
pretty
ugly
ſick
brave
cowardly
wife
fooliſh
I
you
he
ſhe
they
this
that
to eat
to drink
to ſleep
to laugh
to cry
to ſing
to whiſtle
to ſmell
to hear
to ſee
to ſpeak
to walk
to run
to ſtand
to ſit
to lie down
to ſmoke a pipe
to love
to hate
to ſtrike
to kill
to dance
to jump
to fall
to break
to bend
yes
no

Fig. 19. William Berwick split this blank vocabulary form from the filled-in vocabulary for the Delaware Indians, as revealed by the corroded inkblot common to both (see fig. 18a). Mss.497.V85, American Philosophical Society Historical and Literary Committee, American Indian Vocabulary Collection. Courtesy of the American Philosophical Society.

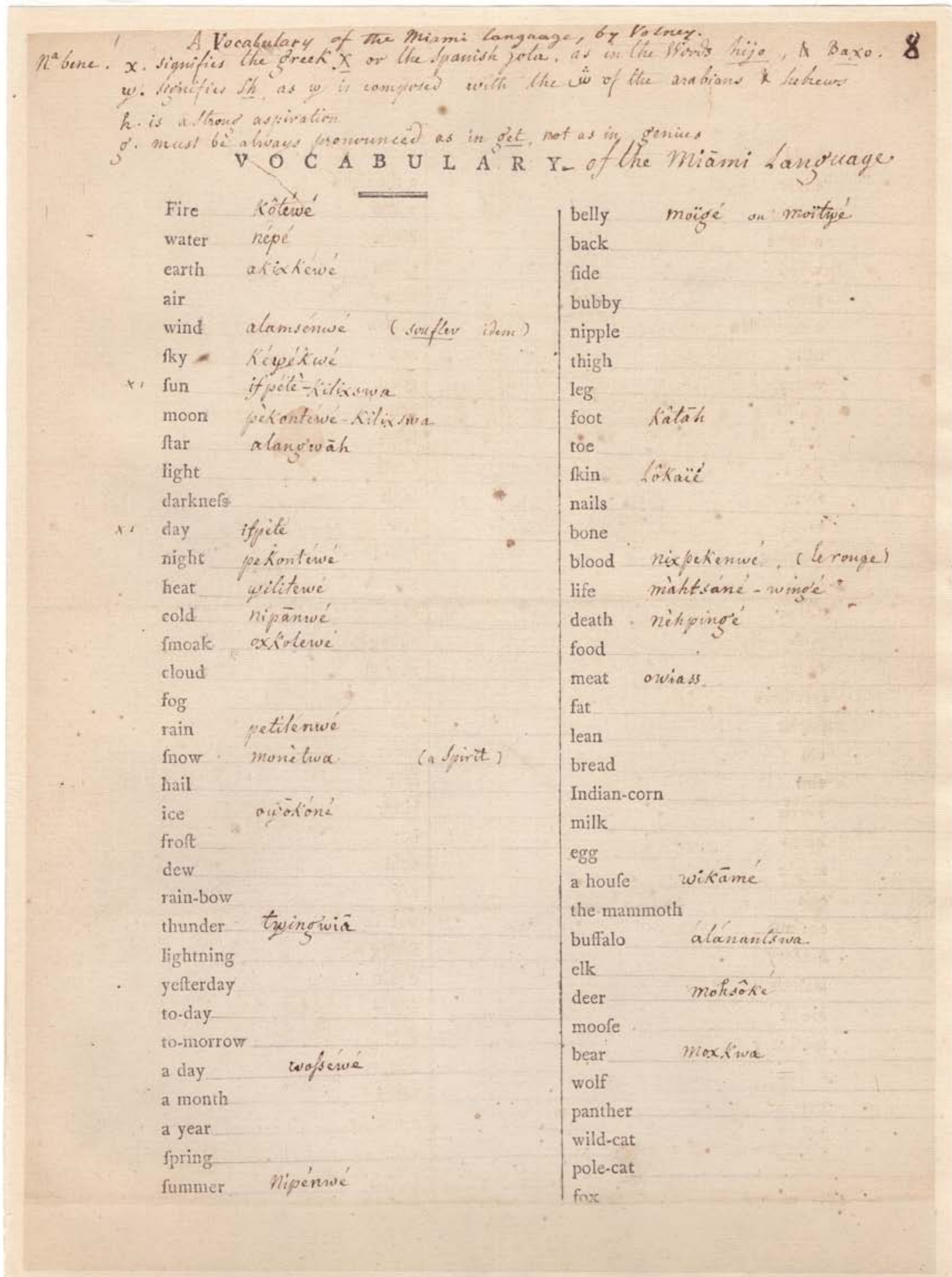


Fig. 20. Top left quarter of the vocabulary form for the Miami Indians. Although William Berwick cut the other vocabulary forms in half after mounting, the Miami form was mounted in quarters, perhaps because it had already split along previous folds. The cut horizontal edge of each of the four quarters was provided with a false margin of antique paper to approximate the leaf size of the bound volume for which they were destined. Mss.497.V85, American Philosophical Society Historical and Literary Committee, American Indian Vocabulary Collection. Courtesy of the American Philosophical Society.

to display in the society's 2006 *Treasures of the APS* exhibit. In her 2003 treatment report, Downey noted that the form "had been restored within recent years," an ironic testament to the durability of Berwick's 90-year-old restoration. She went on to describe how the form had been cut, mounted onto heavy wove paper, and laminated with silk, with a cloth hinge (likely Berwick's favorite tracing cloth) attached over the cut edge for folding. Downey continued, "The object was also trimmed along the edges: the bottom of the Jefferson signature has been trimmed away." Given Berwick's frequent insistence that "not a particle of the writing has been injured or lost" (this particular example comes from his letter to Hays on November 16, 1903), it seems likely that this trimming was carried out by an earlier binder of the vocabulary lists. Downey observed that the heavy lining paper was "weak and brittle," with dog-eared and torn corners, and that the cloth hinge was also torn. Her 2003 treatment involved reinforcing the hinge and secondary support, leaving the existing restoration intact.

In 2015, both the Delaware and Nanticoke vocabularies were slated for exhibition, this time in the APS Museum's *Gathering Voices: Thomas Jefferson and Native America*. By this time, the lining paper and silk crepeline were markedly weak and brittle, providing inadequate support for the original documents. Downey also tested the iron gall ink on both forms with bathophenanthroline test strips and found evidence of free iron(II) ions in the inscriptions. These findings led Downey to perform a calcium phytate treatment on the vocabulary forms, during which the silking, lining paper, and residual adhesives were removed or reduced to the extent possible. Once the thin handmade paper of the original documents had air-dried, Downey was able to see that both sheets were skinned unevenly across their back surfaces. This, along with the papers' unusual reactions during bathing, led her to conclude that they had been previously faced with "strong gelatin or glue" and split.

Looking through the Berwick-Hays correspondence, which had been uncovered during Smith's first research trip to the APS Library around 1998, Downey discovered Berwick's references to splitting the vocabularies. A corroded inkblot common to both sheets allowed her to link the Delaware vocabulary she had just washed with the blank vocabulary form from which it had been split (see figs. 18a, 19). With this knowledge in hand, Downey sized the skinned side of the Delaware vocabulary with a 0.5% gelatin solution to combat its curl from the residual facing adhesive. She then mended both documents with Asian paper, bridging Berwick's cuts along the horizontal folds and returning the forms to single sheets (figs. 21a, 21b). Downey also recorded information about Berwick's previous paper-splitting campaign in her treatment reports. Copies of the pertinent letter to Hays now reside with Downey's treatment reports in the objects' folders.

Charles Willson Peale, Diary Vol. 1, 1765–1767, Mss.B.P31

The earliest Charles Willson Peale diary in the APS collection is a small volume bound in green parchment, 6 × 4 in., designed to fit comfortably in a pocket. The back cover of the volume once had a fold-over flap with a metal pin that snapped into a metal clasp on the front cover to hold the book shut. Peale appears to have used the blank volume not only as a diary (the first leaves describe a 1765 trip to Boston on which he suffered from toothache) but for to-do lists and daily recordkeeping. Several leaves in the middle of the volume recount expenses for food, pigments, and canvas. Other leaves contain technical drawings or sketches of people in ink or graphite.

Two of these pencil sketches date to Peale's 1767 stay in London, where he studied under American ex-patriot portraitist Benjamin West. During his studies, Peale found his way to Franklin's residence and was allowed to entered the house despite his lack of an invitation. From the stairs, Peale spied Franklin in an inner room, busily engaged with a previous visitor. Rather than retreating, he pulled out his pocketbook and documented the scene. The two sketches, made on facing pages of Peale's diary, reveal an aging Franklin holding a young woman on his lap, caressing her hand, and kissing her (fig. 22).

For the APS Museum's 2017 exhibition, *Curious Revolutionaries: The Peales of Philadelphia*, curators wanted to display the diary open to the scandalous sketches, but the volume was initially in no shape to be exhibited. The binding was detached and only the front cover and the torn, crumpled spine remained (fig. 23). Although the spine of the binding was half an inch thick, the surviving leaves made a pile less than a quarter-inch high, suggesting that much of the original book was missing. Furthermore, the leaves had been reassembled into a set of four small pamphlets during a previous restoration campaign, likely under the direction of Kyle or Carbone, given the hard modern sewing thread that was commonly used during that period (fig. 24). The pages had never been numbered, making the order of the pamphlets—and of the leaves within them—unclear. In one place, Peale had clearly turned his diary sideways to write a poem across two facing pages, but when the leaves were resewn into pamphlets, the two halves of the poem were separated by an unrelated folio of paper (figs. 25a, 25b). In 2017, the goals of conservation treatment were to determine the original order of the leaves and to rebind them in their original cover, adding new material as necessary to make the book strong and functional.

Several physical and textual clues assisted the author in approximating the original order of the diary. Many of the leaves had suffered extensive water damage in the past, with varying degrees of brown discoloration, bleeding ink, marks from rusted straight pins, and mold stains. Other leaves, and the extant cover of the volume, had very little water staining, confined to

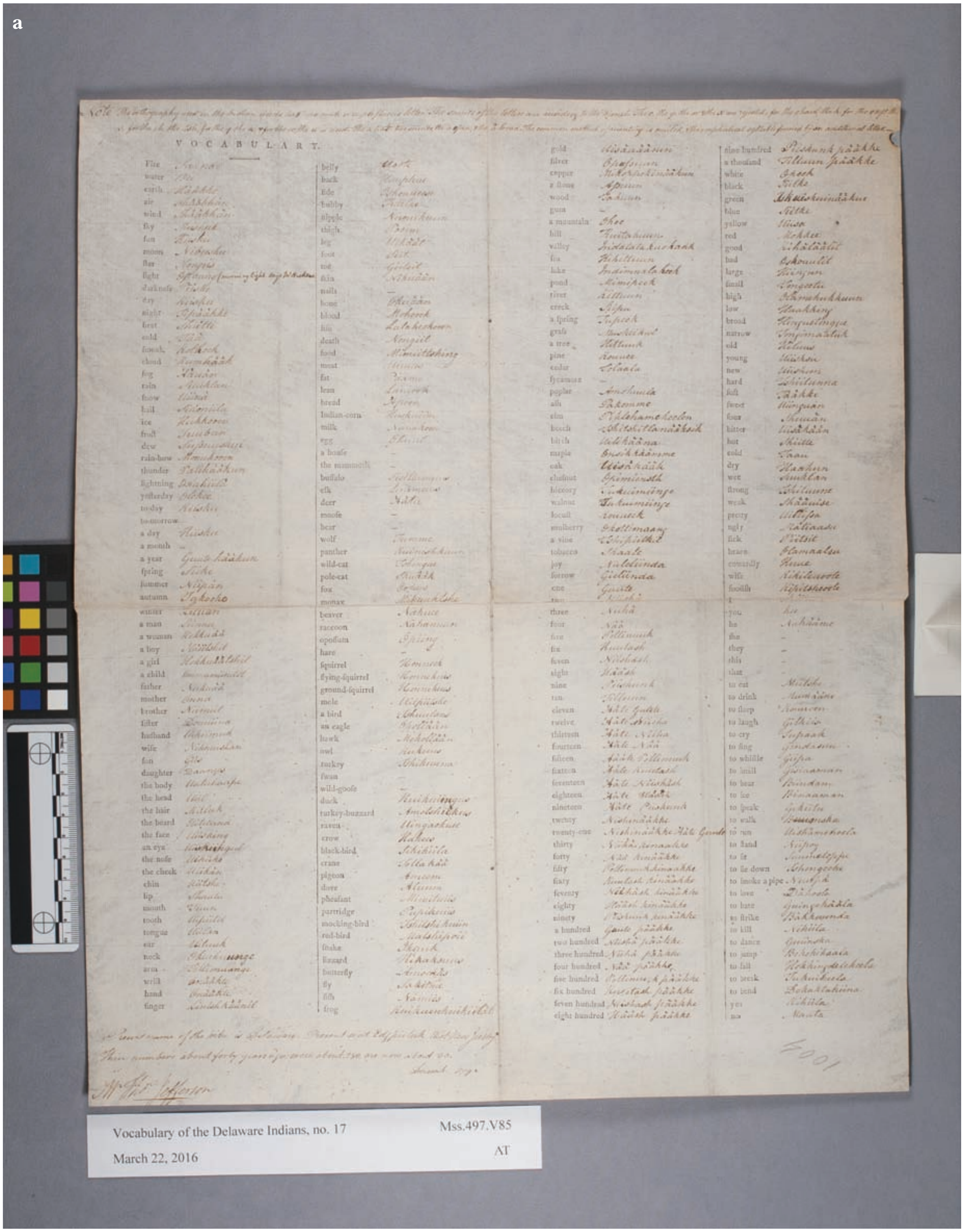


Fig. 21. Vocabulary of the Delaware Indians (a) and Vocabulary of the Nanticoke Indians (b) after treatment in 2016. Anne Downey performed calcium phytate treatment on these vocabulary forms in 2015 and 2016, removing William Berwick's brittle mounting systems at the same time. The sheets were mended to form single sheets once more, although they remain half their original thickness. Mss.497.V85, American Philosophical Society Historical and Literary Committee, American Indian Vocabulary Collection. Courtesy of Anne Downey.

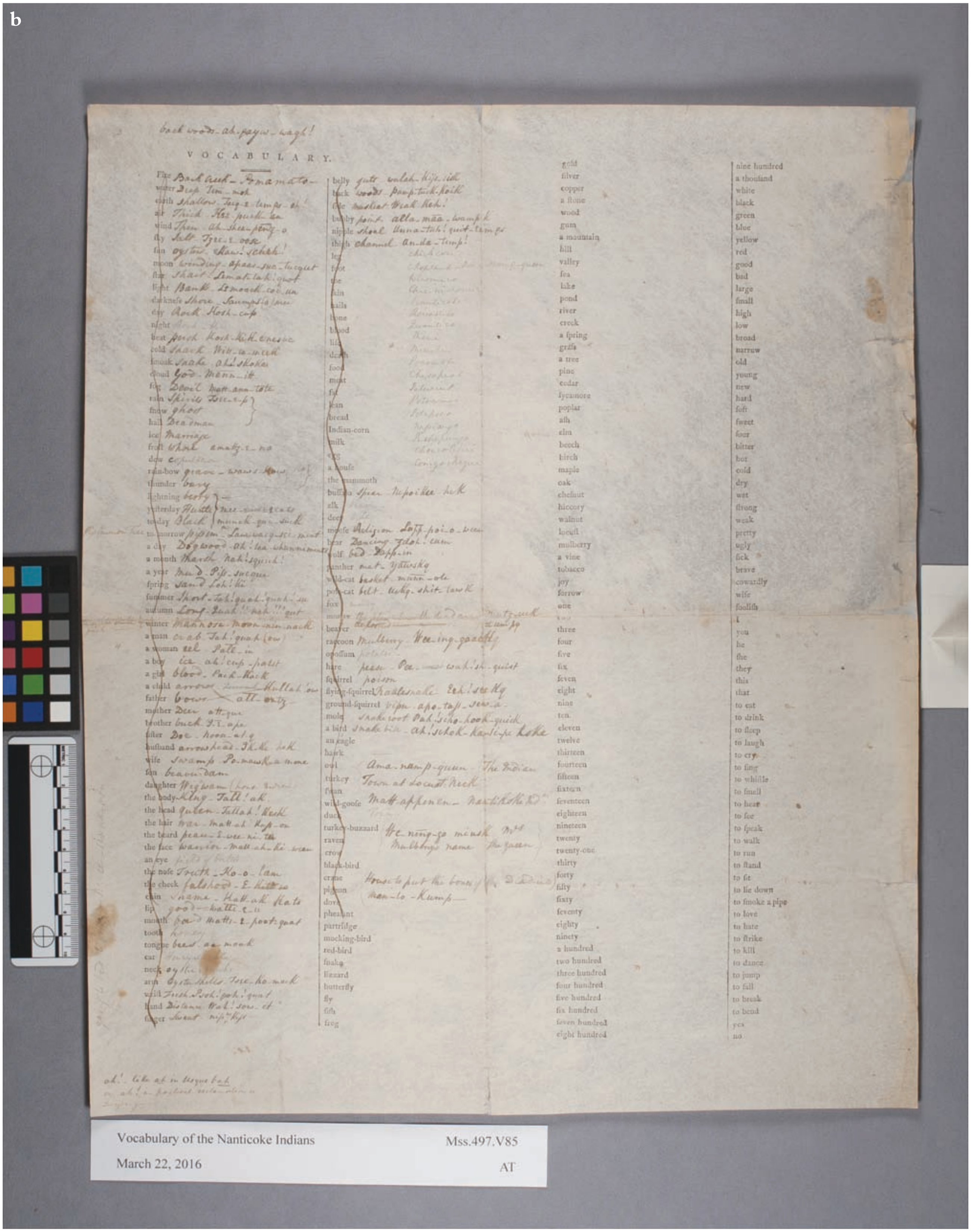


Fig. 21. (Continued)

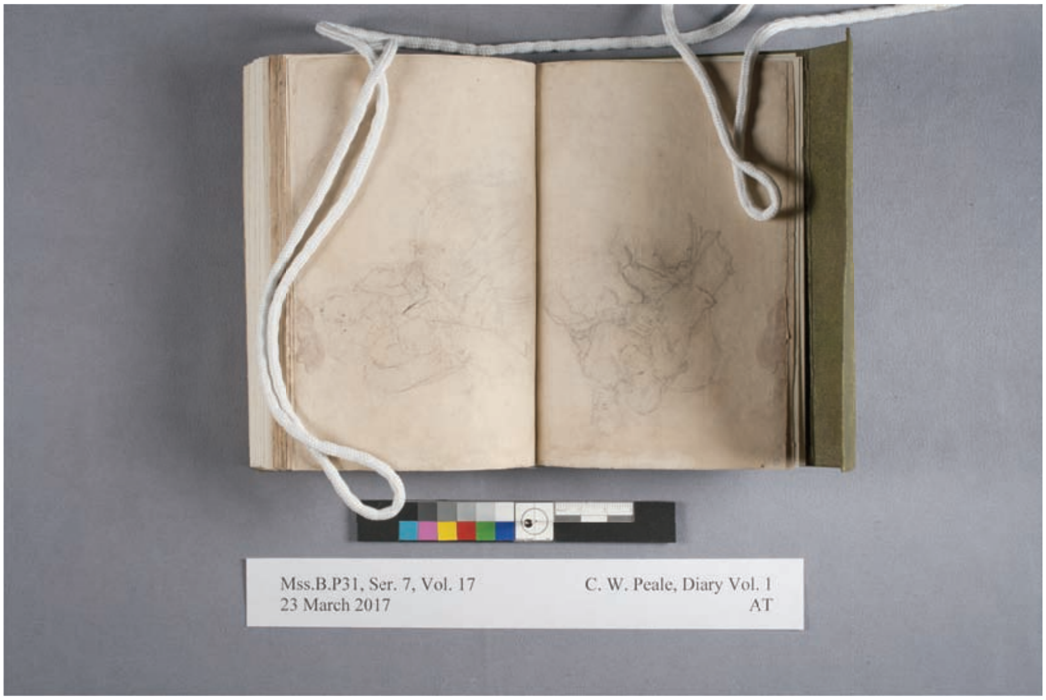


Fig. 22. In 1767, Charles Willson Peale hid outside the London room where Benjamin Franklin was fondling a young woman and sketched their activities in his pocket diary. After conservation treatment, these pages were on display in *Curious Revolutionaries*. Mss.B.P31, Peale-Sellers Family Collection, 1686–1963, American Philosophical Society.

Fig. 23. When Charles Willson Peale's diary arrived in the APS conservation department, all that was left of its original parchment binding was this detached front cover with the tattered spine attached. Mss.B.P31, Peale-Sellers Family Collection, 1686–1963, American Philosophical Society.

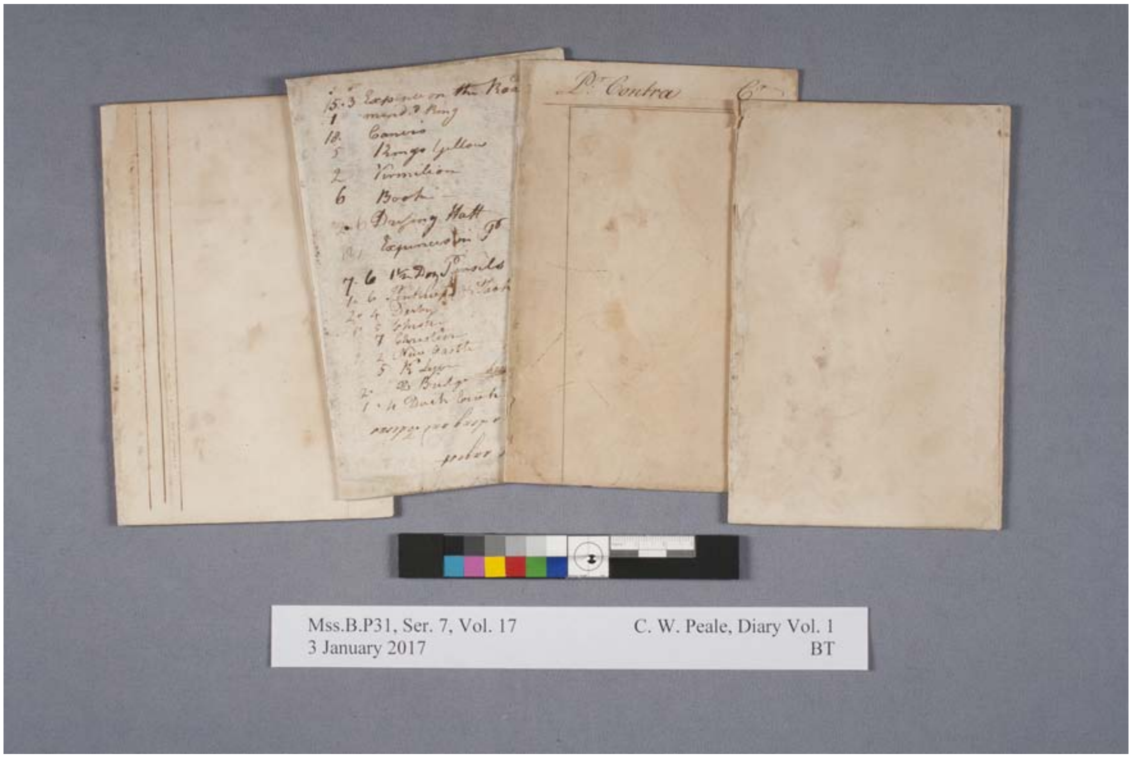


Fig. 24. Sometime between 1948 and 2015, the surviving leaves of Charles Willson Peale's diary were guarded and sewn into four thin pamphlets with hard modern sewing thread. The pamphlets on the right exhibit moderate discoloration and staining from moisture and mold. Mss.B.P31, Peale-Sellers Family Collection, 1686–1963, American Philosophical Society.

the very edges of the leaves. The clean, white leaves were also dated to Peale's diary entries from 1765, allowing the surviving cover to be identified as the front cover. Sometime after 1765, Peale appears to have flipped the book over and resumed writing from the back (a common practice for his time), and many of the severely moisture- and mold-stained leaves are upside down in relation to the first leaves. These observations led the author to conclude that the extant leaves composed the first section and the last two sections of the diary, which are dated to 1767. There were most likely several sections between them in the original diary; these are now missing.

The minimal moisture staining on the front cover and leaves, along with the severe moisture- and mold-staining of the last leaves, provided a rationale for the missing back cover of the diary, whose parchment binding would have been extremely susceptible to water damage. The mold stains and tide lines also proved to be extremely helpful in reordering the water-damaged leaves. Stains at the fore edge of the diary could be aligned, and the leaves could be ordered so the size of the stains progressed logically as the pages were turned, becoming larger toward the back cover.

A 1948 microfilm of the diary was also helpful, revealing that the book had already been water damaged and improperly rebound by that date. Mold stains in the back of the book showed that certain leaves had been bound in upside down. The undamaged leaves, however, appeared to be logically ordered.

Based upon the evidence from the moisture staining, the microfilm, and the text of the surviving diary pages, the leaves were collated with a soft graphite pencil to correspond to their most likely original order. The pamphlets were then disbound, and the folios were reguarded where the hard, thin thread from the previous treatment had cut the paper. The missing portion of the diary was replaced with sections of blank alkaline paper (fig. 26). The reordered book block was then resewn with soft two-ply linen thread, and rebound using the original front cover and spine, which were stabilized with acrylic-toned Asian paper reinforcements. A new back cover with a fore-edge flap was created from alkaline cardstock covered with acrylic-toned handmade Western paper (fig. 27).

Both the photographic and written documentation for the project provide evidence of the book's previous binding campaigns and of the rationale for redoing the work. In this case, both the erroneous page order and the damaging sewing thread provided reasons for re-treatment. Repairing and reusing the book's original binding also restored some of its historical context, giving researchers and museum viewers a better understanding of how Peale would have used the volume.

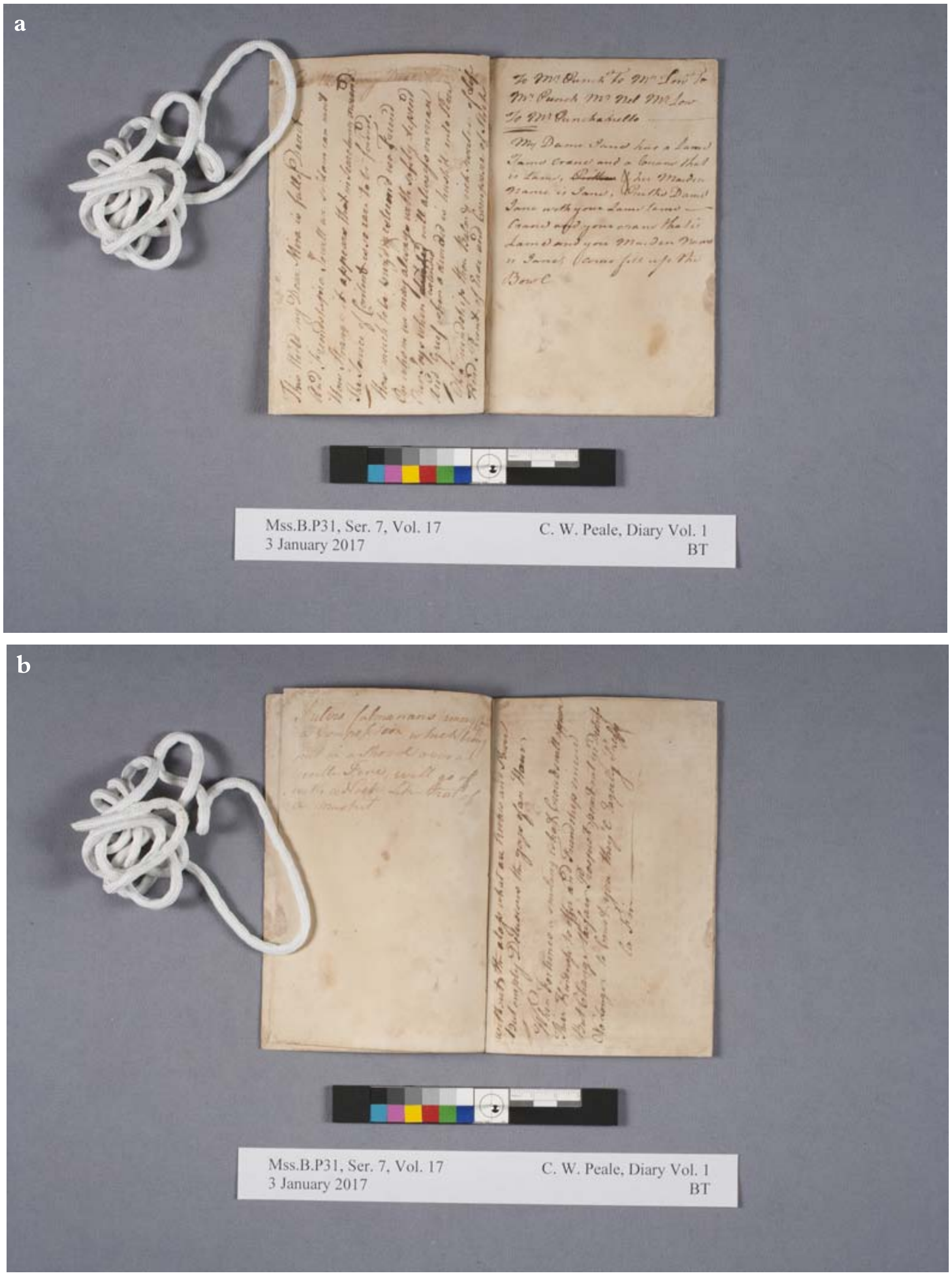


Fig. 25. Charles Willson Peale turned his diary sideways to copy Samuel Wesley's popular song lyrics, "The world, my dear Mira, is full of deceit," written in 1784 for the Duchess of Norfolk. The 20th-century restorer who sewed the diary into pamphlets also misordered its leaves, breaking the song in the middle and preventing it from being read. Mss.B.P31, Peale-Sellers Family Collection, 1686–1963, American Philosophical Society.

James Thackara and John Vallance, Plan of the City of Washington, 1792, Printed.Maps

A 1792 engraved map of Washington, DC, was selected for display as part of the APS Museum's 2019 exhibit, *Mapping a Nation: Shaping the Early American Republic*. This exhibition focused on the role of maps in defining the borders and character of the fledgling United States. The map of Washington, which displays the proposed blocks and government buildings of the new capital, was selected to illustrate the complex process of creating such a map. Although the map was

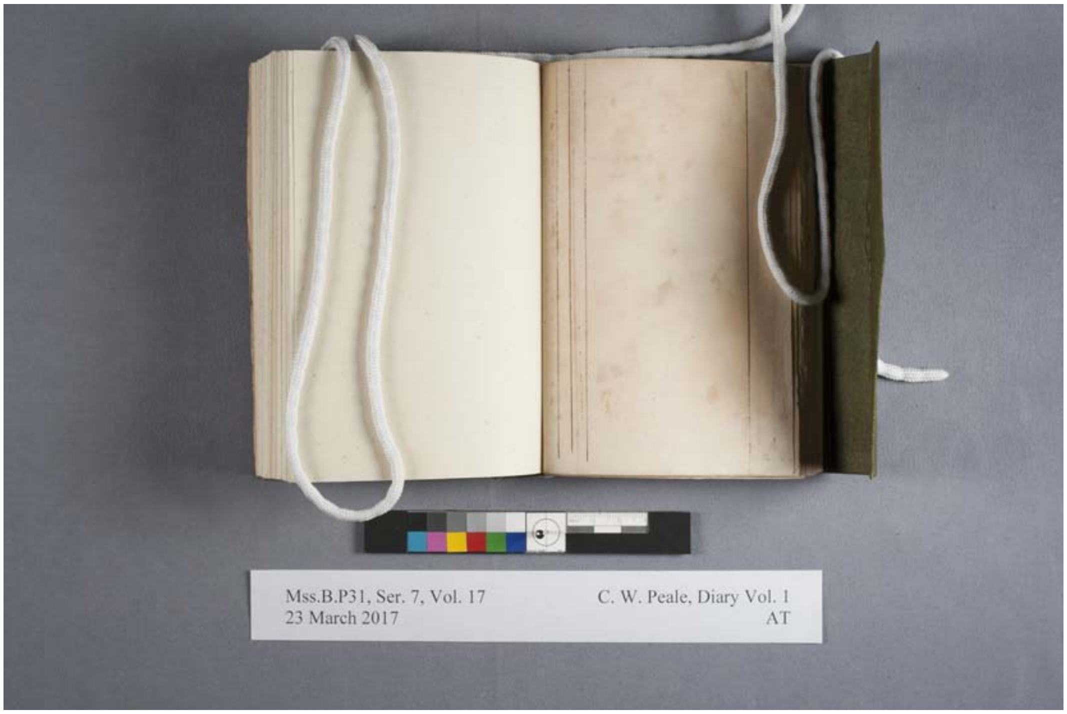


Fig. 26. Conservation treatment for Charles Willson Peale's diary included inserting new leaves of modern paper at the middle of the book to replace the leaves that have been lost. Here, the new leaves appear on the left, whereas the surviving mold-stained leaves from the back of the book are visible on the right. Mss.B.P31, Peale-Sellers Family Collection, 1686–1963, American Philosophical Society.

Fig. 27. A new back cover and fore-edge envelope flap for the diary were created using alkaline cardstock and handmade Western paper toned with acrylic paint. After conservation treatment, Charles Willson Peale's diary can be read in a binding that approximates its original format. Mss.B.P31, Peale-Sellers Family Collection, 1686–1963, American Philosophical Society.

eventually engraved by James Thackara and John Vallance of Philadelphia, Andrew Ellicott led the surveying team that compiled the information leading to the map. In 1784, Ellicott had assisted Rittenhouse in extending the survey of the Mason-Dixon line. From 1791 to 1792, he surveyed the proposed District of Columbia and Federal City for Secretary of State Thomas Jefferson, aided by free Black astronomer and surveyor Benjamin Banneker. The exhibit noted that Banneker was paid less than other team members and had to eat separately, illustrating one of the ways in which people of color were marginalized during nation building. The final map incorporates the work of all of these men, as well as the earlier work of city planner Pierre Charles L'Enfant.

The society's copy of the map was presented by David Steuart Erskine, 11th Earl of Buccan, a Scottish antiquarian and supporter of the American Revolution who had received the map from George Washington. His holograph iron gall ink inscription along the right edge of the map reinforces the white, male, Eurocentric power structure of the emerging nation:

> This Plan which was sent to me by the illustrious Washington April 22 1793, I dedicate to the memory of C. Columbus, B. de las Casas, Sir W. Raleigh, W. Penn, John Locke, Benjamin Franklin, Samuel Adams, John Hancock, Generals Warren and Montgomery, and to that of all the good and brave men who contributed to the establishment of American Happiness and I bequeath this plan to the Phil. Society of America instituted Jan: 2d. 1769.

Above Buccan's dedication is a slip of bluish paper bearing the inscription "G Washington to the Earl of Buccan." Buccan apparently cut the autograph from Washington's original letter accompanying the map, as it is densely written on the opposite side, and secured it to the map with a dot of adhesive. When the front of the map was silked overall sometime after its arrival at the APS in 1802, possibly by Rugh or Spawn, the slip was removed from the map (creating a hole in the inscription), silked separately, and re-adhered on top of the silk-laminated map.

By the time the map was selected for exhibition, it displayed multiple long cracks (perhaps the original reason for silking), losses filled with white and brown papers, and several edge tears. It was also markedly discolored, particularly at the top left edge, which was stained brown (fig. 28). The library's iron gall ink inscription marking the 1802 receipt of the map was also haloed. These condition issues were judged severe enough to warrant calcium phytate treatment to stabilize the

Fig. 28. James Thackara and John Vallance, Plan of the City of Washington, 1792, Printed Maps Collection, American Philosophical Society. Before treatment, the map was discolored overall, with significant staining at the top left corner. The 1802 iron gall ink inscription was also haloed. The map was likely silked by Carol Rugh or Willman Spawn in the 20th century. Courtesy of Anisha Gupta.

Fig. 29. James Thackara and John Vallance, Plan of the City of Washington, 1792, Printed Maps Collection, American Philosophical Society. Anisha Gupta and Anne Downey performed calcium phytate treatment on the map to stabilize the iron gall ink and reduce staining. Although removing its silk lamination was not one of the goals of treatment, the silk released readily in the bath, and its removal improves the legibility of the treated map.

inks and bathing to reduce the staining and discoloration. To prevent further damage to Washington's signature, the attached slip was detached from the map prior to bathing, using a scalpel to break the weak adhesive join. The remainder of the silk was readily removed during bathing (fig. 29). In this case, although removal of the silk lamination was not one of the goals of treatment, the previous conservation effort was reversed in hopes of improving the map's legibility.

After bathing, the map was mended again with Japanese paper and toned cast pulp. Washington's untreated signature was hinged to the map in its former location with Asian paper and wheat starch paste, with its silk lamination still in place (fig. 30). The silk from the remainder of the map was labeled with graphite and retained in the conservation laboratory as a piece of historical evidence. Although no earlier conservation records exist for this map, its previous lamination and mends are noted in the treatment report that now accompanies the object.

Minutes of the Indian Treaty Council Held at Easton, 1757, Mss.970.5.M659.1

From 1756 to 1758, during the French and Indian War, a series of conferences in Easton, Pennsylvania, sought to make peace between the Native peoples of the Wyoming Valley (often

Fig. 30. James Thackara and John Vallance, Plan of the City of Washington, 1792, Printed Maps Collection, American Philosophical Society. After bathing it, Anisha Gupta mended the map with Japanese paper and toned cast pulp. She also reduced the worst of the residual staining with a cosmetic overlay of translucent Japanese paper. The untreated slip bearing Washington's signature was hinged to the map in its former location. Courtesy of Anne Downey.

allied with the French and represented by Lenape leader Teedyuscung) and the colonial government. The Lenape people in particular had been at war with Pennsylvanian colonizers since the fraudulent 1737 Walking Purchase forced them from their homeland in the Lehigh Valley to the Wyoming Valley, traditionally controlled by the Iroquois. The Iroquois, who were allied with the British, subsequently sold the land upon which the Lenape had settled to Pennsylvania and Connecticut, sparking violent hostilities between the Lenape and Pennsylvanian settlers.

Teedyuscung aired Lenape grievances at the first treaty councils in 1756, and he elaborated upon them in 1757, asking for a colonial secretary to take down his words. Charles Thomson, who later became clerk of the Continental Congress, was appointed to serve in that role. The council meetings held between July 21 and August 7, 1757, concluded in a peace treaty between the Pennsylvania government and the Lenape, but the treaty did not return Lenape land or end the colony's conflict with other Native groups. A more widespread peace was struck during the final Treaty of Easton in 1758, which returned some of the land taken from the Iroquois and pledged that British settlers would not trespass on Native lands in the Ohio region west of the Allegheny Mountains. These treaties created a tenuous alliance between the British colonial government and local tribes that had previously supported the French.

The APS now holds later copies of the minutes from the 1756 Easton treaties, believed to be produced between 1780 and 1820, and these were treated by Rugh in 1935. Far more importantly, the society also preserves Thomson's original manuscript minutes from 1757, representing Lenape land claims with maps based on Teedyuscung's own sketch of the debated territories and a contemporary British map of Pennsylvania drawn by Lewis Evans. These minutes—apparently a first draft based on Thomson's rough notes—were subsequently bound in multiple oversewing campaigns. The minutes' original binding may not survive; the undated finding aid for the collection describes a "half morocco [binding],

Fig. 31. Minutes of the Indian Treaty Council Held at Easton, 1757, Mss.970.5.M659.1, American Philosophical Society. By 2004, Willman Spawn's silk-laminated guards had stiffened, causing the leaves of the minutes to crack along the edge of the silk. Courtesy of Denise Carbone.

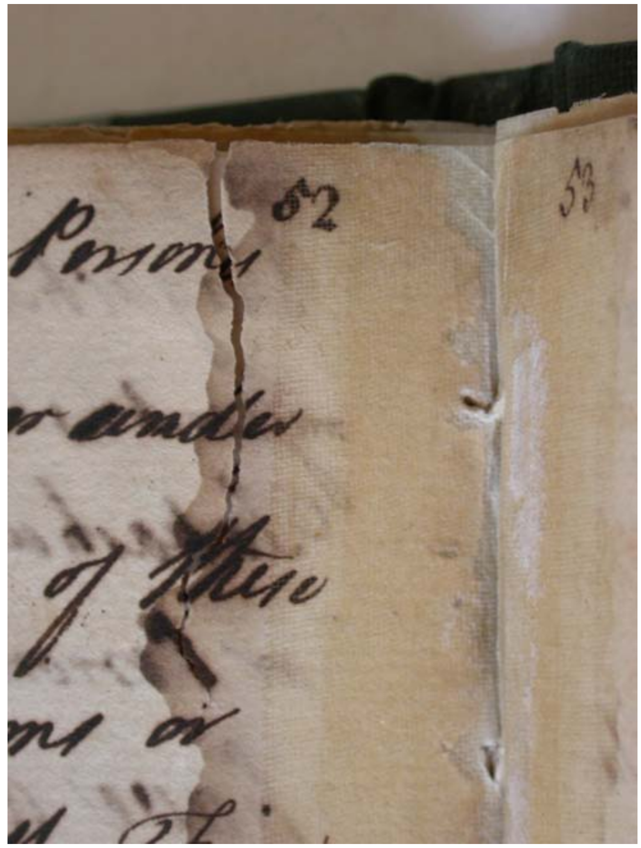


Fig. 32. Minutes of the Indian Treaty Council Held at Easton, 1757, Mss.970.5.M659.1, American Philosophical Society. In this 2004 treatment photograph, a severe tide line can be seen extending from Willman Spawn's guard and silk lamination, suggesting that his rice starch paste allowed components of the iron gall ink to move laterally within the paper. Such tide lines were common throughout the book block prior to washing. Courtesy of Denise Carbone.

covers detached, and a few leaves loose." This description may refer to a 19th-century half binding of purple embossed sheepskin with marbled paper sides, whose boards were stored with the volume throughout its complicated treatment history.

Spawn allegedly mended and guarded the minutes during his career, sometime after 1950, and rebound them in a three-piece case binding covered with green paper. This binding remained on the book until 2004, when the volume was disbound and partially treated in preparation for the society's 2005 *Treasures Revealed* exhibit. Carbone's treatment notes from disbinding, which remained with the book until treatment was completed in 2019, noted the book's single-folio endleaves of stiff paper and extraordinarily wide guards, which were apparently designed to allow the book to be oversewn without damage to the original manuscript. Treatment photographs found on the APS servers show that the paper guards (apparently of a soft bond paper) were lined with silk that extended onto the manuscript leaves for about an inch on each side. In the years since Spawn had conserved the book, the silk lamination had become stiff and brittle, and the treaty minutes were cracked throughout the book block adjacent to the silk (fig. 31). Carbone also noted extensive tide lines to the manuscript leaves, generally along the gutter edges, probably resulting from the earlier silking treatment (fig. 32). Carbone disbound the manuscript leaves, which also displayed extensive iron gall ink corrosion, with cracking and dropout (fig. 33), and turned them over to Downey for paper treatment.

To address the leaves' discoloration, brittleness, and staining, Downey bathed them in ethanol- and pH-adjusted deionized water, alkalized them with magnesium bicarbonate, and sized them with methyl cellulose to strengthen them. The silk and existing paper mends were removed in the bath. She then mended the leaves with acrylic-toned Asian paper and wheat starch paste. Although calcium phytate treatment might have been appropriate for the manuscript, the society was not yet using that technique in 2004. In 2019, when the manuscript's iron gall inks were tested with bathophenanthroline test strips, the strips remained white or turned a barely

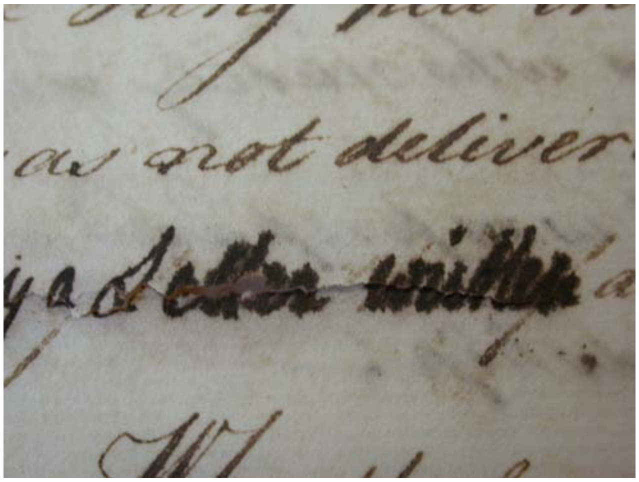


Fig. 33. Minutes of the Indian Treaty Council Held at Easton, 1757, Mss.970.5.M659.1, American Philosophical Society. The minutes displayed severe iron gall ink corrosion prior to bathing in 2014, with cracking and dropout where the ink was heavily applied. Courtesy of Denise Carbone.

perceptible pink, suggesting that most of the excess iron(II) ions contributing to strikethrough and cracking of the ink were washed away during bathing. Bathing also served to reduce the extensive tide lines and staining throughout the book.

Two leaves from the minutes were displayed separately during the 2005 exhibition, and the book was not returned to a bound format until 2019, when it was again slated for display in *Mapping a Nation*. The curators requested that the book be shown intact, as the maps for exhibition appeared on facing pages (fig. 34). To preserve the manuscript's original format to the extent possible, the author examined the leaves' watermarks to determine how they had originally been gathered. The orientations of the watermarks and countermarks showed that the leaves had not been gathered at all, but written and bound as individual folios of handmade laid paper. The leaves were guarded into their original folios, provided with new endleaves of handmade paper, and sewn through the fold over ramie ribbon supports. After discussion with the curators, they were rebound in the surviving 19th-century boards—the

Fig. 34. Minutes of the Indian Treaty Council Held at Easton, 1757, Mss.970.5.M659.1, American Philosophical Society. Maps on facing pages of the minutes—featuring Native and colonial depictions of the traditional Lenape lands—were displayed in 2019's *Mapping a Nation*, for which the book was returned to a bound format.

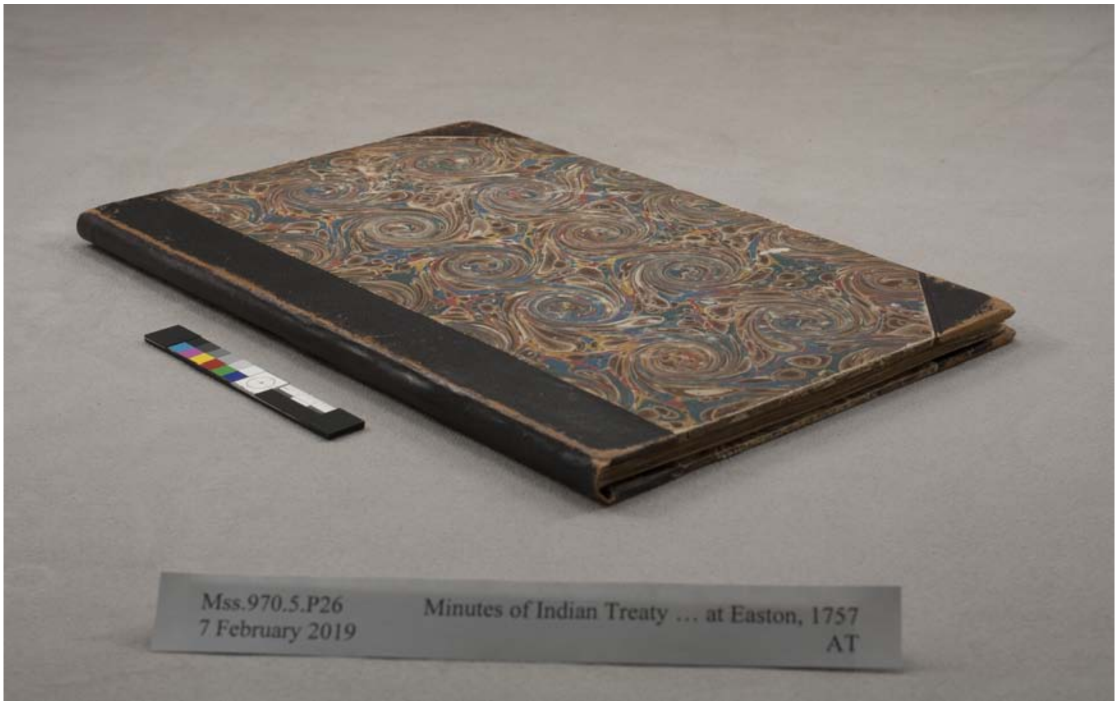


Fig. 35. Minutes of the Indian Treaty Council Held at Easton, 1757, Mss.970.5.M659.1, American Philosophical Society. The minutes were rebound in the earliest extant binding surviving to them, with 19th-century half-bound boards and a new spine of laminated cotton and paper.

earliest extant binding materials remaining to them—with a new spine of toned, laminated Asian paper and airplane cotton (fig. 35). All of the previous treatment was described in the final report, and Spawn's green paper quarter case binding was provided with a four-flap wrapper and stored in the box with the treated book. The recovered paper treatment form was also scanned as a PDF, and with the earlier treatment photos it was added to the digital conservation archive for the minutes.

Benjamin Franklin, Ledger A and B, 1730–1740, Mss.B.F85f6.5

In 1730, when 24-year-old Benjamin Franklin began keeping his financial records in a tall, narrow leather-bound book labeled "Leidger A" and "Leidger B," he had already moved to Philadelphia, created a discussion group of local businessmen known as the Junto (precursor to today's APS), and begun publishing *The Pennsylvania Gazette* newspaper to promote his ideas and observations. In September 1730, he began a common-law marriage with Deborah Read, and their hands are almost the only ones found in the pages of the ledger book, which contains their financial transactions over the following decade. During these years, Franklin brought his young son William into the new household, wrote the charter for the Library Company of Philadelphia, began publishing *Poor Richard's Almanack*, and established the Union Fire Company. He and Deborah also began a family but lost their son to smallpox.

Little of this personal history is directly reflected in the content of the book, which is concerned with the credits and debts of the Franklin household. As was common at a time when books and paper were costly, the couple kept two systems of accounting in the same binding: a daily journal of transactions at the front of the book and a ledger of transactions indexed by client at the back of the book. When the ledger at the back became full, they began using the remaining blank leaves in the middle of the book. The book was not strictly business, however: one of the last leaves shows Franklin's experimentation with different varieties of iron gall ink, providing evidence for his scientific bent (fig. 36).

Ledger A and B is the earliest Franklin account book known to survive and has long been recognized as one of the treasures of the APS manuscript collection. Shortly after joining the society in 1935, Rugh picked up where Berwick had left off and treated seven of Franklin's manuscript record books, including Ledger A and B. Her treatment notes for the volume state, "Loose leather cover attached. Boards stiffened where broken down. Extensive repairs to torn pages. 1 double fold covered with chiffon, hinged & replaced in book" (Rugh 1935, 9). The unsigned slip she pasted into the back of the book provides further (albeit minimal) detail: "page repairs; leather cover strengthened and repaired 6/35" (fig. 37).

Ledger A and B was not treated again until 2019, almost 85 years after Rugh's repairs were made. For many years, the volume had been handled regularly during tours featuring the

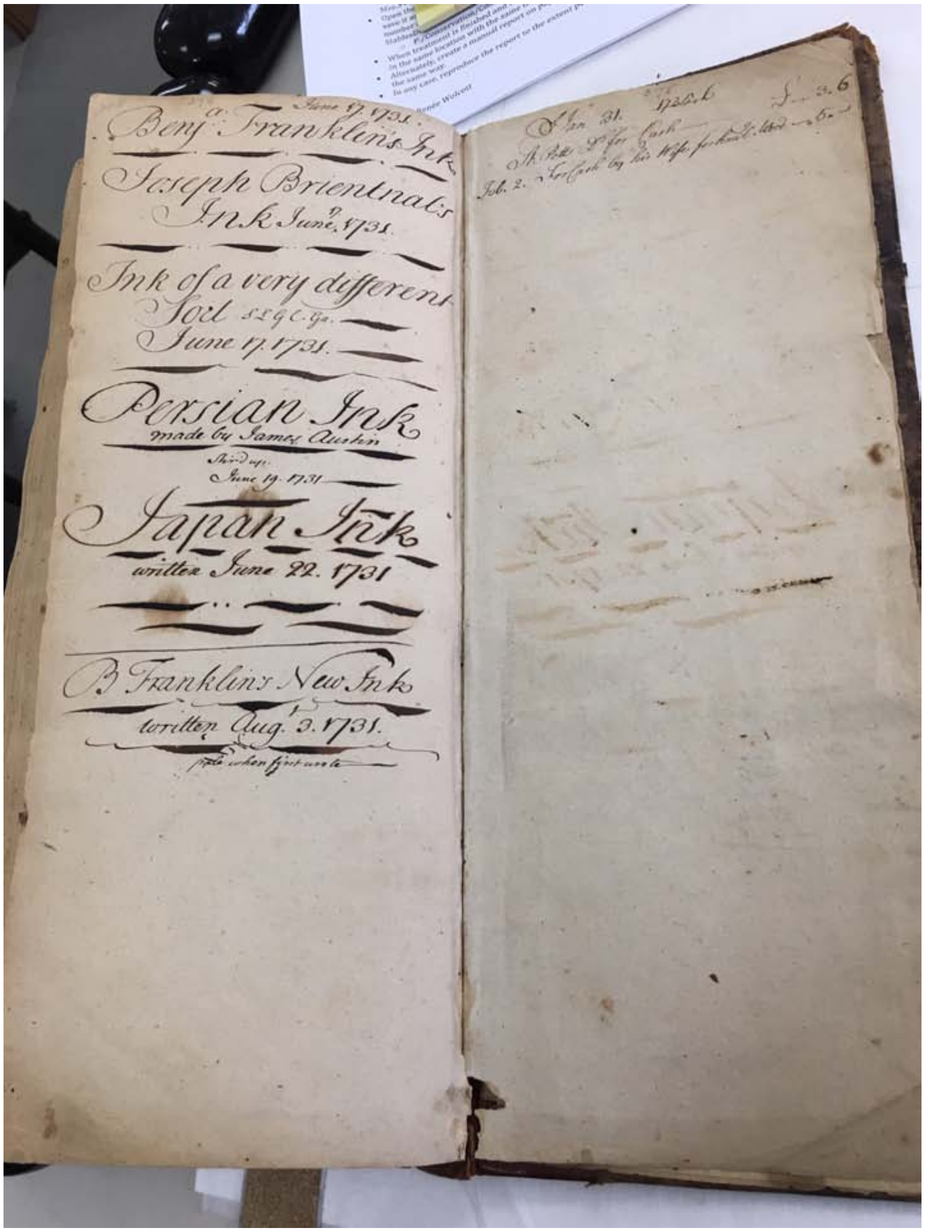


Fig. 36. Benjamin Franklin, Ledger A and B, 1730–1740, Mss.B.F85.f6.5, American Philosophical Society. One of the last leaves of the ledger book displays a dated list of different iron gall ink recipes, including Benja. Franklin's Ink, Joseph Brientnal's Ink, Ink of a very different sort, Persian Ink made by James Austin, Japan Ink, and B. Franklin's New Ink, all presumably part of an experiment on Franklin's part.

society's most noteworthy collections, and the extensive use had taken its toll. When the book was brought to conservation for treatment, Rugh's identity remained unknown, but examination revealed details about her repairs that were not included in her minimal treatment notes. In this case, she had replaced the endcaps of the book not with chrome-tanned calf but with vegetable-tanned leather turned in over the pastedowns, and by 2019 it had become red, weak, powdery, and torn (fig. 38). The endcaps were once again pulling away from the spine of the book block, and the original leather was also split or lost in many new areas: over the joints, at the center of the spine, and at the top fore edge of the front board. The corners of the cover were also severely abraded, with associated loss to the pasteboards beneath the leather.

Although Rugh's page repairs remained strong (and largely invisible), the nearly 200-year-old paper had become increasingly brittle and discolored, and routine handling had caused new edge tears, chips, and creases in the outermost leaves.

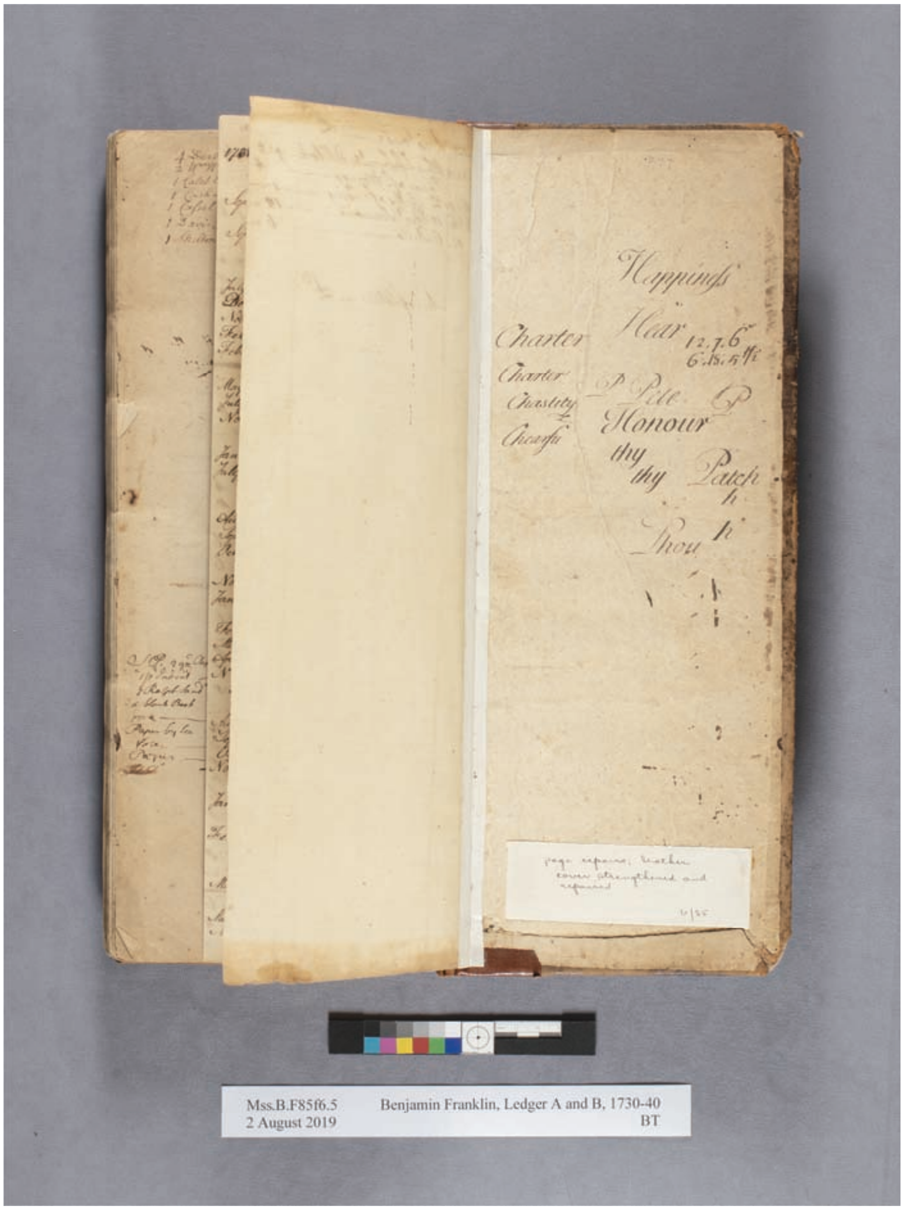


Fig. 37. Carol Rugh's 1936 treatment slip for Franklin Ledger A and B, adhered to the back pastedown, states that she made page repairs and strengthened and repaired the leather cover, but it does not specify the materials used. Benjamin Franklin, Ledger A and B, 1730–1740, Mss.B.F85.f6.5, American Philosophical Society.

The two detached leaves that Rugh had trimmed, laminated with silk, and hinged to the back pastedown with a strip of linen tape remained securely attached, but both inner hinges were split, and several of the book's fiber-cord sewing supports were broken over the joints (fig. 39).

Curators asked that the book be made intact and safe to handle, so treatment focused on mending new damage to the book block, reinforcing the tenuous board attachment, and repairing new cover damage while strengthening and reintegrating the existing restorations. The book block and inner hinges were mended with acrylic-toned Korean paper and wheat starch paste. Lascaux 498 HV, which is reversible with heat or ethanol, was used in all of the binding repairs. To reinforce board attachment at the head and tail of the spine, the leather was lifted as necessary, and strips of ramie ribbon were adhered to the spine and boards over a reversibility layer of Korean hanji (fig. 40). The deteriorated endcaps from Rugh's treatment campaign were not removed, but they were reinforced with new, chemically stable components. A loss in the headcap was filled using layers of cotton textile and cotton blotter, and both modern endcaps were faced with acrylic-toned hanji. New losses and splits in the boards and original

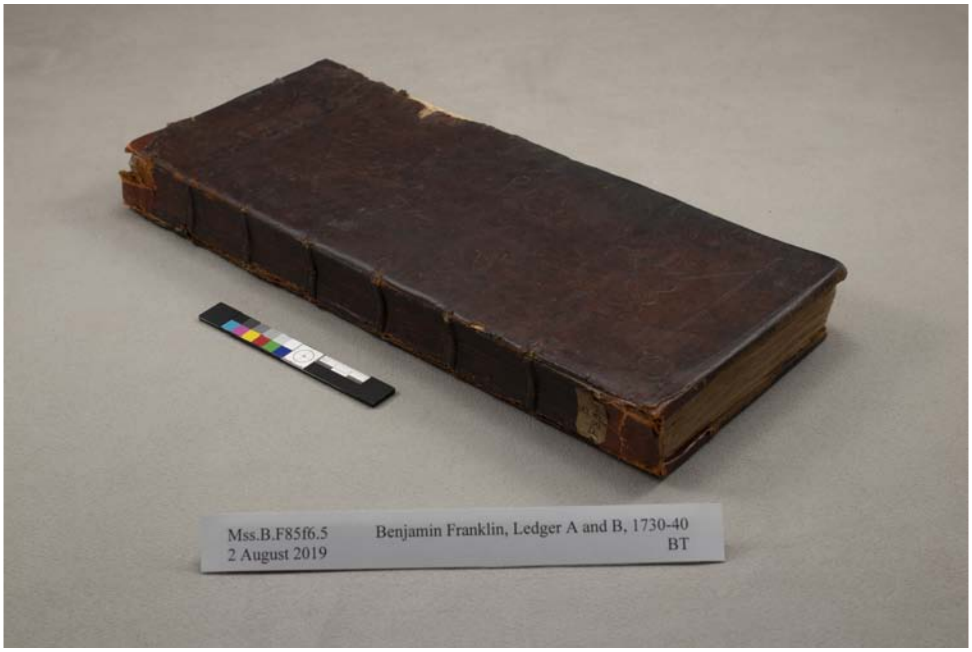


Fig. 38. By the time Ledger A and B was treated again in 2019, the vegetable-tanned leather Carol Rugh had used to repair its endcaps was weak, red, powdery, and torn. There was also new damage to the leather over the joints and front board. Benjamin Franklin, Ledger A and B, 1730–1740, Mss.B.F85.f6.5, American Philosophical Society.

leather were filled and mended with the same materials. After local toning of the leather mends, the binding appears intact once more and is safe to handle on tours (fig. 41). Rugh's repairs remain in place beneath the new materials, as do her exposed turn-ins and her repair slip on the back pastedown. Her role in the conservation history of the book, which was only uncovered during the research for this paper, will be added to the existing treatment report.

Considerations for the Re-treatment of Library Materials

Although the society's long history of binding, restoration, and conservation may be unique, all libraries contain previously repaired books and documents. Sometimes the earlier binders and restorers are known to the present conservators, and sometimes the repair materials themselves are the only evidence for earlier approaches to collections care. In addition, although museums generally rely on program-trained conservators, many libraries have continued to employ binders and book artists trained in artisanal practices, whose knowledge of chemistry, materials science, and conservation ethics may lag behind those of their peers. Book owners and donors also frequently take repairs into their own hands, employing everything from pressure-sensitive tape to bathtub bathing. These complex histories of repair should be assessed whenever a previously treated artifact is slated for conservation.

It should be noted that when the preceding treatments were undertaken at the APS, the society's conservation department had no established protocol for interrogating the significance of prior repairs, documenting them, or retaining historic repair materials. In performing these treatments, the conservators approached former repairs as they would approach any other aspect of an object's history. They documented the prior treatments in their reports, but some repair materials were kept for future reference, whereas others were stored with the objects or discarded. The general approach to these treatments may be summed up as follows:

- Prior repairs were left intact unless they caused physical or chemical harm, posed a handling risk, or introduced errors that might mislead a user.
- Prior repairs that were visually distracting might also be removed or disguised prior to exhibition.
- Prior repairs might also be removed as the side effect of conservation treatment designed to stabilize new chemical or physical damage.
- Where re-treatment was necessary, all prior repairs were documented before treatment.
- Where feasible, the materials used in prior repairs were retained as a form of historical evidence.

Although these points are a laudable point of departure when developing a protocol for considering prior repairs, they do not go far enough. In addition to documenting the

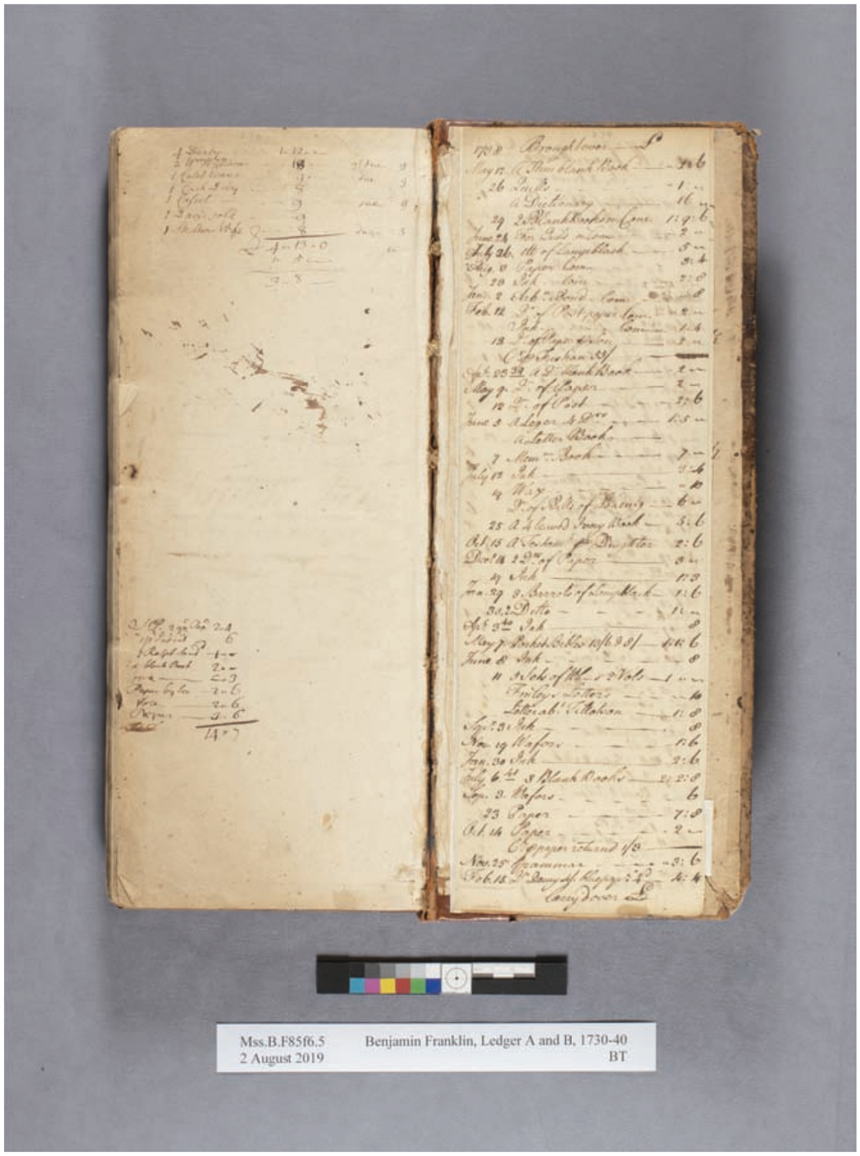


Fig. 39. Before treatment in 2019, the inner hinges of Ledger A and B were split, and several of the sewing supports were broken over the joints, making board attachment tenuous. Here, the split back hinge is shown adjacent to two detached leaves that Carol Rugh trimmed, mended, silked, and hinged to the back pastedown. Benjamin Franklin, Ledger A and B, 1730–1740, Mss.B.F85.f6.5, American Philosophical Society.

existence of prior repairs—ideally with great thoroughness—conservators must also assess their historical and cultural significance before beginning treatment. In her 2003 article on the subject, Jean Portell invited conservators to go beyond the usual assessments for prior repairs (i.e., their chemical and physical stability, their visual impact on the artifact, and the costs involved with removing them). She urged conservators to consider other, less tangible factors as well, as existing repairs may be chemically unstable but culturally significant, or may possess historical or spiritual value in their own right (often the case in collections of indigenous artifacts). Repairs may also have been made by the object's maker or prior owners, and should be considered in light of that history.[3]

Portell (2003) closes with a list of questions to consider when re-treating an artifact:

- Is the repair aesthetically unacceptable? (Who decides this?)
- Are the materials or methods used in the repair unstable, or has the repair damaged the object? (Does an unstable or hazardous condition require immediate attention?)
- Is the repair documented? (Has the old repair acquired significance as an attribute of the object, to the extent that the object is now expected to match its old description?)
- Was the repair done by a historically significant person? (If so, does this fact enhance the object's appeal or value?)

Fig. 40. During treatment in 2019, board attachment was reinforced by adhering strips of ramie ribbon across the spine and over the boards under the leather, separated from the original materials by a reversibility layer of Asian paper and wheat starch paste. Benjamin Franklin, Ledger A and B, 1730–1740, Mss.B.F85.f6.5, American Philosophical Society.

Fig. 41. Carol Rugh's existing leather repairs were not removed in the most recent conservation treatment of Ledger A and B, but they were mended and reinforced, as were new instances of leather damage. The restored book can now be safely handled on tours of the APS treasures. Benjamin Franklin, Ledger A and B, 1730–1740, Mss.B.F85.f6.5, American Philosophical Society.

- Is the repair culturally appropriate and desirable? (Would it be helpful to consult someone who is familiar with the object's culture of origin, such as a member of that group?)
- Does the object, even after repair, have sacred or ritual significance? (Should an appropriate expert be consulted before proceeding with any further treatment?)
- Was the repair done by, or supervised by, the artist? (If so, might the repair interest art historians?)
- Is the intent of the artist known? (If the artist has documented his or her preferences regarding exhibition and preservation of the artwork, where might one find this information? If the artist is living, should he or she be consulted?)
- In the case of an electronic or digital artwork, is there a record of a prior substitution or migration? (If the work was reformatted, would knowing what method was used reveal how the work may have changed, and could that information influence a decision about how the work will be treated next?)

Although Portell's questions concern works of art, they are equally pertinent to library materials, whether they are generally recognized as artworks or not. Thanks to Jefferson's interest in Native languages, for example, the society holds extensive records and some artifacts related to indigenous peoples, and these objects would ideally be stored and repaired using materials and methods that their originating tribe or nation deems appropriate. Certain authors (including 19th-century minister and novelist George MacDonald) are known to have restored their own libraries. Less famous book owners of all eras have used everything from sewing thread to straight pins to pressure-sensitive tape to keep their bindings together. The significance of these interventions can change over time and may vary from object to object. Without asking the appropriate questions, conservators may remove critical historical context while making a good-faith effort to stabilize a given book or manuscript. Pretreatment dialogue with librarians and curators is crucial, as they often know more about an object's intangible context: its prior owners, history of use, and cultural significance.

Ideally, the conservation history of APS collections would also be apparent, and the value of any prior repairs would be understood. The reality is far from ideal, however, as is likely the case at many institutions. Conservation documentation at the APS has been inconsistent, and until recently there was no organized digital or physical archive for any records produced. The history of previous treatments traveled by word of mouth from one generation of staff to the next, and each conservator apparently retained his or her own treatment notes. Without Spawn's intervention and Smith's documentation, today's conservators would still not know about Berwick's and Rugh's treatment efforts. It is hoped that more conservation records will be found in the APS Archives; however, they are currently inaccessible. Processing these collections will help, but the conservation information they contain must still be formatted in such a way that future conservators can use it.

Establishing systems that improve access to conservation records (from file-naming protocols to shared conservation databases to archival retention policies) will ensure that future conservators can put prior repairs in context. Adding previous conservation or restoration treatments to the systems as they are found will help build a history for re-treated artifacts. Historic documents may be appropriately cataloged, filed, scanned, or transcribed for ease of reference. Prior treatments may also be added to conservation databases or spreadsheets for ease of tracking. Knowing who previous binders, restorers, and conservators were—and understanding their materials and methods—can lead to improved treatment decisions in the future, including the choice of whether or not to retain existing repairs. Retaining samples of the materials used in former treatments, when feasible, will provide physical evidence for historic practices and perhaps assist in identifying the previous restorer for a given work.

Improving today's documentation practices will ensure that future conservators possess all of the data necessary to make informed choices of their own. Whenever possible, conservation documentation should name any former restorers or conservators, describe their repairs thoroughly, and provide the rationale for the current treatment approach. What papers and adhesives were used in the previous treatment? How have they aged? What has their effect been upon the original materials? How did their history impact the treatment plan? Future conservators will appreciate knowing not only why an object was treated at a given time but also which factors were considered in the decision to retain or remove existing repairs. Stating the goals of treatment and describing the reasons a given course of action was selected will help put our own choices in context when the objects we have treated need attention once more.

ACKNOWLEDGMENTS

Mary McDonald, head of publications at the American Philosophical Society, suggested the book project that prompted this research (*Art, Science, Invention: Conservation and the Peale-Sellers Family Collection*, published in the 2019 *Transactions of the American Philosophical Society*). Madalina Veres's extensive archival research for her timeline of the American Philosophical Society provided a firm foundation for further inquiry into the history of conservation. Christine Smith was incredibly helpful in securing image permissions and providing additional information about William Berwick and his work. David Gary, associate director of collections, Anne Downey, head of conservation, and Anisha Gupta, assistant conservator, have provided endless support and encouragement. APS CEO Bob Hauser has provided wise and generous leadership during the current pandemic.

NOTES

1. An expanded version of this paper, including more bookbinding and conservation history from the APS Archives as well as revisions for a lay audience, is scheduled for publication in the *Proceedings of the American Philosophical Society*.
2. Spawn brought the Berwick-Hays correspondence to light during Smith's first research trip to the APS, around 1998. The APS Librarians at the time did not know the papers existed, and Spawn came out of retirement to show Smith where the boxes of correspondence were kept. Many of the APS Archives remain unprocessed to this day and may reveal more details about the institution's conservation history.
3. Hanson is listed among the 1897 graduates of Drexel Institute Library School (*Library Journal* 1897, 358), and she remains the only female APS Librarian in the society's history, as well as the first of only two APS Librarians to have been trained as a librarian or archivist.
4. One of Portell's case studies involved Smith's treatment of George Washington's will, which had been previously restored by Berwick. Smith reversed prior repairs selectively, leaving Civil War–era sewing thread and Berwick's paper mends in place while removing stiffened silk and transparent paper mends that obscured the writing. Throughout the process, she worked with the will's present owners and other advisors to guide her treatment approach. Her intensive research for this re-treatment process led to the development of *Yours Respectfully, William Berwick*.

REFERENCES

Baker, J. 2004. FAIC oral history interview with Willman Spawn and Carol Spawn, April 24, 2004. Unpublished transcript. FAIC Oral History Files. Winterthur Museum, Library, and Archives, Winterthur, Delaware.

Berwick, W. Berwick-Hays correspondence. 1900–1920. Unpublished letters and treatment samples. Archives. American Philosophical Society, Philadelphia, Pennsylvania.

Brückle, I., and J. Dambrogio. 2000. "Paper Splitting: History and Modern Technology." *Journal of the American Institute for Conservation* 39 (3): 295–325. https://cool.culturalheritage.org/jaic/articles/jaic39-03-001.html.

Committee on the Library Minutes. May 21, 1941. Archives. American Philosophical Society, Philadelphia, Pennsylvania.

Committee on the Library Minutes. February 12, 1942. Archives. American Philosophical Society, Philadelphia, Pennsylvania.

Committee on the Library Minutes. October 21, 1942. Archives. American Philosophical Society, Philadelphia, Pennsylvania.

Committee on the Library. 1965. Unprocessed Executive Committee Files. Archives. American Philosophical Society, Philadelphia, Pennsylvania.

Eldridge, B. P. 2002. Carolyn Price Horton: 1909–2001. *Abbey Newsletter* 25 (5). https://cool.culturalheritage.org/byorg/abbey/an/an25/an25-5/an25-505.html.

Kyle, H. 1993. Conservation at the American Philosophical Society: An institutional profile in 1992. In *The Changing Role of Book Repair in ARL Libraries*. Washington, DC: Association of Research Libraries. 1–5.

"Library Schools and Training Classes." 1897. *Library Journal* 22 (7): 358–59.

Metzler, V. A. 2002. "An oral history of Fritz and Trudi Eberhardt, Conducted by Valerie A. Metzler, Archivist/Historian on 6 and 7 July 1993, at the Eberhardt Home Outside Schwenksville, Pennsylvania." *Guild of Bookworkers Journal* 37 (2): 8–99.

Minutes of the American Philosophical Society. 1774–1778. Archives. https://diglib.amphilsoc.org/islandora/object/text:167524.

Minutes of the American Philosophical Society. 1787–1793. Archives. https://diglib.amphilsoc.org/islandora/object/text:161419.

Minutes of the American Philosophical Society. 1793–1798. Archives. https://diglib.amphilsoc.org/islandora/object/text:169770.

Minutes of the American Philosophical Society. 1799–1804. Archives. https://diglib.amphilsoc.org/islandora/object/text:163793.

Minutes of the American Philosophical Society. 1805–1814. Archives. https://diglib.amphilsoc.org/islandora/object/text:163794.

Minutes of the American Philosophical Society. 1815–1825. Archives. https://diglib.amphilsoc.org/islandora/object/text:163997.

Minutes of the American Philosophical Society. 1834–1839. Archives. https://diglib.amphilsoc.org/islandora/object/text:167747.

Minutes of the American Philosophical Society. 1840–1842. Archives. https://diglib.amphilsoc.org/islandora/object/text:167815.

Minutes of the American Philosophical Society. 1842–1846. Archives. https://diglib.amphilsoc.org/islandora/object/text:167816.

"Minutes of the Meetings of the American Philosophical Society During 1929." 1929. *Proceedings of the American Philosophical Society* 68 (1): ix–xix. https://www.jstor.org/stable/984394.

Portell, J. P. 2003. "Prior Repairs: When Should They Be preserved?" *Journal of the American Institute for Conservation* 42(2): 363–80. https://cool.culturalheritage.org/jaic/articles/jaic42-02-010.html.

"Report of the Committee on Library for 1964." 1965. *Proceedings of the American Philosophical Society* 109: 187–98. https://www.jstor.org/stable/985857.

Rugh, C. P. 1935. Record of work done for the American Philosophical Society by Carol Rugh, May 6, 1935, to December 31, 1935. Unpublished conservation notes. Archives. American Philosophical Society, Philadelphia, Pennsylvania.

Rugh, C. P. 1937. Summary of 6 months restoration work at the American Philosophical Society, November 1, 1936–April 30, 1937. Unpublished conservation records. Archives. American Philosophical Society, Philadelphia, Pennsylvania.

Shryock, R. H. 1960. "The Planning and Formal Opening of Library Hall." *Proceedings of the American Philosophical Society* 104 (4): 349–56.

Smith, C. 2016. *Yours Respectfully, William Berwick: Paper Conservation in the United States and Western Europe, 1800 to 1935*. Ann Arbor, MI: Legacy Press.

Woodward, E. 2017. "The Epidemic in the Archives: A Layman's Guide to Cellulose Acetate Lamination." *RBM: A Journal of Rare Books, Manuscripts, and Cultural Heritage* 18 (2): 108–22. https://rbm.acrl.org/index.php/rbm/article/view/16820/18410.

FURTHER READING

Lindsey, A. 2002. "Conservation Experience in Working with Chrome Tanned Leather." *Book and Paper Group Annual* 21: 99–103. https://cool.culturalheritage.org/coolaic/sg/bpg/annual/v21/bpga21-21.pdf.

Lingelbach, W. E. 1946. "The Library of the American Philosophical Society." *William and Mary Quarterly* 3(1): 48–69. https://www.jstor.org/stable/1922895.

Veres, M. 2018. The American Philosophical Society: Celebrating 275 Years of Promoting Useful Knowledge. https://diglib.amphilsoc.org/labs/timeline-275-main/#event-the-american-philosophical-society-brh2celebrating-275-years-of-promoting-useful-knowledge-h2.

Veres, M. 2019. In the Heart of Philadelphia: The Story of Library Hall. https://diglib.amphilsoc.org/labs/Library-Hall/index.html.

RENÉE WOLCOTT
Associate Conservator of Library and Archival Materials
American Philosophical Society
Philadelphia, PA
rwolcott@amphilsoc.org

Abstracts presented during the Book and Paper Group Session

Thinking Beyond the Frame

Victoria Binder and Allison Brewer, Fine Arts Museums of San Francisco

For centuries, the frame has been the indisputable method of displaying two-dimensional artworks in Western society. The frame is versatile in appearance and forms a contained environment that protects the object. Yet it has its limitations. It can be costly, be incompatible with the object, and create a barrier between the viewer and the work. Endless frames on a gallery wall, typically in standard sizes, can sometimes create monotony and disengage the visitor. In this rapidly changing world, art institutions are shifting their approaches to engaging the audience, with trends toward immersive and dynamic exhibition environments. This includes the display of artwork and artifacts.

As exhibitions become more unconventional and lively, there is a need to think safely beyond the frame. For decades, the paper laboratory at the Fine Arts Museums of San Francisco has been developing safe alternative methods of displaying works on paper that present unique challenges with regard to size, material, and context. The honing of these methods over the years found its ultimate application in two recent major exhibitions at the de Young Museum, "The Summer of Love Experience: Art Fashion and Rock & Roll" (2017), and "Ed Hardy: Deeper Than Skin" (2019). Both exhibitions, celebrating creativity and countercultures, showcased a wide variety of works on paper and presented big challenges. "The Summer of Love Experience" consisted of more than 200 works on paper, including rock posters, album covers, ephemera, and a large 10 × 21 ft. screenprint billboard. "Ed Hardy: Deeper Than Skin" featured nearly 400 of Hardy's tattoo and fine arts pieces, including conventional prints, drawings on delicate ruled paper, tattoo parlor flash art on illustration board, preparatory drawings on tracing paper, works on thick amate paper, and large Tyvek paintings, including one 500 ft. long scroll. To honor the original intent of the works and the vibrant and nontraditional nature of the art, and (not the least concern) the budgets for the exhibitions, alternative display methods were required. Solutions for these multifaceted exhibitions required close collaboration with curators, designers, and technicians. Methods of display included the use of rare earth magnets and presenting many works on paper uncovered, in different ways. Acrylic sandwiches, generally frowned upon, were also successfully employed and turned out to be a huge cost savings.

Display solutions necessitated a balance of creativity and safety, and despite many unconventional display techniques, no art was harmed during the course of the exhibition. The logistics of treating and mounting so many artworks in a short period of time also demanded streamlined systems. One of the outcomes beyond the exhibition itself was the development of a test kitchen for display methods, a permanent showroom wall with the various possibilities for display.

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

Laid Bare: Preserving Our Nation's History in View of the Public at the National Park Service

Angela Campbell, Senior Conservator, National Park Service

As is clearly laid out in its mission statement, the National Park Service (NPS) "preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations." Although the majority of the public associates the NPS with its natural resources, its cultural resource holdings exceed 50 million artifacts, reflecting the broad and diverse and often painful history of our nation. More than half of these artifacts are in collections located in the NPS's Northeast Region (Region 1), which extends from Virginia to Maine. As a conservator for the NPS, I am routinely faced with the challenges of both encouraging the exposure of these artifacts "for the enjoyment, education, and inspiration of this and future generations," as well as ensuring their preservation and safety. Two distinct projects revealed some of the inherent tensions between these responsibilities: the Zuber wallpaper in the dining hall at the Martin Van Buren National Historic Site and a large mural at the Salem Maritime National Historic Site.

The Martin Van Buren National Historic Site, like all national parks, is tasked with sharing its cultural resources with the public. The site is home to a beautifully conserved Zuber wallpaper in what was used as the main dining hall of our eighth president's home in Kinderhook, New York. The spectacular wallpaper, depicting a hunting scene, was precious when it was purchased by Van Buren, who was eager to display his sophistication, and it was displayed on the walls of the home without pause for almost 200 years, at which point the paper was in such a state of disrepair that two conservators, James and Patricia Hamm, removed the paper for an in-depth, off-site treatment. The paper was returned to the walls of the home in the 1980s, and it is a source of pride for the park to be able to allow visitors to walk through the space to view the wallpaper that bore witness to the dealings of eminent 19th-century dignitaries and politicians.

Unfortunately, environmental fluctuations and the lingering hands of visitors have caused minor but repeated damage to the paper. In an effort to share the story of the wallpaper, as well as the importance of its preservation, I was invited to participate alongside an interpretive Park Ranger in making a short film, titled *Saving the Scene: National Park Service Conservation of Martin Van Buren's Zuber Wallpaper at Lindenwald*. Since the paper is on view in an historic home, and access is limited to small groups of visitors on guided tours, the park's challenge is to figure out a way to provide a window into the site for a broader public. To do this, the park enlisted a filmmaker and cinematographer to make a high-quality video that could be shared with the ark's virtual visitors through Facebook. The film is about seven minutes long and allows anyone who follows the Martin Van Buren National Historic Site to learn more about the historic home and the conservation of the Zuber wallpaper.

Across state lines, the Salem Maritime National Historic Site in Massachusetts, the first National Historic Site established in the United States, is home to 12 historic structures and all the paper and paper-based objects that go with them. In 1978, when a historic structure newly acquired by the NPS was being renovated, an intricate wall mural comprising approximately 1,000 faces and figures individually cut from performance posters local to the area was discovered. The faces were adhered directly to what was, at the time, the wallpapered wall of a meeting space. In an effort to preserve the mural, the piece was cut out of the wall, with horsehair plaster and lath intact, and placed into storage without fanfare. Since the mural was too large to treat in the regional laboratory based in Lowell, Massachusetts, the piece was treated on site, in the Salem Maritime National Historic Site Visitor Center, beginning in 2017.

The Visitor Center is open to the public and, despite being an NPS building, is treated by tourists as a gateway to all that Salem has to offer. Since the mural is both visually arresting and enormous, hundreds of visitors from all walks of life, visiting for any number of reasons, engaged with the project. I worked closely with both the curatorial staff and the interpretive staff at the park to ensure a clear message, particularly when discussing some of the more culturally and racially charged elements of the mural.

The large scale of the mural and unusual nature of the materials contributed to the complexity of the treatment. Initially, the parameters of the project were limited to removing an unevenly applied, very-discolored coating layer that substantially obscured the many variations of lithographed color on the printed faces. After a variety of removal techniques were tested, including mechanical removal with a micro scalpel and solvent-based gel systems, an acetone-based gel was successfully applied and the coating layer was reduced with relative ease.

As the coating layer was gradually reduced, the colors of the underlying lithographs appeared bolder and more vibrant. Throughout the process, visitors to the Salem Maritime National Historic Site asked questions and engaged with both me and Sarah Freshnock, who was working as an intern and assistant on the project. Most people asked a few questions and then wandered off to the bathroom or in search of witch-related sights and signage, but occasionally someone would spend more time looking closely at the faces and ask about the figures in blackface cut from advertisement posters for minstrel shows. Originally, I planned to touch briefly on that particular element of the project, but in light of current events, I believe the intersection of 19th-century Salem and today's racial awareness deserves more focused attention.

Prior to beginning treatment, the curator of the Salem Maritime National Historic Site, Emily Murphy, and I had many discussions about our roles in preserving the mural: inevitably, we were going to be asked about the figures, and we wanted to be clear in our message to the public. Signs were erected around the mural explaining some conservation basics, as well as some of Salem's complex and infamously intolerant past. The message was this: in keeping with the NPS mission statement, the intent was to preserve *unimpaired* this cultural artifact, a part of Salem's local history, for the education of future generations. That said, the piece was removed from the Visitor Center after treatment and relocated indefinitely into park office space, where it remains framed and hung on the wall today. The space is used for public events, but the less frequently visited space allows for clearer interpretation and conversation.

There have been countless examples in recent years, months, and even days relating specifically to the display of culturally insensitive and racially oppressive artifacts. Some have been destroyed, many have been damaged, and many more have been relocated to storage quietly and indefinitely. It is intimidating to be in a position to discuss the ethics surrounding these issues. It is easy to fall back on job descriptions and mission statements and to say that it is not a matter of personal choice or preference. But in the broader sense, we know that is untrue. Public opinion, consisting of thousands of individual opinions, sways legal rulings and official guidance. As a body of conservators, we are tasked with preserving the cultural heritage of the world, and according to the AIC Code of Ethics and Guidelines for Practice, we are governed by "an informed respect for the cultural property, its unique character and significance, and the people or person who created it." Similarly, the code states that we are obligated to "promote an awareness and understanding of conservation through open communication with allied professionals and the public." Adhering to that code puts us in a position fraught with insincerity. In addition, the NPS mission statement is clear in stating that the work of preservation is for "the *enjoyment*, education, and *inspiration* of this and future generations." Are we as conservators to show respect for an artist's blatant displays of racism? Or the collecting tendencies and social-climbing instincts of an American president who owned enslaved Africans? Are the insulting figures we have preserved enjoyable to the public? Are they inspirational? Is our only option to scurry everything off to storage? Technically not destroying it, but also technically not allowing it to exist as it was meant to? I don't know the answer. In many ways, each situation is unique. We can look to other countries and other examples for ways to successfully navigate these issues, but ultimately we as a field should approach these projects with as much sensitivity and open-mindedness as possible and should perhaps place greater value on the voices of people who have endured centuries of systematic oppression being spoken over by firmly established mission statements and rules created by a predominantly white, single-sided perspective. It is my hope that we can engage in conversations that allow us, as a field, to make informed decisions based on input from the broadest possible community for whom we carry out our work.

The views and opinions of the author or any federal employee interviewed for this publication do not state or reflect those of the U.S. government.

Varnished Artworks Created by Children During Art Therapy Sessions: Legal and Material Considerations

Laura McCann, Conservation Librarian, New York University Libraries, and Chantal Stein, Annette de la Renta Fellow in Objects Conservation, Metropolitan Museum of Art

A novel conservation challenge arose during research into varnished artworks on paper created by children during art therapy sessions at the Wiltwyck School for Boys from 1951 to 1957. The artworks are part of a large collection that documents the life and work of artist and pioneering art therapist Edith Kramer. As products of art therapy, the artworks are not only art; they are also medical documents, subject to specific regulations in the United States. These regulations impact conservation goals and documentation protocols. This presentation will detail analysis undertaken to identify the materials to best conserve the works, and will then describe how that analysis informed actions to make the works available to researchers while ensuring legal compliance with the health care privacy laws in the United States.

Although Kramer used pseudonyms in her publications, most of the artworks reveal private health information that must be withheld for 50 years after the death of the art therapy recipient, according to health care privacy laws. Restricting access to the collection for up to 100 years (many of the artists are still alive) was considered an unacceptable option. Therefore, the conservation goals included temporarily obscuring access to private health information until the restrictions are lifted. The 42 expressive works under discussion depict a range of subject matter, including people, animals, objects, fantastical beasts, and cityscapes. They are executed in charcoal, graphite, and/or matte opaque paint. Kramer then hastily coated the surfaces with a brush-applied varnish she describes as "plastic paint." The unevenly applied varnish is grayish in tone, slightly tacky, and contains many bubbles and accretions. Application of the varnish disturbed the original media, dramatically altering the surface texture from matte opaque to semigloss. Microchemical spot testing, SEM-EDS, and FTIR analysis were undertaken to study the varnish and paint media. The methodology will be presented along with the results that suggest that the varnish is a PMMA product and that the paint includes a polysaccharide binder and various inorganic extenders, informed by the analysis and research into brush-applied acrylic-based varnishes available.

In the 1950s in the United States, a number of mounting strategies were employed that temporarily obstruct access to the private health information until the privacy regulations expire. Where the noninterventive mounting techniques could not block access to private health data, an interventive solution was developed that involved applying toned paper patches over the private information. These patches are visible and easily removable by future conservators without impacting the varnish layers but are not overly intrusive to the viewer. Reversibility is required, as once the privacy restrictions expire, the patches can be removed. The specific protocols were developed in collaboration with archivists to ensure that documentation practices adhered to the privacy regulations and that the composition and function of the obscuring mounts and patches are communicated to all stakeholders. These protocols provide a model for sharing conservation data with current and future stakeholders.

JESSAMY GLOOR AND LAUREN TELEPAK
DISCUSSION GROUP CO-CHAIRS

Library Collections Conservation Discussion Group 2020
When Damage Has Meaning: How Conservation Interacts with Interpretation

INTRODUCTION

The Library Collections Conservation Discussion Group held a virtual panel of two curators, an archivist, and five conservators to discuss their encounters and relationships with damage and with signs of use and creation. The panelists shared examples of damage that tells stories, approaches to treatment (or nontreatment) for this damage, the importance of strong conservator-curator/archivist communication in decision making, and how conservators can add and contribute to the interpretation of library materials. The discussion centered on decision making around damaged materials, communication, and sharing expertise with a wider audience.

SUMMARY OF PRESENTATIONS

VICTORIA STEVENS
APPETITE FOR DESTRUCTION: THE JUDGMENTS BEHIND THE CONSERVATION OF INTENTIONAL AND UNINTENTIONAL DAMAGE

Victoria Stevens looked at three separate objects to examine the definition of damage and how it can function as an integral part of these objects' stories. She used these examples to show that an understanding of damage and how it occurred must be factored into a conservator's decisions.

The Distribution Book of the Salters' Company, one of the great Livery Companies of the City of London, was the first example. The book was a 1609 stationery binding that covered 173 years of the company's charitable giving. It was saved unscathed from the 1666 Great Fire of London but was badly damaged in World War II when the cellar where it was kept for safety exploded from a buildup of gasses in 1945. Stevens categorized the volume's history of damage into several categories. The first was "constructional evidence and damage," or damage that occurred during the creation of the object, in this case, rope marks from the drying process. The marks evoke the drying loft of a 17th-century paper mill, contrasting with the blemish-free paper manufactured today, and remind us of the type of damage that paper conservators avoid at all costs in their own treatments. Unfortunately, the rope line created a weakness throughout the text block. Next was "evidential damage through use." Here these were signs of prefire use from handling, such as ingrained surface dirt, especially in the fore edge and lower half, and gaps between sections. "Evidential damage through use and abuse" was the most dramatic category. The scorching and fire damage from the World War II explosion caused extensive embrittlement, cracking, and discoloration, and left a 4-cm halo around the edges of the text block. This damage was accelerated through use, resulting in extensive edge tears, chipping, and losses. The final example of both use and abuse was where a scribe folded the pages vertically to create straight columns. Like the rope marks, when combined with the explosion damage, these creases were now more liable to split and tear. Stevens took a delicate approach to strengthen these areas, using RKO 100% kozo Japanese paper with wheat starch paste in the most vulnerable areas, switching to RKO remoistenable tissue with 3% gelatin where there was iron gall ink media, and avoiding the media whenever possible. In this way, the evidence of creation, use, damage, and abuse were all maintained while allowing the book to be used.

T. E. Lawrence's undergraduate thesis manuscript of 1910 was the next example. The volume was the Jesus College's examiner's copy and included Lawrence's margin annotations in preparation for publication in 1936. Lawrence was one of the first scholars to complete an undergraduate thesis, and the thesis covered his trek on foot through what is now Syria. He studied the crusader castles and reported his findings in a typescript that he almost certainly constructed into a

This open discussion took place *virtually* on August 4, 2020, during AIC's 48th annual meeting. The moderators organized and led the discussion and recorded notes. Readers are reminded that the moderators do not necessarily endorse all comments recorded, and although every effort was made to record proceedings accurately, further evaluation or research is advised before incorporating any observations into practice.

text block himself, in a rough guard book style using an over-stitched sewing method. He inserted drawings, photographs, postcards, and maps on homemade guards. The text is full of character, including Lawrence's apologies to his tutor for not being able to map out accurate floor plan measurements of a particular keep due to their being "a lusty colony of snakes" at the base of the tower, or apologizing again to his publisher for his lack of detail as he "had malaria rather heavy these days."

Lawrence trimmed the support pages by hand, as shown by jagged scissor cuts, sometimes into the pages below. These accidental cuts, clear evidence of Lawrence's working methods and a glimpse of that instant when he must have realized he was cutting more than the page he intended, were in the tail gutter and on thin paper. Stevens made the decision to repair these accidental cuts because of their vulnerable position, but again with a delicate approach to preserve the evidence.

The final example was a 1798 publisher's proof copy of William Wordsworth's *Lyrical Ballads*, his first collection of poems created with his friend and fellow Romantic poet Samuel Taylor Coleridge. Several corrections needed to be made, and to show that this was a rejected proof, the printer spoiled the copy by tearing several inches into the first leaf. (In the following, see Hosselkus and Johnson's presentation for one way to correct already-printed copies and Ryan and Wingfield's presentation for a more dramatic way to reject a proof.) Without this background information, the tear just appeared to be severe handling damage, in a vulnerable position, at the front of the text on this beautiful and important first edition copy. Stevens repaired it and only learned of the tear's significance later. Thanks to reversibility, Stevens was able to remove her repair. Without the tear, the book is just another valuable first edition. With the tear, the volume is part of the story of the creation of this well-known text, and like the first two examples, a precious survivor. All three examples illustrate the importance of taking a step back before treating damage or signs of use, to understand where they come from and what they mean.

Victoria Stevens, ACR, Library and Archive Conservation and Preservation Ltd., UK

TODD PATTISON
THE ROLE OF CONSERVATION IN THE ELECTRONIC AGE

Todd Pattison used damage to highlight the conservator's key role in interpreting physical evidence, and the fallacy of using a single digitized book to represent an entire printed edition.

The digital version of one copy of a printed book is often considered to represent all physical copies created, regardless of the copies' individual histories. Digitization projects attempt to capture "the best possible image," with damage being a problem to be "reversed" by conservators, who return the book to an idealized state for digital capture. Instead, Pattison argues, the variation in production and the visible damage in these volumes is valuable information about the dissemination and consumption of printed books. Conservators, with their specialized knowledge and skills, are best placed to recognize and interpret the significance of damage.

Pattison's first example showed how production damage can illuminate a book's creation process. *Six Months in a Convent*, the narrative of Rebecca Reed, who claimed to have been under the influence of Roman Catholics, was issued during the height of anti-Catholic sentiment in Boston. Predicting a hit, the publishers had the text stereotyped before printing. These thin metal stereotype plates could then be easily reprinted without the additional cost of resetting the type. The publishers struggled to keep up with demand in March and April of 1835, printing more than 50,000 volumes by the fall of that year.

Benjamin Bradley's bindery was able to meet the ambitious production schedule, completing as many as 1300 bindings a day. Although these were cloth publishers' bindings, Bradley used four different board decorations, and close examination of damage to the text and covers tells more of the binding story. Even though the text was printed from stereotyped plates, the copies are not identical. The metal plates were put on and taken off the press bed many times, apparently somewhat carelessly, to produce the 50,000 volumes. With Arielle Rambo, chief of cataloging at the Library Company of Philadelphia, Pattison identified 31 instances of significant damage to the plates, such as loss of text at the bottom of one page and a long scratch on a different page. Examining 39 physical copies and 5 digital copies allowed them to order the copies chronologically by the degree of damage.

This allowed the librarian and conservator pair to determine the sequence of the different covers in this edition. In the first two bindings, Bradley used dies he already had on hand, which included his signature, presumably while waiting for an overall brass die specifically commissioned for this book. This overall die appears on the third binding, without his signature. Bradley then had his signature engraved on the die, resulting in the fourth and final binding. About 90% of the bindings have this fourth, signed overall die, and more than 95% of the extant bindings include the Bradley name somewhere. Besides receiving about $5000 for this one book, Bradley issued almost 50,000 books advertising his bindery on the covers, a powerful marketing tool that the publisher failed to recognize.

The next example was the adhered-board binding structure. Here, boards are attached to the text prior to covering, using a leaf or stub of the endsheet construction, and the boards are not laced on with the sewing supports. This structure was widely used during the same period that case binding was first introduced, and books bound this way can often be misidentified as case bindings if there is no damage to make the structure visible. The skills, experience, and expertise of a conservator are often critical for distinguishing between these binding methods.

Once the adhesive is applied and the pastedowns are put up, it is difficult to distinguish between the attaching leaf and an extended spine lining, which is sandwiched between the board and pastedown on many case bindings. Raking light on one example illuminated the attaching leaf's location underneath the covering material, showing that the boards were attached prior to covering, unlike in case binding.

Removing later, damaging endpapers on an 1838 binding revealed the adhered-boards' structure of another binding. In addition, the cloth was trimmed extremely close at the bottom edge, and the binder used one of the clipped corners to cover the board. There is a readily available digitized version of this text, so this copy becomes more useful for its physical characteristics, which show not only how binders were working but also their attitudes about what was good enough to sell. For this reason, Pattison did not treat this volume further, and encourages conservators, especially in library settings, to expand their roles to interpret and convey physical aspects of bound volumes to curators and library users.

Pattison also used conservation skills to carefully deconstruct some examples acquired specifically for this research. They were treated with certain conservation principles in mind, especially that the deconstruction could be reversed in the future, by re-adhering the pastedown that Pattison lifted. He proposes that conservators may occasionally selectively deconstruct objects for teaching or research purposes, especially when those objects are as plentiful as the industrialized book of the 19th century.

Digital surrogates are convenient, and libraries will steadily move toward their creation and use, performing more "advanced" weeding of collections, if conservators do not help make the argument for physical objects. To stay relevant and continue to tie conservation toward institutional missions, Pattison advocates that conservators use their skills to facilitate research and pedagogy more fully, especially as conservators are often in the best position to illuminate various aspects of material production and use.

The digital capture of one object will never fully capture all of the information represented by a group of objects, especially for printed books. The same is true when looking at conservation. Rather than try to return objects to some "ideal state," we need to preserve all of the information, often including damage that we might initially consider treating, and then we must be able to identify, explain, and communicate the significance of that damage to others.

Todd Pattison, conservator, New England Historic Genealogical Society

ELIZABETH RYAN AND REBECCA WINGFIELD
SALVAGED FROM LAKE ERIE: CONSERVING GINSBERG'S IMPROVISED POETICS AND PRESERVING A STORY

Elizabeth Ryan and Rebecca Wingfield used examples from Stanford University Libraries' Allen Ginsberg papers to illustrate a system for balancing the competing demands of historical authenticity, long-term preservation, and user access. The 1300 linear ft. collection is one of the libraries' most heavily used, and the ephemeral nature of parts of the collection and its traces of use and abuse are all part of the story it tells.

Wingfield used the original draft of "Howl," and its materiality, to illustrate Ginsberg's centrality in the Beat Generation, plus why these materials are requested for exhibitions both at Stanford and internationally. Ginsberg typed this first draft on three-hole punch paper in a burst of inspiration. Ginsberg then folded and mailed the draft to Jack Kerouac for his critique. Kerouac then mailed the draft to another friend, John Clellon Holmes. The draft, on its fragile paper and with multiple folds, documents both the spontaneous creative process and the importance of circulating drafts and soliciting criticism.

The collection is also popular for teaching and shows students not only the various drafts of poems but also that poetry involves more than just writing texts. Audio and visual recordings document collaborative readings in bars, clubs, and campus auditoriums, highlighting the ephemeral and performative aspect of Beat poetry. Handmade construction paper flyers, handbills, beard trimmings, and Ginsberg's shoes round out the picture.

In 2016, an antiquarian dealer offered Stanford University Libraries one of the original proofs of Ginsberg's 1971 work *Improvised Poetics*, initially printed by Anonym Press in an edition of a thousand. Ginsberg was unhappy with the book's design and the numerous typographical errors, and the publication was abandoned. Legend says the edition was dumped into Lake Erie by the publisher, but several copies were salvaged by an enterprising fan with a rake.

Unsurprisingly, this copy shows severe water damage. Stanford already held a copy of the corrected 1972 edition but was missing this original proof printing, which adds more layers to the text's creation. Wingfield brought the conservation department into the discussion to start strategizing about how to preserve this damage while still allowing researchers and students to use the item.

Ryan said the book generated considerable interest at the monthly conservation department meeting. Their conservation laboratory is remote from the libraries and uses the online tracking tool Jira to take curator and collection manager requests. The system includes space for bibliographic details and other relevant information. The department also holds campus office hours for in-person consultations (and has plans to continue these via Zoom during the pandemic) and uses collaboration tools for file sharing. Ryan emphasized that it is helpful to have multiple communication channels.

Physically, this *Improvised Poetics* volume is a single section of folios with a laminated paper cover wrapper attached with staples. Water damage, detached and torn covers and leaves, mold, and corroded staples were all problems to be addressed within the context of Wingfield's request to keep the damage from submersion visible. Ryan proposed a treatment to stabilize the book, and Wingfield agreed, with the caveat that after treatment it should be clear that this item had been underwater for a while. Staples and surface corrosion were removed and inactive mold vacuumed. Torn leaves were repaired, and the covers and pages joined with toned chochin Japanese paper. The covers were consolidated with paste and attached to the existing folios with loops of linen thread passed through the existing staple holes.

This copy is signed by Allen Ginsberg and came with a ticket stub, adding another chapter to the story. According to the dealer's description, this book was signed at a 1986 Detroit event. The owner relayed that at first Ginsberg refused to sign this copy, having disavowed the book, but finally relented for the sake of their friendship. The ticket stub was placed in a Mylar L-sleeve and is stored with the book in a custom corrugated box. This background story is recorded in the treatment documentation.

Ryan referenced Fiona McLees' ICON Book and Paper Group presentation on the conservation of three Franz Kafka manuscripts at the Bodleian Library, "From author's draft to select library holding: the metamorphosis of Franz Kafka's manuscripts." McLees offered a framework for evaluating conservation treatment outcomes from access, user, and stakeholder perspectives, acknowledging the sometimes-uneven effects that even small treatments and enclosures can have on intangible qualities. Ryan believes that the *Improvised Poetics* treatment has had a favorable outcome within this framework. The volume retains that intangible quality, the aura of a Beat-era lake-dump survivor. In this case, the paper was not brittle, and all parts were there, so it was possible to return the item to its original format. This balance is often difficult to achieve with other modern ephemeral materials, and layers of housing may be needed to enable users to safely view brittle pages. This runs counter to the intention of items that were produced with casual regard for longevity. Damage that happens because of this attitude is part of the story, and balancing this intangible quality with physical conservation is a challenge that benefits from research use and curatorial perspectives.

Ryan pointed to recent talks and discussions that address the problematic lack of diverse perspectives in cultural heritage preservation, which ask whose stories conservators may be erasing. Cultural aesthetics and historic perspectives about damaged objects vary, and seemingly small decisions made at the bench accumulate and contribute to a larger narrative, further emphasizing the importance of thoughtful and collaborative decision making. Making documentation accessible and widely available promotes transparency about conservators' work and decision making. Preservation department head Kristen St. John and operations manager Ryan Lieu have been working with the Linked Conservation Data Project so that the profession can more easily share observations and practices. On an institutional level, the department is currently revising their treatment documentation forms so they can feed into metadata created by other library departments. These records will eventually link to Stanford University Libraries' catalog, making them available for anyone to learn which interventions have been made by conservators, and the rationale behind these decisions.

Elizabeth Ryan, conservator, Stanford University Libraries
Dr. Rebecca Wingfield, curator for American and British literature, Stanford University Libraries

ERIKA HOSSELKUS AND JEN HUNT JOHNSON INTENTIONAL ACCIDENTS: IDENTIFYING CORRECTIONS IN EARLY PRINTED MATERIAL

Jen Hunt Johnson and Erika Hosselkus discussed their discovery of the intentional use of iron gall ink to edit the text in an early printed Peruvian periodical, *Gaceta de Lima*. Ongoing research seeks to understand how extensive these corrections were, to confirm the point at which they were made, and to understand what this might reveal about printing in colonial Peru.

Iron gall ink burn-through is a common occurrence in many early manuscripts. Although burn-through is generally an unfortunate and unintended consequence of iron corrosion, one example at the University of Notre Dame's Hesburgh Libraries proved to be clearly intended. The *Gaceta de Lima*, an early printed Peruvian periodical (1749–1776) came to the conservation unit in preparation for the exhibit *In a Civilized Nation: Newspapers, Magazines and the Print Revolution in Nineteenth-Century Peru*. During the course of treatment, an unusual burn mark was discovered obliterating a single word in the printed text in one issue of the periodical (November 1759–January 1760). The mark was suspicious, as it burned completely through the page but was controlled and isolated. A second mark was later found in an earlier issue (March 1758–April 1758), this time partially obliterating a single word of text.

The *Gaceta de Lima* is Peru's earliest official newspaper. It began regular and continuous publication in 1744 when Peru was still a colony of Spain. The paper served as the mouthpiece of the colony's highest officials. The University of Notre Dame holds one of the few extant collections of this important newspaper, including at least 15 unique issues held nowhere else. The *Gaceta de Lima* regularly reported on the health of colonial officials, epidemics, civic and religious festivals and processions, city council elections, arrivals and departures of ships in the Peruvian capital, and other occurrences of public interest, and was published through the 1770s.

Hosselkus wanted to display multiple issues of the *Gaceta de Lima* to fill an entire flat case in the exhibition. The

University of Notre Dame's collection, acquired in the mid-1990s, arrived in a red 19th-century binding that had broken into chunks over time. Faced with this challenge, Hosselkus approached Johnson to discuss conservation treatment options for the *Gaceta de Lima*.

Hosselkus and Johnson ultimately decided to disbind the volume to reflect how the issues were originally disseminated and to permit the display of multiple issues simultaneously. Holes and stains in an early text usually do not signify anything unusual, but in thinking about what created a mysterious burn mark, Johnson realized that this did not look like accidental damage. It clearly had the appearance of being burned or corroded along the edges, but the burn appeared too controlled and too perfect, only obliterating a single word in the printed text.

In working through the leaves, the second instance of damage was discovered, but here the cause of the damage was far more obvious. Magnification revealed that a brown substance had been applied on top of the printed text, and surrounding the word was a rust-colored halo, consistent in appearance with the damage observed with corroded iron gall ink. These areas of damage were determined to be intentional strikeouts, made to correct the printed text, as opposed to accidents of chance. In the previous example, the burn-through of the iron gall ink had been so accelerated that the entire word disappeared in the fallout. For confirmation, they collaborated with Dr. Khachatur Manukyan, a colleague in the nuclear physics laboratory on campus to analyze samples throughout the text using XRF. The results showed high concentrations of iron in the areas with the brown substance.

Excitingly, these corrections are not unique to the copy at Notre Dame. The John Carter Brown Library at Brown University also holds a copy that features these same corrections. One word is struck out—"electo," or "elect"—and was likely corrected to reflect that the individual under discussion, a bishop, had already assumed office by the time this issue went to press. This was an official publication, so titles and status designations were likely particularly important, making a hand correction worthwhile. This technique has implications for understanding early printing practices, particularly those that may be unique to an early periodical publication. Continued research aims to determine how common such handmade corrections were, whether certain printers made them while others did not, and what the content of the corrected text reveals about such editorial efforts. This project has also led to an interest in other ink markings that appear to have been made by readers, rather than printers, prompting questions about how readers interacted with these early newspapers.

Treatment for the *Gaceta de Lima* continued as planned, but no efforts beyond documentation were made to address the areas damaged by the corroded ink. The issues were disbound, guarded with lightweight kozo paper and wheat starch paste, and then resewn as individual pamphlets, grouped as initially issued. They were housed individually in acid-free folders and stored flat with the library's rare boxed items.

It can be easy to dismiss minor damage in early printed material, particularly in books or publications where there is a significant amount of physical material. This project provided a great reminder of the tiny clues that materials give us to offer more context and that a successful conservator-curator relationship provides opportunities to explore these questions and make new discoveries that might otherwise be overlooked.

Dr. Erika Hosselkus, special collections curator and subject specialist for Latin American studies, University of Notre Dame
Jen Hunt Johnson, special collections conservator, University of Notre Dame

QUINN FERRIS AND SIOBHAN MCKISSIC
RECONSIDERING DAMAGE: COLLABORATIVE APPROACHES TO THE CONSERVATION OF THE GWENDOLYN BROOKS' ARCHIVAL COLLECTION

Quinn Ferris and Siobhan McKissic reflected on their work with the Gwendolyn Brooks' Archival Collection. They used the thought processes and the questions that arose around their collaboration as a conservator and an archivist with this collection to begin a discussion about a shift in approaching conservation treatment, especially for archival collections.

Gwendolyn Brooks was one of the most influential American poets of the 20th century. Born in 1917, she came of age in Bronzeville, Chicago. Her poetry shone a light into the small and large happenings of Black life on Chicago's Southside, and she used her work as a poet and educator to uplift the voices of Black writers and advocate for issues that affected Black people. Brooks received significant recognition and acclaim when she received the Pulitzer Prize for poetry in 1950 for her book *Annie Allen*, making her the first Black person to win in any category. She was the Poet Laureate for the State of Illinois from 1968 until her death in 2000 and served as the Consultant in Poetry to the Library of Congress in 1985, a position now known as the US Poet Laureate.

The Brooks Collection is defined by the wide range of materials and the editorial marginalia and labeling Brooks left behind on those objects. Brooks wrote verses on her grocery lists, pasted clippings onto other clippings, and bundled photographs in albums, one behind the next. She created new layers of meaning by reworking drafts of poems already published. As she tore lines of poetry out of her notebooks, ripped photographs, clipped the corners of correspondence, and taped addresses to the backs of the many cards she received, her papers became a sweeping reflection of her personality, her awareness of her legacy, and her desire to impose a distinctive organization.

The first attempt to conserve this collection came in anticipation of an exhibit at the Poetry Foundation in Chicago in 2017 curated by Anna Chen, a former rare book curator, which opened a series of dialogs and investigations between herself and Ferris around the notions of damage, best practices, and stewardship. Once McKissic took over the management of the collection in 2018, she joined Ferris in this work and they began to draw further connections between those earlier conversations and how they align with broader questions of social justice and inclusivity in both special collections libraries and library conservation.

The treatment approach, although basic in methodology, challenges established notions of how conservation should (or should not) be perceived. Ferris and McKissic wanted to avoid adding a layer of conservation "interpretation." Instead, Ferris used conspicuous repair, and high-contrast loss compensation, to maintain the evidence of intentional damage. This treatment philosophy is intended to honor both the "damage" to the collection as part of its life, as well as the need to use the archive in perpetuity as part of a research collection.

Ferris and McKissic note that *damage* in conservation is defined as "physical harm caused to something in such a way as to impair its value, usefulness, or normal function." So what do we do when we encounter an object whose value is specifically derived from or enhanced by the damage that has occurred? Furthermore, how do we reconcile the creator's use of materials, like pressure-sensitive tape, that we have learned are inherently bad when their existence is inextricably linked to the value of the item? When damage is viewed in the pejorative, it frames conservators as the people charged to fix or correct that damage, which has historically led to unintended misinterpretations and prescriptive attitudes about caring for collections. Ferris and McKissic not only implore the audience to begin interrogating standards of practice that prioritize a right way of doing things without acknowledging nuances in a particular collection or item but also their own motivations that can result in unintentional loss of context and/or unequal treatments for related materials within a single collection.

The speakers also pointed out that if we choose to take on the responsibility of fixing an object before it is damaged "further," we should ask how we are leaving the user out of the conversation. How are we othering and belittling the user's knowledge before they have even entered the room? And finally, how can "showing our work" and making conspicuous treatments give users back one of their senses and recognize the true fragility of an item? If patrons can see the "bandage," they will know to be gentle, which will extend the life of collections while increasing use and engagement in the field of preservation and conservation.

The presenters proposed the need for a paradigm shift—not to the treatment methodology itself, but to the intellectual framework around that methodology. They propose that we should reconsider damage, both intentional and incidental, in our collections. An unconcealed treatment approach gives the user more information about the history of the object and about its creator's intentional care practices. McKissic and Ferris suggest that just because conservation professionals have the skills to remove the tape, reconsolidate broken objects, and artfully conceal areas of repair and compensation, it does not always mean they should. The nature of the relationship between archivist/curator and conservator needs to deepen beyond just writing treatment proposals and granting approval into a symbiotic partnership in the care and advocacy of collections. Finally, this connection between conservator and curator/archivist also needs to extend out to the users, considering them as part of the "community of care," especially when a collection is defined by damage and removal.

Quinn Ferris, senior conservator for special collections, University of Illinois at Urbana-Champaign
Siobhan McKissic, archival and literary manuscript specialist, University of Illinois at Urbana-Champaign

DISCUSSION

After the presentations, the moderators took questions and comments from the chat box and read them to the panelists. The answers have been paraphrased.

Question: For the conservator plus curator/archivist duos: What advice do you have for strengthening and maintaining open channels of communication between our professions?

Ferris: One thing that has made this collaboration exciting is that Siobhan [McKissic] and I are friends, but you can't always count on that being an element of a working relationship. We've had a lot of discussions recently about conservators getting a seat at the table and being included in discussions, and that's really a two-way street. If we want to be brought into consideration by our allied professionals, we also should bring them into conversations that we have internally and make them feel like our partners. The more that happens, the more there will be opportunities for it to happen, and the more there will be opportunities for co-educational scenarios or collaborative projects.

Wingfield: For *Improvised Poetics*, an engagement with conservation started at the point of acquisition. I knew upfront that I had questions about this item, how usable it was going to be, and what kind of treatment it might need. I also had concerns about wanting to preserve that damage, because it was central to what the object is and its history. Echoing the earlier comment, it's about recognizing our respective strengths, specializations, and professional knowledge. As a curator, I have had conservators come into classes so that students can learn how a conservator and curator see different things in a single object. I'm trained as a literary critic, so I tend to want to go right to the text, whereas a conservator goes right to the material aspects. This is another way to build that connection between curators and conservators.

Johnson: At Notre Dame, curators and conservation meet once a month to go over treatments. This has been a great way to share some of the work we're doing and to open up conversations with our curators. I give a lot of credit to our department head, Liz Dube, for keeping that going. Curators can share their knowledge of materials as well, which develops mutual respect between both sides of the table that allows some of these conversations to come up down the road. When I noticed this issue in the *Gaceta de Lima*, my first thought was to share with Erica [Hosselkus] and see if she could add information to help me understand what that mark might be. Asking "How can we educate each other?" and "How can we learn from each other?" is important in developing those relationships.

Ryan: It was a pleasure to join Rebecca [Wingfield] in a class in special collections to talk about the conservation of the James Joyce *Ulysses* first edition. This was an opportunity to watch students use and interact with collection materials we worked on. I think that having that kind of experience in the reading room as a conservator helps us think about our work through a user's or researcher's lens. We also do monthly office hours on campus, and our department head, Kristen St. John, is on campus and engaged in what's happening there. This is very helpful, and in our relationship with curators, we often present a range of options from less to more invasive and so create a dialogue about how far to take a treatment, which really helps to inform how we make our decisions.

Stevens: The dialogue between archivists or librarians and conservators is the key to everything because we're both going toward similar goals, which is use. Without that discussion about how an object is going to be used or the scope for its use, conservation is completely bound and, in the worst-case scenario, is pointless. There are no reasons why wonderful collections that require careful handling can't be accessed in a physical way, with some thought between conservators and curators. It's all about touch, feel, smell, sound—all those things that make these objects really come alive. Digital screens are so useful and so interesting but are ultimately frustrating because you want to touch something, to feel something, to get that connection. The only way that conservation can facilitate that is by having a really clear dialogue with the curator, the librarian, or the archivist.

Question for Beth [Ryan] and Rebecca [Wingfield], and Siobhan [McKissic] and Quinn [Ferris]: Your presentations mention the need to reassess our frameworks for conservation, and even how we define damage. I like the phrase "the need for us to interrogate our perspectives" when considering treatment. Can you please talk more about that?

Ferris: One of the things that was hard was that at the time of working on this collection, I was a relatively new conservator. The conversations I was having were not necessarily going against, but rather expanding, ideas that I had adopted in the early part of my post-grad school education and training. It was eye-opening to feel that I wasn't doing a "good" job, even though I was sticking to the request of the curator to a T, and really having incredible conversations with her and learning a lot. There is so much of our practice that can sometimes be stuck in who taught us, how they taught us, and what they taught us. While all of that is valuable, it can sometimes lead us to one-track thinking without realizing it. At least it did for me. A good example is that everyone learns a particular way to make paste, and every institution has a very specific technique, and feel their way of making paste is the best. We know there are all kinds of ways to make paste, and it's generally acknowledged that those different ways are functional. I think the same is true for how we internalize the basic directives of what we do. It was incredibly eye-opening for me as a young conservator to have to push back against that in myself.

McKissic: For me, it really is about interrogating the things that we've learned. Similar to Quinn [Ferris], I'm also a new archivist. I have been doing it for a while, but in terms of having that degree and the "professionalism" of it all, I'm relatively new. I'm coming at it from the perspective of having worked almost exclusively with Black material and Black institutions before coming to Illinois. The way we did things was good, but not always what would be considered standard, and I think everyone agrees that you can't always get to "standard." When I started to learn how larger institutions do things with the resources they have, I'd have people tell me "Oh, you know you can't really do that. Oh, that's not the way it is." And I'd ask "Why? For what reason?" We're lucky right now in terms of archives and conservation, to be in the middle of a good amount of scholarship coming out about decolonizing our professions and thinking really critically about what things we need to keep and what things we do not really need anymore. I just think it's time. It's really time.

Wingfield: I want to echo something that Siobhan [McKissic] said in her presentation, that from a curatorial point of view, "the damage is the good stuff." That's really where you get at what makes an item unique. You see the traces of its history.

There's a lot of work that still needs to be done around stripping the word "damage" of its overly pejorative connotations. I appreciate the work that our conservation department at Stanford is doing to document the conservation work that they've done, because that too is now part of the story of *Improvised Poetics*, specifically of the copy that we have. The idea of giving patrons and scholars and students access to that work is really important to understand the history of the object and why certain things happened to it and why it's in the state that it is right now.

Ryan: I think that when you've been working on books for a long time, you become increasingly sensitive to details and decisions about intervention. Concerning *Improvised Poetics*, I'm thinking about how Quinn [Ferris] said "just because you can." That was at the forefront of my mind while I was working on this book. I realized I had to keep restraining myself from doing more. I so wanted to remove those little bits of paper on that cover image and I had to keep saying, "no, don't do that." It was an interesting exercise in restraint. Having someone say "I want this to look like it was dumped in water" was liberating in a way. Since that treatment, my approach has shifted a bit. I approach treatments with damaged materials in a more questioning manner. You have moments in your work where your perspective shifts a little, and this was one of them.

Question: I'm interested in the idea of doing less treatment as a way of respecting the creator, their intentions, and avoiding imposing a conservation view on materials. Do you think there are preservation techniques that favor this view? Obviously, a good environment, but maybe even "more Mylar, less mending"?

McKissic: I love Mylar. I'm also an archivist. so I'm usually just seeing things that are ripped and torn. You get 50 boxes, and everything is ripped in half. Sometimes I say "We don't need to call conservation for this. This is not the best use of Quinn [Ferris]'s time today." Usually, I'll text and say "Should I do more of the Mylar?" Mylar is life! I love it. Let's hear from a conservator.

Ryan: If we have a set of materials that are similar, for instance, the brittle journal issues containing the first printing of James Joyce's *Ulysses*, we might prioritize some of the more important issues for more in-depth treatment so they can be handled and leave the other issues untreated.

Ferris: One of the directives that we have started investigating is this idea of doing treatments on items before they have been damaged. For instance, clearly, they have been damaged by the creator and there are big losses there. I was taught to assume that *that* damage can lead to more damage down the line. For those sheets of paper where there are losses that go quite far into the paper, we say somebody is going to damage that because they're handling it, but that's an assumption we make without a lot of evidence. I personally haven't had to treat something after it has been circulated in the reading room and then been further damaged through handling. I'm not saying that there isn't handling damage, there certainly is, but I really believe in this idea of "What if we approached talking to the people who are using the materials as a way of bringing them into the care and keeping of these materials? What if, instead of making them feel afraid that they're going to do more damage to something, what if we make them feel like they are the front line in learning how to protect the object and become part of its history?" This is a more positive outlook and removes the onus to do the treatment before we really understand how people are interacting with these materials. This depends on the individual object and its context, but I am interested in seeing more of us investigating this as we progress in this line of thought.

Johnson: I would like to echo Quinn [Ferris]. I struggle with that question, "How is this item going to be used?" We can be overprotective of certain items, and when you think about the type of box or enclosure, it all impacts how a user will interact with that object. In some cases, that is supportive and helpful, and in other cases, it does create this distance and a layer of removal from accessing the piece. If you can provide appropriate education and ways to handle something safely, in some cases we could give a little bit more trust to our users. I do understand that there are plenty of cases where that's not always worked out. That's something that I really struggle with when I think about "What does this object really need? What's important about it? How is any sort of protective measure going to impact that feature?"

Comment: Communication can certainly be a preservation technique.

Question for Todd [Pattison]: When deconstructing a book to reveal internal structures that are not readily visible before the intervention, are there special housing needs or even handling needs that have to be expressed to researchers? How might you identify books that might benefit from "deconstruction" and exposure before you begin treatment?

Pattison: This tags along to the question that we just had in terms of communicating to the user and starting to re-examine what can be damaged when someone's going to use an item. How likely is that damage? How extensive would the treatment be if we feel that there would be further damage? When is that treatment going to need to take place? In 2 years? In 5 years? In 10 years? Sometimes I do think we should put treatment off and say "Let's wait to see when it gets damaged to do that treatment," because in the intervening time we may learn something about that object and realize that we don't want to treat it for whatever reason.

To get to this specific audience question, I try to not do a lot of deconstruction. Let me make it clear that I'm not taking things apart all the time, but there are certain questions that I think either people have answered incorrectly in the past, or that we just don't know. If you can find objects, again that aren't particularly precious either from a monetary standpoint or from a historical standpoint, that we can learn from, I think that makes a lot of sense. You need to be careful that you understand an object fairly well before you start to do any deconstruction on it, and you have to realize that it might be in a more vulnerable position. Boxing is probably going to be a key, depending upon how you deconstruct something. I ask myself "Is there a strong need to answer this question, or am I just being curious?" In that case, there's a lot of things I'm curious about that I'm never going to answer, so I just forget that. But there are certain questions that researchers need to have answered because they've either misinterpreted objects in the past, or that would help to explain some questions that they really haven't been able to get to the heart of yet. Users by and large tend to really be respectful of the objects if we model that respect and set good examples. Damaging objects is the last thing users want to do, so they tend to be very careful, especially if we give them any kind of education about how they can use the material.

Question: What are some other instances of unusual evidence of use or manufacture you've come across that might be less well known to conservators?

Pattison: One thing that is probably well known to conservators, but that is a real dilemma, is what to do with repurposed business records, for example, business or ship log records that have been reused as a scrapbook with newspaper clippings or other ephemera pasted on top of what one researcher really wants to see. This new use has been a very immediate act, organizing and curating that ephemera. That can be damage, if you will, although I would call it more reuse. These objects are difficult to approach as a conservator because you have two competing research interests.

Ryan: The damage found in early manuscripts and papyrus can be useful in digital fragmentology practice. For example, in some cartonnage papyrus records, we removed plaster to reveal the writing underneath. We were curious to know if papyrologists might be interested in our pretreatment documentation records. They said the records could be very useful because knowing that plaster was there before treatment could provide an archaeological context that might help digitally link fragments that have been separated over time and place. This is a good example of how pretreatment documentation can be useful to non-conservators.

Stevens: I think it was brought up in the Ginsberg presentation. One of the things that really fascinates me about industrial era bindings is metal components or components that are incompatible with each other. Obviously, the Ginsberg volume is a fairly extreme example. If it's been in saltwater, that's about as bad as it can get for those staples. The whole canon of wire stitch bindings will eventually be utterly destroyed by well-intentioned but ultimately difficult decisions. The staples that hold them together are a unique form of binding as valid as any other, that's systemically and without a great deal of thought being deconstructed. They are very tricky, they do create a preservation nightmare, and they are corrosive, but I think that we do have to triage our objects before we pick up a bone folder. I just listened to a presentation on early publisher's bindings and cloth cases. There are fascinating examples of things that are at incredible risk of being obliterated by conservation. I really do think as you progress through your career you do less and less, and you make much better judgments about the things that you're going to be conserving and what you're going to be leaving alone. Again, we're getting back to the curatorial/custodian/conservator conversation about the capacity of your object, as a conserved object or as an object that's going to be left alone. Metal components in bindings in particular and other ephemeral or sensitive objects, like textile linings, are absolutely fascinating.

Question: There was mention of bringing the descriptive terminology of conservation work in line with that used in archives and libraries. Can you give some examples? Is the concept of intentional damage noted or encountered in the descriptions in catalog records?

Ryan: Our department head is involved in the Linked Data Conservation Project that is working to improve information sharing for conservation treatment documentation across institutions through its work with standard terminologies and data modeling. For treatment documentation at Stanford, we're currently working with our operations manager who has a background in data modeling. We're analyzing the terms we use, and how concepts are linked within a treatment and with other standard terminologies. This work will eventually allow us to make our documentation available through Stanford's catalog. Rebecca [Wingfield], you might be able to speak about catalog descriptions. We're trying to put more dealer descriptions in catalog records and are communicating with our rare books cataloger about conservation treatments that may prompt changes in descriptive information in item records.

Wingfield: When we acquire new items, we are trying to put more information that comes from the dealer about the original condition of the item into catalog records. And our catalog records usually note, in the public version, whether or not an item has been to conservation, so that can also be tracked.

Question: In thinking about Quinn [Ferris]'s comments regarding educating those handling objects rather than treating preemptively to prevent additional damage, I am considering digitization. I have found it to be common practice to mend tears and treat so-called vulnerable damage prior to photographing objects for digitization. This is typically done both to (1) prevent the exacerbation of existing damage and to (2) communicate that the object is being properly cared for and not neglected. My question is, do you think this second objective is valuable?

Pattison: I have really strong opinions about this question. I tend to think that when you're digitizing an object, you should be capturing that object at that moment in time. That means doing as little as possible before you digitize it. Now, I would have no problems if you want to digitize it twice. Digitize it first so that someone can see how it was and then do whatever conservation treatment you want and then digitize it again. I don't agree with this idea of putting it into a more idealized state before you digitize it, because you're changing it. We hopefully keep really good records, and I commend Stanford for trying to make those records accessible to everybody. It just isn't the same as being able to have that record of all of it, exactly as it was before you put it out there.

Ferris: I would agree with Todd [Pattison]. Part of the reason we feel an impetus to make things look as though they are cared for is because we have this notion that all damage is bad. So, if we were to investigate or dismantle the idea that damage is bad in our interactions, in our moments of education, and in our moments of collaboration with colleagues, then having a digitized image of an object that is in a less than pristine state wouldn't feel like an affront. While the intention is good, I think it's one that we don't necessarily always engage with, in a way that is circumspect of what we're communicating in an unconscious way.

Comment from the chat box: Some people use the phrase "change in condition" instead of "damaged" to describe signs of use and degradation.

Question: Sometimes archivists/curators hesitate to help make treatment decisions and default to the conservator's opinion. But we want their opinions! For the archivists/curators in the room, what kinds of questions can we ask our curatorial colleagues to encourage their input?

McKissic: This conversation worked for Quinn [Ferris] and me because I have a little background in general preservation and some experience doing minimal treatment. So, we already have a common language. It's really more of making sure everyone's on the same page. The first thing we did when we were talking about this was to ask: What sort of language do you have around damage? What sort of language do you have around treatments in archives? We also shared literature with each other and talked it through. In terms of what sort of questions to ask, it's hard. I say it's just important to make sure there's communication. It's really important to make sure that they understand why you're making the choices you are making and why you are asking the questions that you're asking because we all do different jobs for a reason. We're really focused on the things we are focused on, and that is our job. Sometimes we forget that you can step into someone else's little world to understand them better. I think you should ask them if they want to come to visit. Ask them if they want to watch some of the repairs so that when you're talking, they can fully understand what you mean by this kind of damage.

Pattison: I actually have some standard questions that I ask curators and archivists, because after 30 years in this field, I'm used to them differing to me and the last thing I want to do is drive the conservation treatment. I can let them know "no we can't do this" or "we could do this," but ultimately they need to make that decision. So, first and foremost ask: Why is this important? What are you going to do with the piece? We've collected it; how is it going to be used? How do people access this piece? How do they approach it? What kind of research could they do on it today? What kind of research could they do on it in 50 years? Really asking them questions so that they understand and have the opportunity to think about it. They tend to be very busy. So, really drilling down and trying to get to the essence of what an object really is to your institution. It's not the same for every institution. How are people going to use that object?

Wingfield: It's important to engage curators on how the item might be used and its significance. But I also think it's really important for curators to understand that there's a range of approaches that could be taken. Sometimes I think curators have a tendency to think, "Okay, well the conservator is the expert in preservation so they're saying it needs this treatment, so I have to say yes if I want it to be preserved." Make sure that curators are aware that there is often a range of treatment options possible, including no treatment.

Hosselkus: I'd like to emphasize again the importance of communication, which is a major theme of this panel. Something

I've learned as a curator, working with Jen [Johnson], is that the answer to the question "What should we do with the object?" is never simple. It always evolves. I often find that I start out with an object with one idea in mind. I talk to Jen and she presents options, and my own thinking evolves over time. I've had to become more comfortable with the fact that this is a conversation that fluctuates and changes in response to various input. So, just knowing that preservation and conservation decisions aren't simple is something that, as a curator, I have found useful to come to.

Ferris: Although we had the advantage of Siobhan [McKissic] already having the preservation language, I did not have the archival language. We refer to ourselves as a blanket of "library and archives conservators," but the emphasis of that training, for me anyway, was really on the library and not the archives aspect. In order to feel comfortable working in an archival collection, I had the opportunity and the ability to take an archives class and learn something about the theory of arrangement and description. That was definitely a blind spot in my education. We happen to have an Information School here that was readily accessible for me. I don't necessarily think that would be available to everyone in every situation, but I do think that meeting your partner halfway is really important in figuring out "What are my blind spots in this endeavor? How could improving upon them or expanding them help me be a better collaborator? How can this help me be more circumspect about my thinking about this object or this treatment?"

Stevens: I think that's a really good point Quinn [Ferris]. I think that we demand, all of us, that our process-driven treatments are understood, but I think that we don't have the tools that we sometimes need to understand the way an object fits into a collection from a curatorial point of view. And I think that gap is something that conservation courses could help fill. To be able to understand a little bit more about the archives and library approaches to description. This is definitely a two-way conversation.

Question: I find myself having many professional conversations about how "intervention *is* damage," but it is simultaneously an unpopular opinion to "do less." What would it take for current conservation to transition to a less-is-more approach to intervention?

Pattison: First, I want to echo something that Rebecca [Wingfield] said—that no conservation is an option. To me, it's the default setting. You should approach every object with this idea that "I'm not going to do conservation." It's not because I'm lazy. You need to be convinced of the need for conservation. What's the overwhelming or overriding reason that you would want to change this object? You have to understand you're going to change it no matter how careful you are with your documentation and with everything else that you do. You do make changes. I liked it when Victoria [Stevens] talked about the example where she undid a treatment because I think that's a very important lesson to learn. We may want to undo treatments simply because we didn't question why we were doing them in the first place. Why weren't we just leaving it as is and saying nothing has to change? I would say that's your default setting and then someone or you yourself have to convince you that there's a need for conservation treatment.

Johnson: Particularly in treating books, they often come to us with so many layers of intervention before we even get to engage with them. When you're choosing a treatment, if you have something that is a structural concern and you feel compelled to intervene, now you also have to deal with the questions: Up to what point do I intervene? What time or what intervention am I going to take this back to? It becomes very complex. We've had a couple of pieces that have really challenged us, between all the conservation staff as well as the curators, to try to decide on what is the right choice. What is the decision we can make now? That's something as conservators we always wrestle with. We're choosing to do some sort of intervention. Is this something you can live with down the road? Knowing that there might be a loss of information that either you weren't aware of, or for other reasons you just had to move forward and make that decision? That's one of the more challenging aspects and, for me, is one of the most interesting ones. When you're wrestling with those decisions and seeing that evidence in books, there's something really beautiful about potentially being a part of that down the road.

Stevens: There is never an action that is totally reversible. Any action that you do as a conservator has an impact on the object. There is no doubt about it. I think as time goes on, you are constantly looking at ways of shaving off that impact you are having on the object. Removing some of the footprints that you leave. It's great to have other people's fingerprints, but you don't want to leave a heavy print when you're passing through. That goes for everything from humidification downwards, or upwards I suppose. We need to be questioning all the time, is this the right thing for us to do with this object? Is this the right treatment to get the outcome that we want? With a bit more caution and less instant results. Humidification is a really good example of that. Why don't you use weight, which can be equally effective? It's all about slow conservation. I think it is very much about making the right decision for the right object at the right time and moving away from blanket collection-based decisions.

Ferris: Also, to Jen [Johnson]'s point, I wanted to add that I think we have already started moving away from levels of intervention that we used to engage in. In the past, it was assumed that fine binding skills were required because an automatic thing that you would do to a book was to rebind it. There has been some pushback against that. There's been some pushback against the pushback. There is this long-standing debate over whether or not the current professional graduate programs really give book and paper conservators the binding techniques that they need in order to be proficient at this job. I'm not going to weigh in on that, but I think we're already seeing a move away from an automatic, heavy intervention. We're already doing less than we used to. I don't necessarily think that doing less is revolutionary for libraries and archives. We are already dealing with a scope of collections with limited resources, limited time, and limited personnel. Sometimes we do less just because that's what we can do at that time. I also think that the thinking around "why" is changing, and that thought work is really important for the future/new conservators. That really informs decision making, and that's the crux of all of it.

Ryan: When a no treatment option is presented, there is still benefit in the preventive conservation an item will receive. Resources spent on environmental conditions and housings are in themselves a type of treatment that's very useful. I also like what you were saying Todd [Pattison], that something might require more extensive treatment in the future, but just housing it and putting it in a good collection storage area is a kind of benign treatment.

Closing remarks from each of the panelists. Please share something that you want to be sure that our audience takes with them back to their jobs.

All of the panelists expressed thanks to each other and the moderators, and that they enjoyed the discussion and hearing from each other, especially across disciplines.

Johnson: For me, it's the excitement about materials that tell their own story. These decisions are so complicated, and there's so much to know and recognize when we're assessing the damage. We're assessing interventions as well as the language that we are using to identify these things. As we're training new conservators, to Quinn [Ferris]'s point, we should have more of these discussions about how we're making judgments and how we're learning to make assessments. We must recognize that there are so many different ways. We say that, but that's not always the way we act and practice, because it is easy to become too comfortable with what we know we can do successfully. Maybe we tend toward those treatments, and sometimes you just have to do that. So that awareness and being able to continue to talk about this is really fantastic.

Wingfield: Each object is unique, and each is worthy of a discussion. We each bring different areas of expertise to the discussion. I always learn a lot by talking to our conservators. I hope they learn a lot from me as well about our collections. It's this iterative process when we have to work through what is the best course of action for this particular item and for the uses we envision of this particular item, because that also makes a big difference.

Pattison: I would encourage conservators to think like researchers, to think like users, and to approach the object asking questions. If I was a researcher, what would I want to know about this object? How could I possibly use this? How would the treatment that I'm going to do maybe affect and take away some of those options that people would have in the future? Conservation should be about keeping as many options in the future as possible so that people can come to these objects in different ways.

Ryan: I really enjoyed hearing everyone's thoughts on this topic. After reading the primary source literacy guidelines from the ALA [American Library Association] a few years ago, I began thinking more about how our work might influence material interpretation and about how important it is for conservators to engage beyond the conservation field with this topic. I'm especially grateful today for having curators join the discussion.

Hosselkus: For me, the big theme is the importance of collaboration and communication. I do feel fortunate that I get to work with Jen [Johnson], and we collaborate well. Doing this project was one way of helping me to look at objects differently. I'm grateful that we can work with conservators. Just to listen to the kind of depth of discussion about the objects we deal with, the kind of depth of meaning that they can have, and how various layers of meaning that accumulate over time is mind expanding for me as a curator. Sometimes I get deep into the content of a particular piece but don't step back as much to think about an object. So, it's been enlightening and fun to listen.

Ferris: This feels to me like the beginning of a larger discussion or group of thoughts that are going to really have a significant impact on the future of conservation. We do need to keep a conversation going both internally at our own institutions and externally. We should look for places outside of conservation literature to share this information because this is cross disciplinary.

McKissic: It's a matter of collaborating with each other and really thinking of expanding this information beyond these groups, because I know, for me, the people I interact with aren't just conservators. We also have to think really critically, not just about the people who are with us now, but the impact of the work we do and how it will impact future researchers. Patrons who don't necessarily feel comfortable in our spaces. These conversations are something that could radically shift who feels comfortable looking at the materials and who gets access to the material that we're using. Also, we're all in our little spaces, but it's always important to remember that you can cross over. Sometimes it can be as simple as making material, that people don't necessarily see all the time, more accessible. I once had the person who's in charge of the digitization just come to me and say, "Hey, we've gotten a lot of this one thing. Do you have any other things that need help? Are there any authors that you really want to highlight, that you think might need some care, that maybe were really low on your priority list before but need a little shine?" Let's all be friends. We can talk and bring in more people.

Stevens: The use of the object is absolutely essential, and from that center, everything else springs. You need to always consider the object's use and its materiality. People will have a better experience with the object when you can expose these two aspects.

ACKNOWLEDGMENTS

The co-chairs would like to extend their thanks to the panelists for generously sharing their insights and expertise, and to the audience members who contributed questions during the discussion. Special thanks to Elizabeth Ryan for suggesting the session topic and to Siobhan McKissic for adding closed captions to the videos shared during the broadcast. The co-chairs would also like to express appreciation to Eliza Spaulding, BPG program chair; Andrea Knowlton, BPG assistant program chair; and Ruth Seyler, AIC meetings and advocacy director, for their support in developing this program and managing the "behind the scenes" aspects of the virtual session.

FURTHER READING

Balachandran, Sanchita. 2016. Race, diversity and politics in conservation: Our 21st century crisis. *Conservators Converse: AIC's Blog Archives 2008–2018*. http://resources.culturalheritage.org/conservators-converse/2016/05/25/race-diversity-and-politics-in-conservation-our-21st-century-crisis-sanchita-balachandran/.

Bottkol, Joannie. 2020. Sociopolitical Flux, Conservation, and Difficult Heritage. Paper presented virtually at the AIC 48th Annual Meeting, Salt Lake City, Utah.

Brown, Richard Harvey, and Beth Davis-Brown. 2016. "The Making of Memory: The Politics of Archives, Libraries and Museums in the Construction of National Consciousness." *History of the Human Sciences* 11 (4): 17–31. https://doi.org/10.1177/095269519801100402.

Chen, Anna. 2016. "Perfume and Vinegar: Olfactory Knowledge, Remembrance, and Recordkeeping." *American Archivist* 79 (1): 103.

Durant, Fletcher. 2020. "Conservation Is Not Neutral (and Neither Are We)." *ICON Book and Paper Group Together at Home Webinar Series*. Streamed live on June 16, 2020. YouTube video, 49:03. https://www.youtube.com/watch?v=bFKS12TYTEg.

Ferris, Quinn. 2018. (Un)Finished Thoughts: Approaches to Conserving Transitory States in the Working Documents of Gwendolyn Brooks. Poster presented at the AIC 46th Annual Meeting, Houston, Texas.

Ghaddar, J. J., and Michelle Caswell. 2019. "'To Go Beyond': Towards a Decolonial Archival Praxis." *Archival Science* 19 (2): 71–85. https://doi.org/10.1007/s10502-019-09311-1.

Ginsberg, Allen. 1937. Allen Ginsberg Papers, 1937–2017. https://searchworks.stanford.edu/view/4084385.

Ginsberg, Allen, and Mark Robison. 1971. *Improvised Poetics.* Buffalo, NY: Anonym Press.

King, Melissa, Joelle Wickens, and Andrea Keefe. 2020. Outreach and Education Through Collections Care: A Case Study with Central High School in Philadelphia. Paper presented virtually at the AIC 48th Annual Meeting, Salt Lake City, Utah.

Linked Conservation Data. Linked Conservation Data/Ligatus. Accessed November 5, 2020. https://www.ligatus.org.uk/lcd/.

McGarity, LaStarsha, Amanda Kasman, and Julianna Ly. 2020. Treating Tuskegee's Dioramas: A Perspective on Inclusive and Collaborative Treatments Between Institutions. Paper presented virtually at the AIC 48th Annual Meeting, Salt Lake City, Utah.

McLees, Fiona. 2020. "From Author's Draft to Select Library Holding: The Metamorphosis of Franz Kafka's Manuscripts." *ICON Book and Paper Group Together at Home Webinar Series.* Streamed live on March 31, 2020. YouTube video, 1:10:37. https://www.youtube.com/watch?v=Lw8fZaKdZ6Q.

Middleman, Arielle, and Todd Pattison. 2016. "Benjamin Bradley and the 'Profitable Stroke': Binding Six Months in a Convent and the Need for Copy-Specific Cataloging of Nineteenth-Century Publishers' Bindings." In *Suave Mechanicals: Essays on the History of Bookbinding*. Vol. 3, edited by Julia Miller. Ann Arbor, MI: Legacy Press.

Pattison, Todd, and Graham Patten. 2017. "Confusing the Case: Books Bound with Adhered Boards, 1760–1860." In *Suave Mechanicals: Essays on the History of Bookbinding*. Vol. 5, edited by Julia Miller. Ann Arbor, MI: Legacy Press.

University of Notre Dame Hesburgh Libraries. 2018. In a Civilized Nation: Newspapers, Magazines, and the Print

Revolution in 19th-Century Peru. https://collections.library.nd.edu/3df879828f/in-a-civilized-nation.

Wenner-Gren Foundation and SAPIENS in Collaboration with the Society of Black Archaeologists and the Cornell Institute of Archaeology and Material Studies. 2020. "As the Statues Fall: A Conversation About Monuments and the Power of Memory." Streamed live on July 23, 2020. Vimeo video, 2:01:51. https://vimeo.com/439042290.

JESSAMY GLOOR
Paper Conservator
The Huntington Library, Art Museum, and Botanical Gardens
San Marino, CA
jgloor@huntington.org

LAUREN TELEPAK
Senior Collections Conservator
Harvard Library
Cambridge, MA
ltelepak@fas.harvard.edu

LINDA OWEN AND REBECCA POLLAK
DISCUSSION GROUP CO-CHAIRS

Art on Paper Discussion Group 2020
Imaging in Practice: Techniques for the Examination of Works of Art on Paper

INTRODUCTION

This year's Art on Paper Discussion Group program examined the range of techniques conservators are currently using to study and document works on paper, and how they inform our connoisseurship and treatment. Introductory remarks by the co-chairs were followed by five presentations by paper conservators and allied professionals working in private practice, conservation education, and institutions with varying priorities for research and access to specialized equipment.

Although photographic documentation has long been integral to conservation practice, recent advances in digital equipment, instrumentation, and image processing have both improved existing technologies and introduced new techniques to conservators. These developments have allowed more conservators to examine works on paper in UV, visible, and infrared (IR) spectral ranges and expand into hyperspectral imaging. Collaboration with allied professions to perform elemental and molecular phase mapping of paper objects and computer-assisted integration of imaging with other data increasingly contributes to the scholarship on prints and drawings. These techniques can be invaluable in helping us understand an object's materials, manufacturing processes, and condition.

Given the diversity of conservators' goals and resources, this topic felt timely for several reasons. As conservators all have access to digital imaging, from iPhones to IR cameras, a more unified widespread discussion around workflows and equipment is possible. The development of imaging standards provided in conservation publications, graduate training programs, and professional training workshops provide a shared vocabulary and approach to these tools. Increased access to this technology has generated more case studies that focus application of imaging techniques that are complementary to the study of paper. This program aimed to create a space to share more examples of discoveries made by conservation colleagues.

For many, the months leading up to the program brought the value and need for imaging to the fore as the impact of the Covid pandemic on funding and access made it more urgent for conservators to contribute their knowledge to online programs and materials. As many institutions prioritize digital content, these images can have a positive impact on public engagement and increase visibility of conservation within institutions. Remote work has also called attention to more basic deficits of collection digitization. What will the impact be on conservators who may increasingly be asked to evaluate loans, acquisitions, and treatment decisions based on images or video rather than in-person examination? Is this an opportunity to prioritize resources for documentation?

PRESENTATION SUMMARIES

THERESA J. SMITH
TECHNICAL STUDIES OF WORKS OF ART ON PAPER: WHAT IR LUMINESCENCE CAN REVEAL

Smith discussed a joint project between Oberlin College's Allen Memorial Art Museum and SUNY Buffalo State, started by Judith Walsh in 2015 with funding from the Kress Foundation. The project highlighted the uses of imaging in technical studies performed by the students. The goal of the project was to generate material for a future online catalog of the museum's pre-20th-century drawings, using information gleaned by the students from close looking, digital imaging, and nondestructive analysis. Imaging was used to identify and record materials and condition issues and helped answer curatorial questions about the works. Smith focused on the potential of newer techniques, like IR luminescence, for examination and areas of further research.

Smith proceeded to share examples of the students' images and findings. Visible, angled, and transmitted light, as well as UVA-induced visible fluorescence, reflected UVA, and transmitted IR, were useful in revealing the manufacture and condition of paper supports, artistic process, and prior

This open discussion took place *virtually* on August 11, 2020, during AIC's 48th annual meeting. The moderators organized and led the discussion and recorded notes. Readers are reminded that the moderators do not necessarily endorse all comments recorded, and although every effort was made to record proceedings accurately, further evaluation or research is advised before incorporating any observations into practice.

Fig. 1. P. F. Mola, *Sketch for Lunette with Life of a Saint* (Allen Memorial Art Museum 1961.52), seen in visible light (top); UVA-induced visible fluorescence (lower left); and visible-induced IR luminescence (lower right). Images by Meaghan Perry.

housing of the drawings. One drawing, by P. F. Mola, *Sketch for Lunette with Episode from the Life of a Saint*, was executed in pen and brown ink. Imaging by Meaghan Perry in normal light and UVA-induced fluorescence showed signs of tide lines and foxing. In an IR luminescence image, the paper and media did not fluoresce, allowing the extent of the tide lines and foxing to be fully revealed.

Visible-induced IR luminescence (IR lum) uses visible light to excite electrons in the imaged material, then energy emitted from the material in IR wavelengths is captured in an image. As with other images that detect nonvisible energy, IR lum produces monochromatic (black and white) images. Smith has found IR lum to be a good complement to other imaging techniques. For the study of a drawing by Edouard

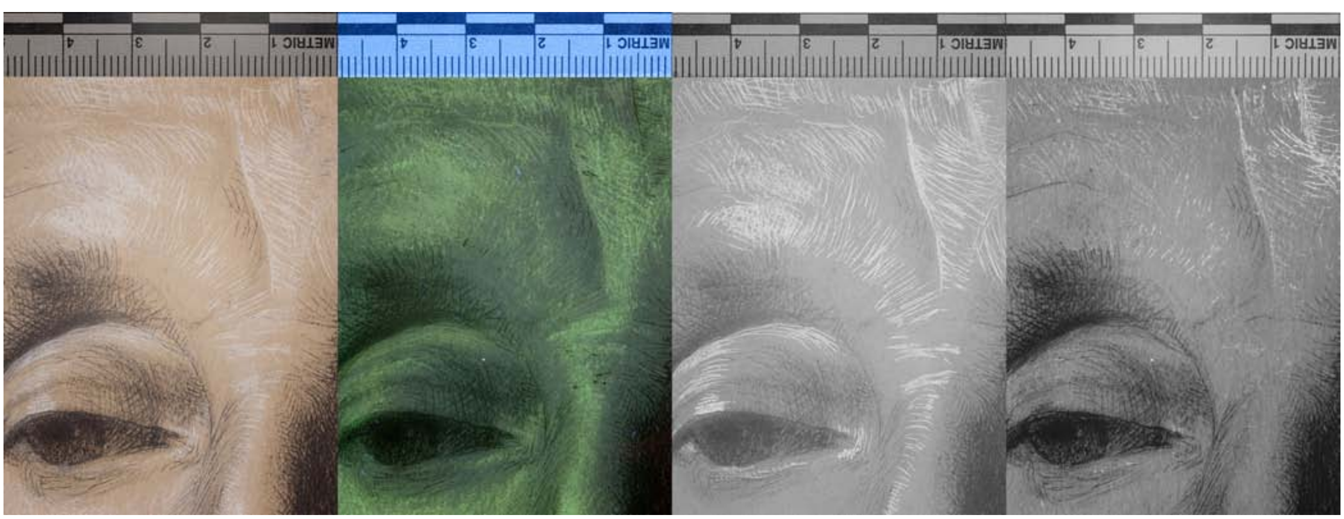


Fig. 2. Details of Eduard Otto Braunthal drawing, *Portrait of Woman with a Headscarf* (CNS 197775), seen (left to right) in visible light, UVA-induced visible fluorescence, reflected UVA, and visible-induced IR luminescence. Images by Basia Nosek.

Otto Braunthal, *Portrait of Woman with Head Scarf*, imaged by Basia Nosek, IR lum proved helpful in distinguishing between the various white heightening materials used by the artist. UVA-induced fluorescence clearly showed the white chalk highlights, whereas the reflected UVA elucidated brush-applied white lead pigment. The IR lum image revealed discrete application of a third white material.

Previously, Smith and Jiuan Jiuan Chen, associate professor of Conservation Imaging, Technical Examination, and Documentation at Buffalo, collaborated on a salted paper print project that piqued Smith's interest in IR lum. The technique proved to be quite helpful when looking at tide lines, excessive mounting adhesive, and foxing spots, often reinforcing what was seen in UV fluorescence imaging. The IR lum images were visually simpler due to the increased contrast from the monochromatic image. Smith highlighted the potential benefits of IR lum, as sensitive artworks are not exposed to destructive UV wavelengths, which is especially important for vulnerable salted paper prints. Smith showed examples of foxing spots found on a salted paper print and showed details in visible, UVA-induced fluorescence, and IR lum. Foxing spots of a fungal origin were visible in both UVA and IR, fluorescing in a similar manner. Metallic inclusion foxing spots were also seen with a darker center in both UVA and IR. Foxing is not always solely fungal or metallic in origin, and, interestingly, a foxing spot with a darker center in both visible and UVA images lacked the dark center in IR lum. Smith then posed the question of what, exactly, was being seen? Is it a third type of foxing? What was the luminescent material?

During the course of the project, many interesting questions arose, prompting Smith and Chen to perform a literature review of scholarship on IR luminescence. Smith shared selections from a bibliography that they are compiling. The earliest reference was from 1937, in which the technique was used to examine writing inks. In 1958, it was used to differentiate between inks and dyes for forensic document analysis. At the same time, IR lum was employed to examine geological minerals, which, not surprisingly, led to its use in the examination of works of art and inorganic pigments. More recently, the technique has been utilized to identify Egyptian blue and cadmium pigments. Smith summarized that IR lum can be useful for differentiating both organic dyes and inorganic pigments because there are multiple chemical pathways for generating IR luminescence, as in crystalline materials for mineral pigments and coordination complexes of chromophores for dyes and inks. Smith identified future areas of research into the sources of IR luminescence of foxing.

Fig. 3. Anonymous, *Male Portrait*, albumin photograph mounted to board (private collection), seen in visible light (left) and visible-induced IR luminescence (right). Images by Jiuan Jiuan Chen.

IR luminescence has not been studied for works on paper or photographs, and many questions and areas of interest arose from the project. Showing an image of a mounted albumen photograph with foxing and a fluorescing ring around the image, Smith pondered some of these issues. What is being seen? What materials or combination thereof are causing the fluorescence? Is it image deterioration? Silver oxides or silver sulfides?

Smith is also trying to characterize the IR luminescence of paper and the role of fiber materials. She showed an IR lum image of an array of partially processed paper pulp samples made from different fibers, including abaca, hemp, linen, and various types of cotton. The abaca exhibits strong luminescence, whereas the different cottons display a range of luminescent intensity dependent on their processing stage. What is the effect of different paper fiber types, sizing, and peroxides on IR luminescence? Acknowledging that there is much to learn, Smith expressed hope that more paper and photograph conservators would integrate IR lum into their imaging practice and help further the conversation. Smith and Chen have recently published detailed information about the practical setup and use of IR luminescence in JAIC (Chen and Smith 2019) .

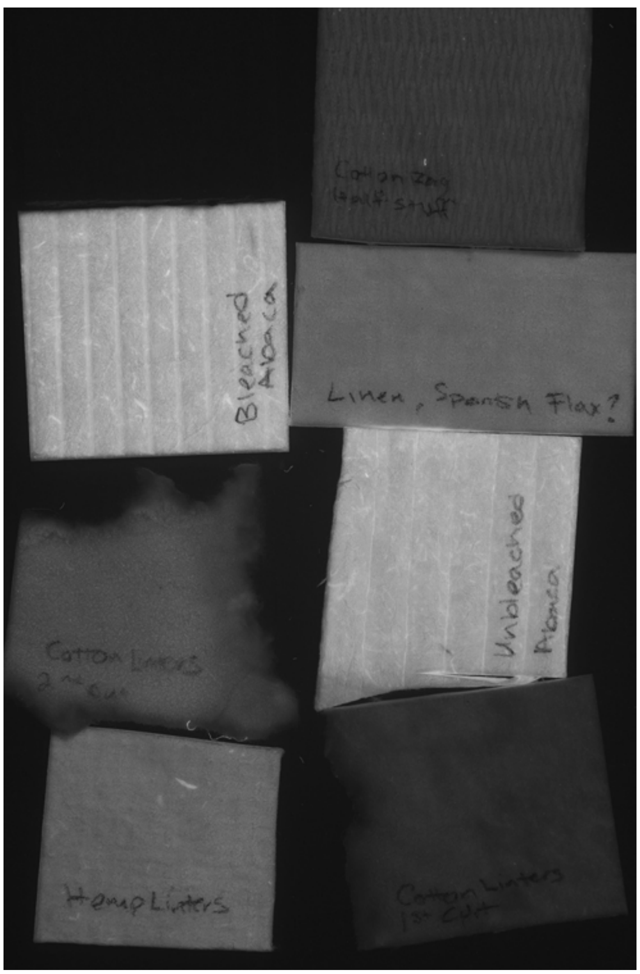


Fig. 4. Samples of partially processed paper half stuff seen in visible-induced IR luminescence. Clockwise from top right: Cotton Rag, Linen/Spanish Flax, Unbleached Abaca, Cotton Linters 1st Cut, Hemp, Cotton Linters 2nd Cut, Bleached Abaca. Image by Jiuan Jiuan Chen.

Theresa J. Smith, Garman Art Conservation Department, SUNY Buffalo State, Buffalo, NY

VICTORIA BINDER AND RANDY DODSON
A PRACTICAL AND VERSATILE MICROSCOPE IMAGING SYSTEM

Binder presented the microscope imaging system that she and Dodson developed at the Fine Arts Museums of San Francisco's paper conservation laboratory. Microscope imaging systems can often be complex and expensive systems that are challenging to use, with components that can become quickly outdated. Binder and Dodson were able to create a cost-effective, versatile system that is simple to use, with components that can be used for multiple purposes.

Binder started the process of upgrading their microscope imaging system in 2014, to integrate with their Leica Wild MZ6 Stereozoom Microscope and Leica photo port. Their camera, a Nikon Coolpix dating from 2001, was problematic for several reasons: the small viewing screen, its age, and the fact that it was a challenge to operate. As she surveyed the cameras and systems available, Binder found that although many of the systems had features like live view, image capture in different formats, and effective software, they did not meet the needs and the budget of the lab. The software was often complex, and the cameras did not offer significantly more resolution, 3–5 megapixels, than their existing system (3.2 megapixels). In addition, the $2000–$5000 cost was prohibitive to their budget.

Binder had a breakthrough when Dodson introduced her to the CamRanger Pro, a wireless, remote, camera control transmitter. The CamRanger creates a WiFi connection between a Nikon or Canon digital single-lens reflex (DSLR) camera and a phone, tablet, or computer viewing device. The included app allows users to remotely control the camera from their untethered viewing device. Currently available CamRanger products are the CamRanger mini, retailing around $200, and the CamRanger 2, with a price range of $350–$425. Binder then went into a detailed, component-by-component description of the imaging system that she and Dodson created. Some parts were already on hand in the lab, namely a microscope photo port and a Nikon DSLR 12 megapixel camera. They needed to purchase a digital camera adapter ($500) to connect the DSLR to the existing photo port. The CamRanger Pro Wireless transmitter was acquired for $315 and connects to the DSLR via a USB cable. The CamRanger creates its own WiFi hotspot, which the viewing device connects to. A WiFi only iPad for $480 completed the system. The CamRanger free app was downloaded to the iPad, allowing the tablet to connect to the CamRanger and remotely operate the camera. The total cost of the new components of the imaging system was about $1300.

The CamRanger software, according to Binder, is intuitive and simple to use and offers many useful features, such as HDR bracketing, wireless live view, video recording, and wireless image capture. The files are saved to the camera card but can be wirelessly downloaded to the viewing devices. Computers can accept jpegs and raw files, but tablets and phones can download only jpegs. Files can be e-mailed once they are downloaded to the viewing device or shared on social media. Multiple devices can live stream or download images, using the CamRanger Share software. For controlling the Nikon camera, the software has many settings, including shutter speed, ISO, white balance, metering mode, and different image formats, including jpeg and raw.

Binder showed images demonstrating the system in use. The slides illustrated how the live view allowed several colleagues to study a print and, as the iPad is untethered, how it can be passed around for close inspection. Binder noted that this was especially helpful for visiting classes. In addition, the remote operation of the camera helped reduce shake during image capture. The remote operation also proves helpful when photographing large objects from overhead in a studio setup, as demonstrated in an image of Ann Getts, associate textile conservator at the Fine Arts Museum, photographing a textile.

Binder summarized the pros and cons of the imaging system. The many pros included the tetherless viewing device, the simple and easy-to-use software, the variety of file formats for image capture, and image sharing via WiFi. The system is versatile, and components can be separated out for different uses or updated individually as needed. A disadvantage of the system is the lack of a scale; Binder has devised a system to image the scale separately and insert it via Photoshop. The system can be heavy, and Binder noted that she had purchased a heavy-duty boom arm for their microscope. To share images via WiFi, users have to disconnect from the CamRanger's hotspot and connect to their own WiFi. Images can appear blurry or out of focus if the camera sensor's capacity to resolve detail is greater than the microscope lens system; Binder and Dodson have found this to be the case for their microscope when images are more than 24 megapixels.

Binder concluded by acknowledging that many changes in camera features have occurred since 2014, and that many DSLRs or mirrorless cameras now have WiFi capabilities. She expressed interest in hearing from conservators who have used these cameras and learning about their findings, as she hopes to purchase a WiFi-enabled camera for their compound microscope.

Victoria Binder, Legion of Honor, Fine Arts Museums of San Francisco, San Francisco, CA
Randy Dodson, Fine Arts Museums of San Francisco, San Francisco, CA

JENNIFER MCGLINCHEY SEXTON
INVESTIGATING PROCESS USING A USB MICROSCOPE

McGlinchey Sexton shared her experiences using a USB microscope as part of her portable examination toolkit to study and identify processes and materials of works on paper and photographic materials. As a conservator in private practice, she often works on-site and has compiled a toolkit that includes a tablet computer, a cell phone, a mirrorless camera, various imaging targets and rulers, a low-power magnifier, a flashlight, and sometimes a Nikon DSLR. Considerations for weight, size, and cost have influenced many of her choices in equipment.

For work without an on-site microscope, McGlinchey Sexton brings a digital USB microscope, Dino-Lite Edge AM4115ZT, which is a mid-range model retailing for approximately $650 when it was purchased in 2019. The Dino-Lite Edge has a pixel resolution of 1280 × 1026, approximately the same resolution as a cell phone sensor in an iPhone 7, and magnifies from 10 to 220×, with a working distance from 50 to 2 mm. The Dino-Lite itself is conveniently small and portable with integrated LED lighting, but the accompanying stand adds weight and bulk to packed baggage.

For reporting magnification, McGlinchey Sexton relies on scale bars that she includes in the image, as the sensor size of the microscope and the size of the viewing screen directly affect the magnification level that the viewer sees. Scale bars can be configured easily with a calibration slide and the integrated software, DinoCapture. The DinoCapture software is free and straightforward to use, if somewhat limited in its capabilities. Features include live view, and the ability to capture still images, video, and time-lapse sequences, and take measurements. The user can control exposure, white balance, and the LEDs. Controlling the exposure and the integrated histogram is crucial to achieve consistent images, according to McGlinchey Sexton.

The Dino-Lite captures in the visible range, allowing numerous visible multimodal options including normal, specular, raking, transmitted, and UV/visible fluorescence. To capture UV/vis, McGlinchey Sexton uses separate UV lamps and a Wratten 2E filter over the sensor. The circular arrangement of the LEDs around the sensor is excellent for capturing specular images and the surface sheen of the paper. However, using the LEDs can lead to intrusive highlights; to avoid these highlights, the integrated polarizer can be engaged, but oversaturation can be an issue. McGlinchey Sexton observed that true normal light images are possible with ambient lighting, but obtaining even lighting can be challenging.

To achieve raking light images, she uses a LED flashlight equipped with black matboard "barn doors" to narrow the beam of light, better capturing surface morphology of the paper and layering of media. The barn doors reduce the contrast and prevent the highlights from blowing out. Moving the flashlight farther away from the object reduces shadows and allows for a more even capture of the surface morphology. A sidelight cap included with the microscope is inadequate for true raking light images.

McGlinchey Sexton provided some examples of different lighting conditions and the information gained from each setup. Two images of iron gall ink text in normal and specular light showed the halo of discoloration around the letters and the sheen of the ink, respectively. Images of a Donald Varnell work illustrated the layering technique and order of application in normal light and highlighted potential condition issues of loose pigment particles in raking light. As a conservator specializing in photographic materials, McGlinchey Sexton illustrated the usefulness of the Dino-Lite for process identification, with examples of an autochrome in transmitted light and an inkjet in normal light.

Nonetheless, McGlinchey Sexton brought up some limitations of the system. The depth of field is limited, but focus stacking is available on some models. It is possible to achieve focus stacking post production, but good lighting during image capture is crucial. The Dino-Lite stands cannot extend safely over long distances, which is limiting for the examination of larger works. Alternative stands are available but require some adaptation to be successful.

In conclusion, McGlinchey Sexton shared a detailed list of her current examination toolkit components, providing a practical and immediately applicable resource for many conservators.

Jennifer McGlinchey Sexton, MS Conservation, Colorado Springs, CO

KRISTI DAHM

MULTIPLE IMAGING MODALITIES REVEAL EVOLVING IMAGERY IN PICASSO'S GOUACHE

The Faun Musician by Pablo Picasso (1881–1973) is a drawing in brush and black ink and gouache in the Art Institute of Chicago's collection.[1] In 2013, the framed work was brought to the paper laboratory for review prior to exhibition. Irregularities in the surface led Dahm to believe that another composition might lie beneath the gouache depiction of a faun playing a pipe. Picasso is well known for painting over previous compositions, but the practice has not been studied for his works on paper. When the work was unframed, the paper support was revealed to be the frontispiece folio removed from *Cinq sonnets de Petrarque*, a translated volume of poetry by the 14th-century Greek poet Petrarch that was published in Paris in 1947, the same year Picasso created *The Faun Musician*. Picasso had contributed an etching to illustrate the publication. Sewing holes found in the fold of the folio confirmed that it had been removed from a bound volume.

IR imaging at 1.5–1.75 μm was carried out to create a composite image that revealed the composition of flowers beneath the faun. However, the carbon in the ink defining the faun's features and his pipe strongly absorbed IR and made deciphering the lower composition difficult. Using Adobe Photoshop and the clone stamp tool, which copies pixels and then replicates them where desired, Dahm digitally removed the black ink lines from the IR composite, fully revealing the image below. The composition of a vase of naturalistic flowers on a striped tablecloth was fully legible in the digitally altered IR composite. This raised the practical and ethical implications of digitally manipulated images, with Dahm recommending that the original and altered images always be shown together and clearly labeled, so no conclusions are drawn solely from an altered image.

Additional analysis of the *Faun* was done by Dr. Francesca Casadio, Grainger executive director of Conservation and Science, who used Macro XRF to map the elemental distribution of cobalt, titanium, and iron in the work. Surprisingly, the Macro XRF revealed a third composition of spiky flowers with linear petals. This third composition was much more stylized than the naturalistic flowers painted over them. The titanium map clearly showed the initial crayon drawing underneath the gouache as negative space. It was hypothesized that the crayon had acted as a resist for the wet media painted over it. Dahm returned to the work to look for evidence of dry media and found waxy blue crayon strokes along the bottom edge, delineating the stripes on the tablecloth.

When examining the verso of the work with strong raking light, the impression of the crayon was clearly visible, as were finer raised lines that may be details added with a colored pencil. Dahm noted that it is important to recognize that raking light showed more of the initial composition than either IR or Macro XRF, highlighting the need to combine sophisticated analytical techniques with simpler readily available ones.

Kristi Dahm, Art Institute of Chicago, Chicago, IL

MARGARET HOLBEN ELLIS

SEARCHING FOR MOLDMATES IN LEONARDO'S PAPERS

Ellis presented research undertaken with C. Richard Johnson Jr. from Cornell University and William A. Sethares from University of Wisconsin to create computational tools to document and analyze internal paper features including watermarks and chain lines intervals. When surface marks

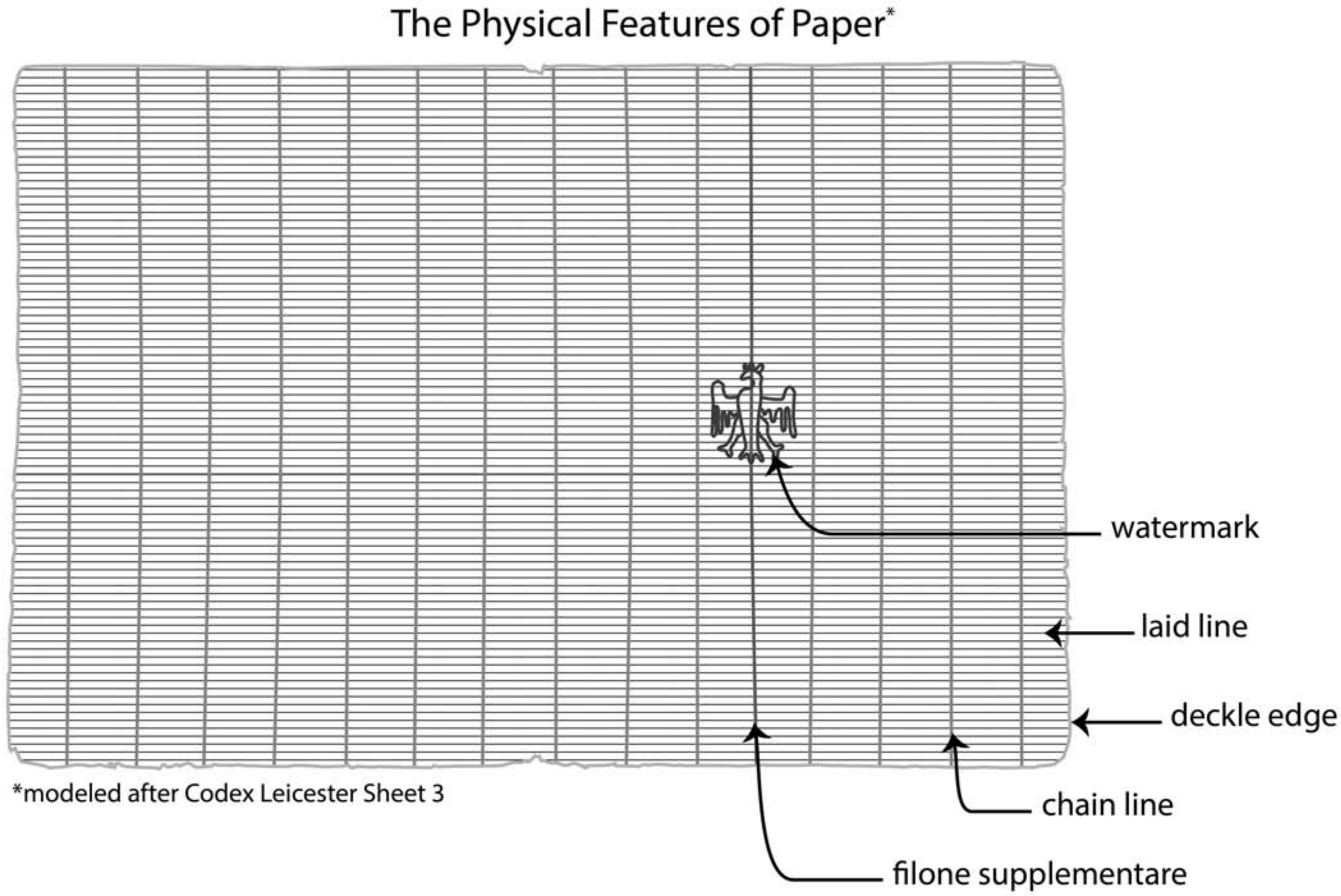


Fig. 5. The physical features of a paper reflect the unique characteristics of the papermaking mold used to form it. Moldmates share the subtle variations in watermark details, chain line intervals, and laid line densities. Twins have seemingly identical, but slightly different, physical features. Drawing by A. Slawik.

(writing, drawing, printing) obscure these features, the watermark is first enhanced. Then the application of two newly developed open source software programs, *watermarkMarker* and *chainLineMarker*, enable slight differences in the watermarks and chain line/wire intervals to be accurately and efficiently measured and compared.

As case studies, Ellis presented applications of these tools to the study of two Leonardo codices, Codex Leicester (contents date ca. 1506–1512, Bill Gates Collection) and the *Codex Arundel* (compilation date ca. 1478–1518, British Library). These are interesting notebooks to compare because scholars have determined that both were created when Leonardo was living in Florence. Therefore, it was conjectured that the papers in them would be roughly contemporaneous and, if purchased from the same paper manufacturer, would share three markers: watermarks, chain line intervals, and laid line densities. Ellis briefly reviewed 16th-century hand paper-making processes to demonstrate the presence and uniqueness of these features, which can help identify moldmates, or sheets made from the same paper mold, as well as papers produced by the second mold of a mold pair that have only slight variations, called *twins*.

As these papers were processed sequentially, papers made from one mold pair were consistently present in individual runs of paper production. Thus, moldmates and twins frequently occur in the reams of paper used to compile manuscripts and printed books. The identification of moldmates suggests a common place of origin and date of manufacture, ranging from the same production run (i.e., days or weeks) to the life span of that particular papermaking mold, estimated to be anywhere from nine months or two years for a popular paper size produced in an active mill. The existence of moldmates and twins within the *Codex Leicester* and *Codex Arundel* or by extension, shared between them, can therefore be used to support existing theories about dating and original collation or point to tantalizing connections either among the folios in the same codex or between codices.

Paper coding involves three steps: elucidation of internal features (watermarks and chain line intervals) by enhancement of images to remove surface marks; measurement of specific,

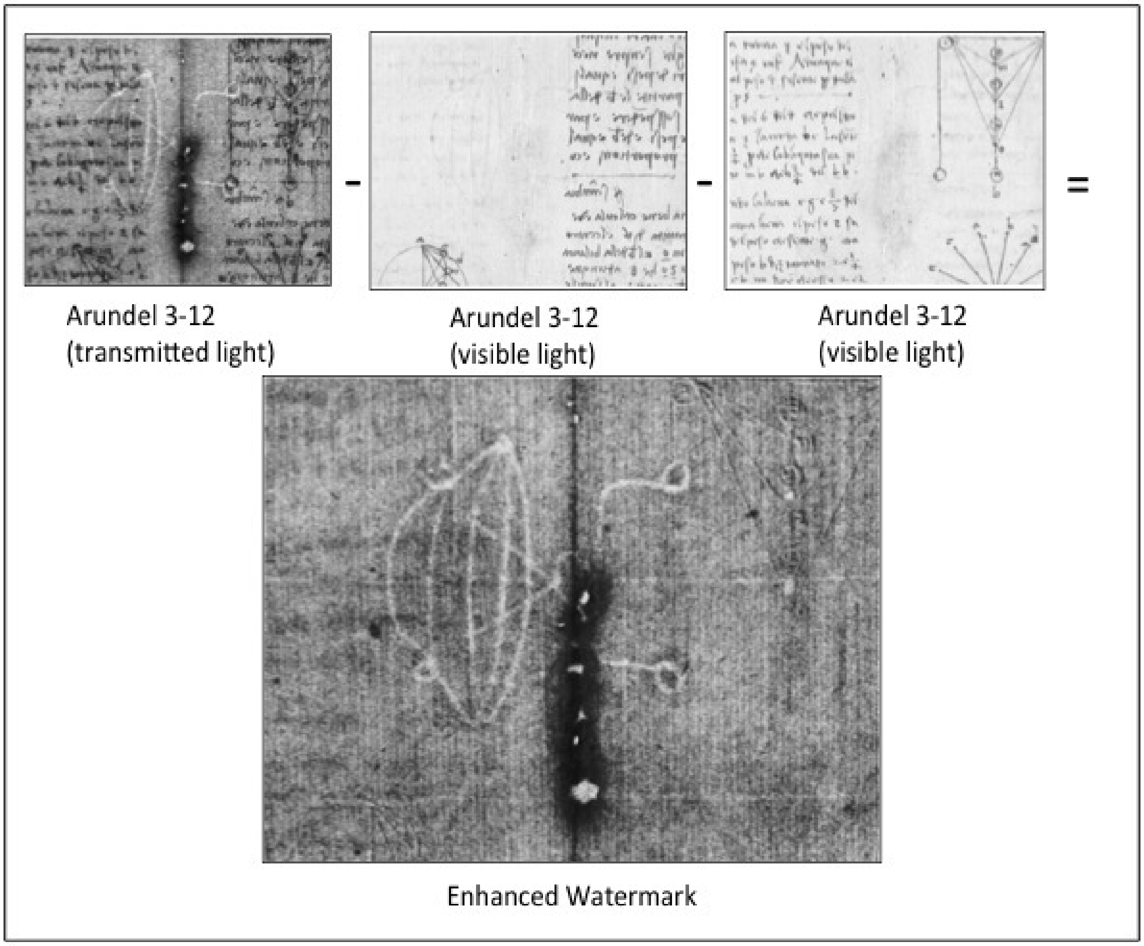


Fig. 6. Watermarks and chain line intervals are enhanced by subtracting optimally weighted visible images of the recto and verso of Arundel MS 263, ff. 3-12 (top center and top right) from a transmitted light image of the same area (top left). The resulting image (bottom center) has been "denoised" of distracting surface marks. Image copyright: British Library Board: Arundel 263 ff 3-12; processed image: William A. Sethares, Ruixue Lian.

unique features of watermarks and chain line intervals; and comparison and matching of these features and intervals to identify identical paper moldmates and probable twins. The pages in Leonardo's papers are typically covered on both sides with dense text and diagrams, and so the virtual suppression of surface interference was necessary to create a clear image of the watermark, chain, and laid lines of the paper.

Using images of a Cardinal's Hat watermark in *Arundel* 3-12, Ellis showed a visual representation of the sequence of subtraction of the two visible light photographs of the recto and verso from the transmitted light image of the watermark to create an enhanced or "denoised" image. A detailed description of this process was recently published in JAIC (Sethares et al. 2020).

To analyze and compare the features in the enhanced images, *watermarkMarker* software was used to measure and plot differences found, for example, in Flower watermarks in *Arundel*, such as the span between leaves and petals. The *chainLineMarker* software reports the ratios of the chain line intervals relative to each other, across the sheet. Code visualizations group papers based on their watermark and chain interval codes.

Analysis of 37 sheets across the two codices identified moldmates and twins for the Cardinal's Hat, Eagle, and Flower watermark types in the *Codex Leicester* and *Codex Arundel*, allowing for accurate collation diagrams and for confirmation that bifolia 1-30 of the *Codex Arundel* are closely related. Cross-codex paper moldmates for the Eagle and Flower watermark types were identified in both codices, suggesting affinities in dates and geographic origin.

Ellis closed by summarizing research undertaken by Sara Gorske with Paul Messier (Yale University) to map the unique variations in laid line frequencies across the mold, using a collection of 16th-century papers. The significance of this coding option is the potential to match papers with no watermark and confirm results using chain line intervals.

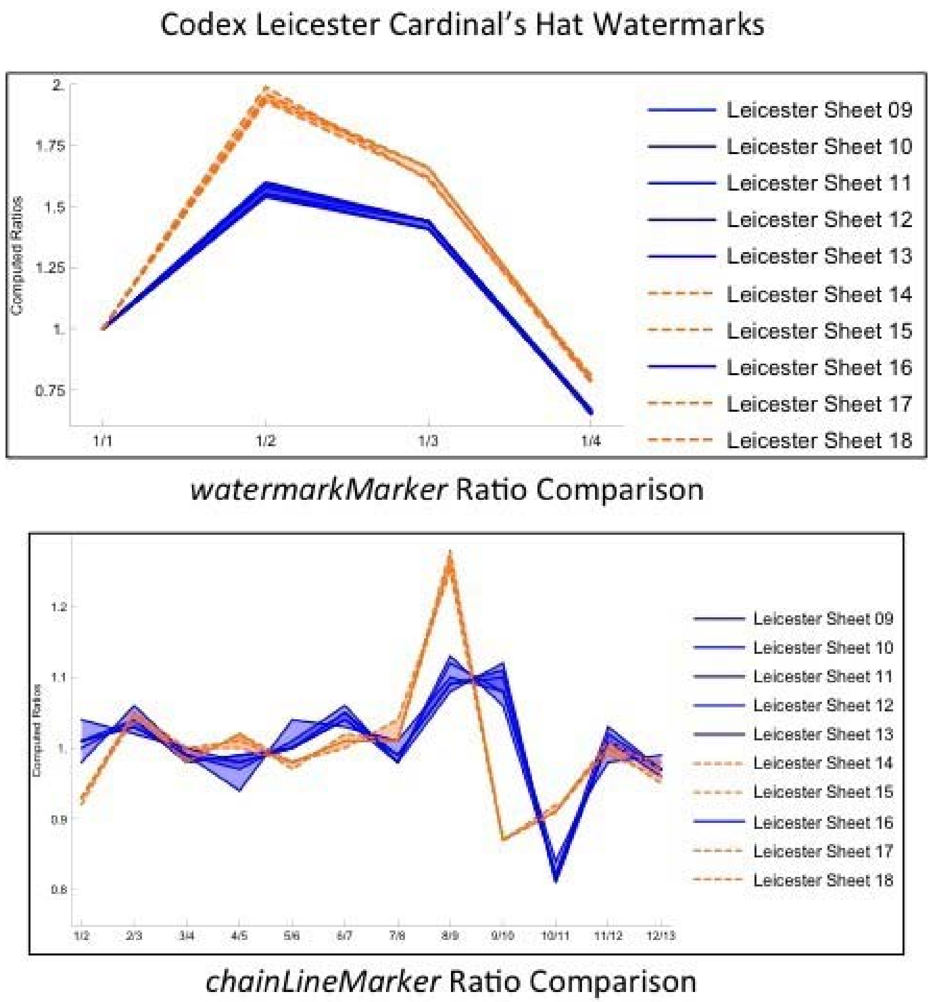


Fig. 7. The code visualizations for the Cardinal's Hat watermarks found in the Codex Leicester indicate that their watermark and chain line interval codes fall into two distinct groups thus graphically demonstrating that these 10 papers were produced by only two paper-making molds. Because moldmates and their probable twins are present in an uninterrupted sequence, it seems likely that the papers came from one run, which ended up in Leonardo's studio. Visualization: C. Richard Johnson Jr.

An article on laid line density mapping is forthcoming in the *International Journal for Digital Art History*. Beyond the characterization of Leonardo's papers, Ellis envisions applying computational coding to other collections of artists' and writers' papers to solve questions of dating, sequence, geographic origin, and aggregation, and encouraged colleagues to contact her with possible paper-coding projects.

Margaret Holben Ellis, Conservation Center, Institute of Fine Arts, New York University, New York, NY

DISCUSSION SUMMARY

After the last presentation, the moderators opened the floor for questions and comments. The wide-ranging discussion encompassed technical, equipment-related recommendations and philosophical perspectives on the expanding role of imaging in conservation practice and ethical considerations of image interpretation to a wider audience.

As conservation educators, Smith and Ellis alternately acknowledged imaging as a growing field in conservation, and expressed the value of having a dedicated professor in their programs for examination and documentation techniques. Smith shared how Buffalo graduates regularly disseminate their diverse knowledge of imaging processes to update workflows and equipment in various laboratories with a range of resources.

The importance of making images, especially those created using specialized techniques, more accessible to clients, curators, and other allied professionals was discussed by several panelists. Questions were raised about how these files are labeled and accessed within institutions, including those that have been adjusted or otherwise altered to make them more

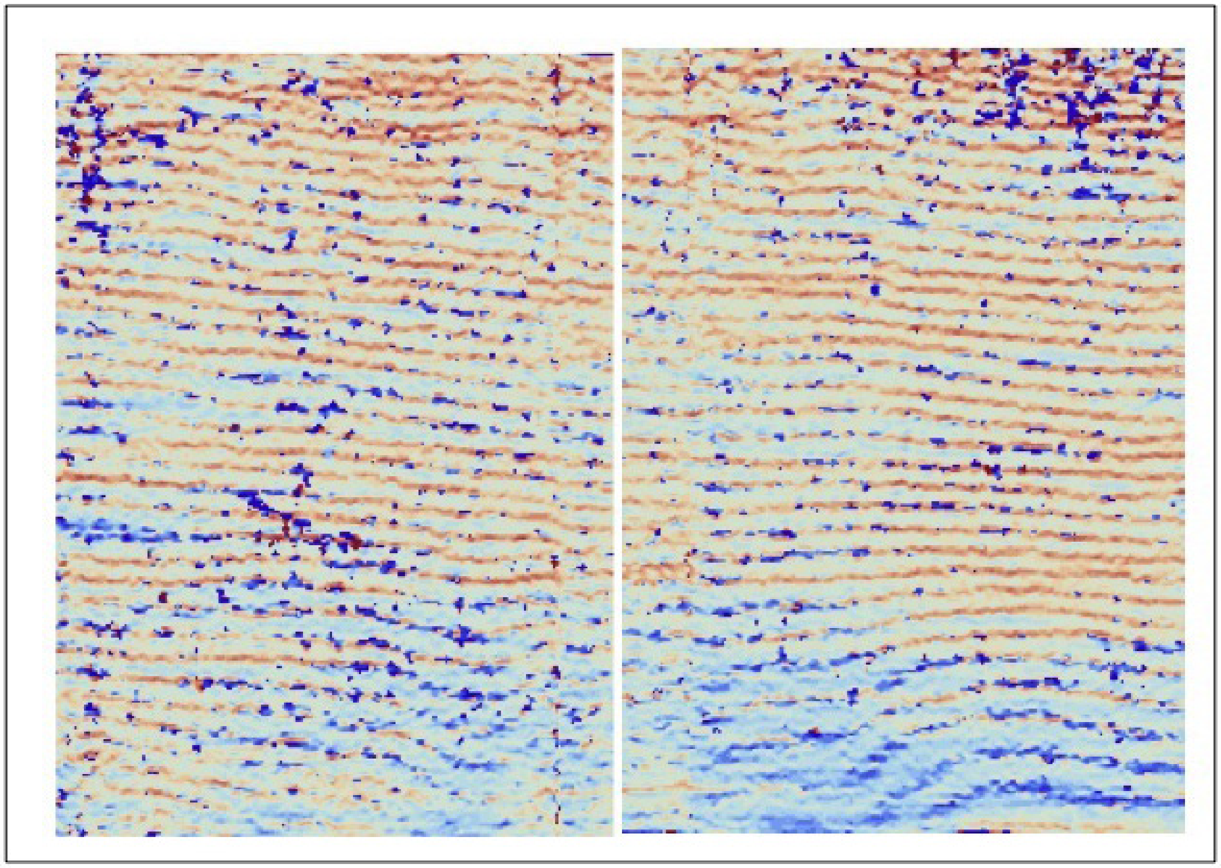


Fig. 8. The frequency of laid lines across a sheet of paper fluctuates in a pattern unique to the mold from which it was formed. The variations in density can be mapped using color and intensity differences. These maps show two adjacent halves of the same 16th-century Austrian paper. Processed image: Sara Gorske.

legible. Dahm referred to a recent talk by Becca Goodman in this year's AIC conference in which she addressed the ethics associated with creation and presentation of these digitally altered images and reviewed current terminology in use for describing them, and suggested marking tools such as watermarks to prevent misinterpretation of individual files. Dahm and others noted the speed with which images can be disseminated online, and that extra care is needed to accurately present and label the information we share. The consistent presentation of a reference image alongside an IR or MA-XRF map image, for example, can help the legibility and interpretation of these images and maintain their context. McGlinchey Sexton discussed the most effective balance between providing too much information and showing enough to be accurate and concise. Including a caption or interpretive text that is linked to the image(s) is best practice to avoid inaccurate conclusions being drawn by scholars, private collectors, and other stakeholders not familiar with interpreting these images.

Ellis reflected on past misinterpretations of x-radiographs and IR images of underdrawings in paintings, and fears the same type of misinterpretation by non-conservators is now occurring with some reflectance transformation imaging studies. She proposed that as our colleagues become more capable in interpreting these images of paper artworks the situation should improve, but that a vital step forward would be more widespread publishing of technical studies by conservators in non-conservation literature. She acknowledged the challenging nature of translating our work to a different language and format. The urgency of this mission was underscored by Smith, who cautioned that the recent trend in art history toward "materiality" may drive scholarly publications about works on paper forward without the valuable contribution of a conservator's perspective. As conservators, we need to reach out more to encourage a cross dialogue between our fields.

Dahm also discussed the development of a new digital asset management system at the Art Institute of Chicago that allows access by curators to all images of the collection, including technical images previously only accessed by conservation staff. To prevent the misinterpretation of these potentially complex images, the conservation department has drafted a legal disclaimer of sorts associated with the technical images that prohibits their dissemination without consultation from a conservator. Binder followed by saying that a similar initiative is under way at the Fine Arts Museums of San Francisco.

In response to requests to describe reactions from curatorial colleagues or clients to information revealed by conservation imaging, Binder spoke first about how the ease of sharing images with their microscope setup has facilitated an ongoing dialogue with her curatorial colleagues and led to conservators being more involved in contributing to curatorial publications, educational material, and other content. She feels like everybody can be sure they are "seeing the same thing" when looking at details of artworks, and be on the same page. Smith discussed how the project with Oberlin was designed to answer very specific questions from the curators about each drawing, and so the documentation of watermarks and any additional information that was revealed was met with eager discussion that will hopefully be documented in an upcoming online catalog. McGlinchey Sexton explained that her private and institutional clients display a wide range of interest and knowledge of looking at details of things and understanding the nonvisible imaging as well. Sometimes they simply want her interpretation that they can present to a collections committee or to have a record of condition. Her job, she feels, is to make sure people can understand as much as they want without overloading them with too much information.

Ellis expressed that she had received some push back from the Leonardo scholarly community in reaction to technical images in her recent studies, along with a general mistrust of science applied to art historical research. She reflected that she does not believe her research supplants connoisseurship and close looking, and should not be used as a stand-alone tool. She hopes this work can help move away from a reliance on Briquet (1907) for dates due to known inaccuracies of this resource, and wants to support traditional art historical and codicological research. Ellis also went into greater detail regarding the availability of the open source software demonstrated in her presentation. Test runs of the tutorials guiding use of the software are under way, but release may take another year. Ellis reported that the first moldmate match in the *Arundel* was just confirmed by the laid line density maps, and that she will keep everyone posted on progress.

Dahm provided additional information regarding the date range assigned to *The Faun Musician*, as well as the attribution of the underlying drawings to Picasso. She reviewed precedents in the technical literature on Picasso and compelling details from the study of *Faun* that support the attribution, and encouraged those interested to contact her or Francesca Casadio at the art institute for further information about the study.

Throughout the discussion, the value of magnification as a primary tool for paper conservators was reinforced by several panelists and colleagues. McGlinchey Sexton recounted how having her microscope set up on-site has helped her communicate key observations about artistic process and condition to her clients. A practical challenge for a portable system is the correlation between increased weight and better stability of the microscope, and McGlinchey Sexton acknowledged that the stands sold by the Dino-Lite company are not sufficiently stable and require modification. Another recommended portable microscope was the Zarbeco MiScope, which Smith mentioned had been used at Harvard to create student tutorials to identify process techniques in architectural drawings. Several commentators discussed current microscope ocular adaptors for smartphones, for portable streaming or capture, such as those made by LabCam or Am Scope that can be effective for replicating a system similar to that of Binder and Dodson if you don't have a camera adapter on your microscope, although the capture of raw image files is not possible.

Binder and Dodson offered advice to those trying to replicate their system now, stating that they have since purchased a larger iPad and another adapter to increase the magnification of their scope. They still wish to have an easier reference scale and would like to explore cameras with now-standard Wi-Fi capabilities. Dodson cautioned the impulse to use the highest-resolution cameras, as the limitation for resolving these magnified images is the lens within the microscope. Thus, as a general rule, there is no benefit to using a camera exceeding 16–20 megapixels (note that current USB microscope cameras are typically 5–12 megapixel systems). Binder appreciates the versatility of their system and that they can swap out and upgrade individual components.

Another portable and stand-alone mount compatible with various devices and cameras that was strongly recommended was the Manfrotto "Magic Arm" with a standard head that clamps to the side of a table.[2] This setup is currently used with a UV documentation set up at the University of Pennsylvania, as well as by reading room librarians for digital consultations with a smartphone for video or image capture. At the New York Public Library, some of the reading rooms are currently using a HoverCam Solo 8 Plus Document Camera to allow remote viewing of objects by patrons. The camera is also being used to examine some objects requested for digitization.

The discussion concluded with current challenges posed by remote work and restricted access to collections and resources in response to the Covid pandemic. The moderators and several panelists reflected on being asked to evaluate artwork remotely for acquisition, loan, and/or treatment. Binder has prioritized educating those present on-site to provide better-quality video and images that are actually useful, and shared the hope that in trying to find new ways to safely supervise installations and do these things remotely, we can pave a future with a greener conservation footprint. McGlinchey Sexton acknowledged that her more remote geographic location in Colorado has made her more accustomed to communicating with images; however, she observed that an unexpected benefit of this time has been the increased comfort of her clients to capture and share helpful video of artworks or conference in this way.

ACKNOWLEDGMENTS

The co-chairs of the Art on Paper Discussion Group would like to thank BPG Program Chair Eliza Spaulding and Assistant Program Chair Andrea Knowlton for their assistance in planning and organizing this session. They would also like to thank the panelists and attendees for their flexibility and willingness to switch to an online platform.

NOTES

1. Pablo Picasso, *The Faun Musician*, June 7–11, 1947. Brush and black ink and gouache on cream wove paper, folded. Gift of Dorothy Braude Edinburg to the Harry B. and Bessie K. Braude Memorial Collection, Art Institute of Chicago, 1998.720: https://www.artic.edu/artworks/150824/the-faun-musician

2. The Manfrotto "Magic Arm" system includes a Manfrotto 244N Variable Friction Magic Arm (MA244N), with a Manfrotto 635 Quick Action Super Clamp (MA635) at one end to attach to the table and at the other end a Manfrotto TwistGrip Tripod Adapter Clamp for Smartphones. Alternatively, Manfrotto has other styles of clamps for camera mounts. This system was shared by Sarah Reidell, Margy E. Meyerson Head of Conservation, University of Pennsylvania Libraries, Philadelphia, Pennsylvania.

REFERENCES

Briquet C. M. 1907. *Les Filigranes. Dictionnaire historique des marques du papier des leur apparition vers 1282 jusqu'en 1600*. Paris: Alphonse Picard et Fils.

Chen, J. J., and T. J. Smith. 2019. "Documentation of Salted Paper Prints with a Modified Digital Camera." *Journal of the American Institute for Conservation*. Published October 3, 2019. https://doi.org/10.1080/01971360.2019.1643527.

Sethares, W. A., M. H. Ellis, and C. R. Johnson Jr. 2020. "Computational Watermark Enhancement in Leonardo's Codex Leicester." *Journal of the American Institute for Conservation* 59(2):87–96. https://doi.org/10.1080/01971360.2019.1703483.

LINDA OWEN
Associate Paper Conservator
Baltimore Museum of Art
Baltimore, MD
lowen@artbma.org

REBECCA POLLAK
Senior Research Conservator, Scientific Analysis of Fine Art LLC
Independent Paper Conservator
New York, NY
rebecca@scienceforfineart.com
beccapollak@gmail.com

JULIE BON

Collaboration and Innovation: Developing the Potential of Environmental Monitoring Data at the National Library of Scotland Through Industrial and Academic Partnerships

INTRODUCTION

The National Library of Scotland (the Library) is the successor to the Library of the Faculty of Advocates, which opened in 1689. In 1925, the Faculty presented its collections, with the exception of the works on law, to the nation, and an Act of Parliament formally constituted the National Library. This National Library Act was further expanded to amend the governance of the Library. It is funded through the government and is governed by a Board of Trustees.

The Library's collections consist of manuscripts and archives, rare books and general and modern collections. The Library is one of only six legal deposit libraries in the UK and the collection grows by more than 2 million items a year: the majority of this, in the region of 89%, is now born-digital material, but the Library still acquires a significant number of physical collection items on an annual basis. Currently, the Library holds more than 31 million items which are stored on more than 120 miles of shelving made up of a mixture of fixed and mobile stacking. The Library takes a mixed approach to boxing, with a number of collections open on shelving and some boxed in either phase boxes or newly designed cabinet boxes.

The Library's flagship building on George IV Bridge, in the heart of Edinburgh, was started in 1938. Construction work was halted during the Second World War and finally completed in 1956. By the 1970s, the growth of the collections was occurring at such a rate that it became clear that further space was required. Work started to build the Causewayside building, on the south side of the city, in 1983, and it was opened in two phases between 1989 and 1995. The Library also encompasses a moving image archive housed in Kelvin Hall in Glasgow and a storage unit for this collection based just outside the city. The book and paper collections housed in the George IV Bridge and Causewayside buildings form the focus of this article.

In George IV Bridge, the majority of the stacks are on subterranean floors. As a solid stone building from the 1950s, the stack areas are consistently environmentally stable and existing air handling systems work well to maintain this stability. The main areas of concern, in terms of the environment, centre around office spaces and areas not originally designed for collection storage, and use, which have been repurposed over the years to accommodate an expanding organisation.

The design of the Causewayside building placed all of the services and access routes to the different floors on the exterior planes, allowing as much space as possible within the centre of the building for collection storage. There are two subterranean storage floors which are environmentally controlled black-boxes. However, some of the detailing of the exterior of the building meant that certain areas were susceptible to water ingress, and this had caused a number of issues for the collections. The Library undertook remedial work to this building from 2015 which involved replacing the roof and making improvements to the external cladding of the building. Defects in the design were rectified, and other improvements were undertaken to ensure that the building is now water-tight, more energy-efficient and easier to maintain.

ENVIRONMENTAL MONITORING AT THE LIBRARY

There have been a number of methods of environmental monitoring employed at the Library over the years, but by 2013, there were several catalysts prompting a change to the Library's approach. At this time, the Library's Building Management System (BMS) was a Trend 963 system. This was a closed-protocol system, and the controllers were no longer supported. Trend 963 systems had been on the market from 2003, and the older, no longer supported,

Papers presented at the General Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

versions were vulnerable to cyber-attack (Trend Control Systems Ltd. 2020). At this time, the Library identified that it needed to upgrade and replace up to 100 sensors across the estate; with sensors costing around £7000 each, this meant that the Library required to find £686,000 of capital funding.

The existing system also had a number of deficiencies, including the nonalignment of three stand-alone monitoring systems and the BMS. All of the systems worked on closed protocols, making access, and the sharing of data, awkward and cumbersome. The existing system required manual monitoring and downloading of data, with further software interventions required to enable data analysis and reporting. This resulted in time-lagged multiple data sets which were difficult to interrogate and led to reactive action and inefficient processing. The existing BMS also offered only very limited submetering for energy usage analysis.

Research and development into system upgrade options continued at the Library, but by 2016 the BMS controllers were completely saturated. There was no availability for further development or expansion, and the system was working to absolute capacity. Over the years, the Library estate BMS controls had been altered, upgraded and enhanced, and it was clear that the existing Trend 963 legacy system and controllers had reached the end of their useful life expectancy. This presented a major risk of failure and needed to be urgently addressed.

In 2017, the new British Standard 4971:2017 was released which demanded higher levels of environmental storage controls than the previous standard (British Standards Institute 2017). Concurrently, all of the energy-saving quick wins across the estate had been exhausted, but the organisational, and political, pressure to achieve lower energy targets was still high. By 2017, Trend 963 systems were being withdrawn and replaced with Trend IQ Vision systems: the Library needed to be able to respond to this change.

Replacing and upgrading the Library's environmental monitoring system across the whole estate became a strategic priority, which came with a number of challenges. There was a need to implement a system upgrade without causing any detrimental effects to the collections. To this end, the temperature (T) in the storage stacks needed to stay between 16 and 20 °C and the relative humidity (RH) between 40% and 60%. It was agreed that there should be no detrimental effect to the organisation's environmental parameters, so fluctuations were not to exceed 10% for RH and 5°C T in any 24-hour period (National Library of Scotland 2016).

The Library also faced a number of common constraints when planning and delivering this system upgrade: there was limited financial funding and resource availability; the Library estate comprised Grade A & B listed buildings, resulting in restrictions concerning structural interventions; there were limited providers in the market with the knowledge and experience required to deliver this sort of project; and no suitable single integrator of services had been identified (Historic Environment Scotland 2019).

DEVELOPMENT OF AN INDUSTRIAL PARTNERSHIP

These challenges and constraints led the Library to develop an industrial partnership with a company that could help develop and deliver the required system upgrade. The Library wanted to be ambitious and develop an entirely new user interface to address a number of deficiencies with the current system. After carrying out a market survey and option appraisal, it was apparent that there was no single provider available but that the Library needed to work with an "integrator" of sorts that could enable and pull together the outcomes required. This led to the development of an industrial partnership with Craigalan Controls Limited (CCL). The Library had worked with CCL before, and the company had emergent experience of working in the heritage sector in Scotland. They had wide experience of developing BMS with an energy-saving focus across other professional areas, including the university, financial and prison sectors (Craigalan Controls Limited 2020).

Through this industrial partnership, the Library became one of the first institutions in the UK, and the first in Scotland, to install this new software using Trend IQ Vision as the front end. The Library was able to work with CCL as an industrial partner to create a bespoke open protocol platform allowing intuitive access, available to those who needed it. The approach taken, in terms of this system upgrade, presented a real opportunity for the Library, as a public-funded body, to support local innovation and business and build a bespoke model which suited very particular needs.

Benefits of the Industrial Partnership for the Library

The integration of a number of systems within this new BMS setup has delivered several benefits for the Library: there is greater environmental control in real time allowing a proactive, rather than simply a reactive, approach to the data; the new system has led to increased energy savings; and the Library now has integrated security systems enabling a faster response to issues. All of this has been achieved while reducing capital expenditure.

The new LEEP (Library Environmental and Energy Platform) system offers a one-stop shop for a number of controls systems. What is particularly exciting is that all of the data is displayed in real time, which is opening up several avenues for further research. Examples of the sort of information being gathered, and options available to the user, include monthly carbon footprint per zoned section of each building; T, RH and rate of change data for floors and zones; external weather (with five-day forecast); energy usage per floor level and percentage of total daily cost for

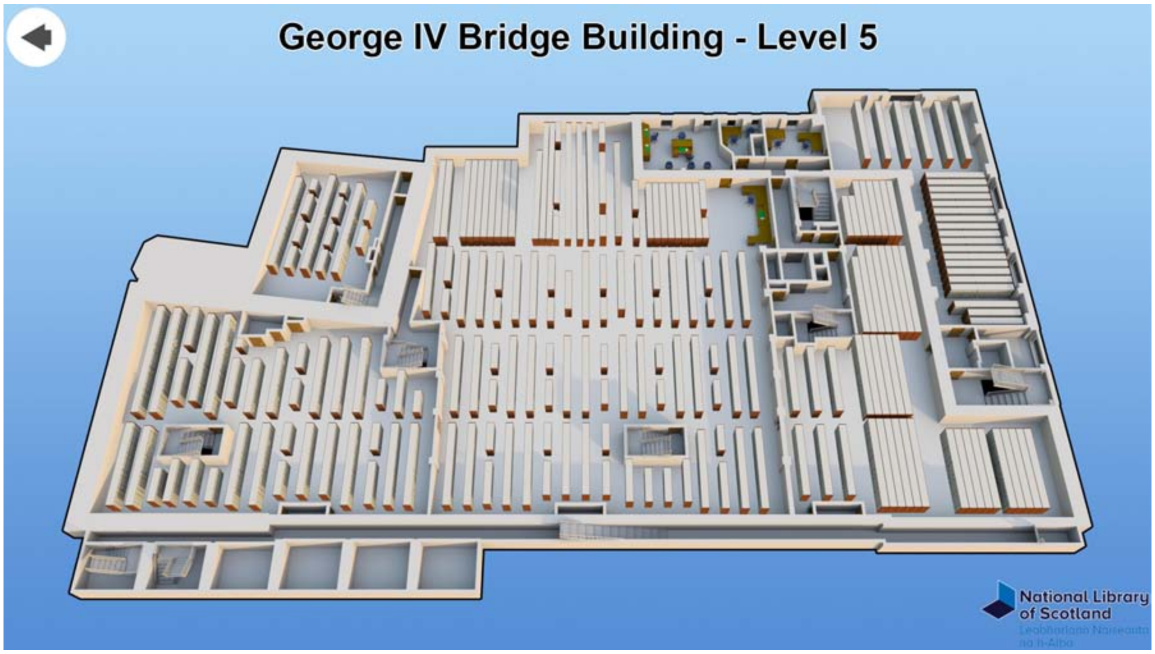


Fig. 1. Screen shot of the Library's new LEEP system.

that building; and sensor alarms across buildings, by floor and by zone, set to cover RH and T compliance against set-points, boiler performance and AHU performance. Other advantages of the system are that it allows access to online data and software storage, remote technical support and energy performance solutions.

The design of the new system also brings a number of benefits to the user, as it is intuitive and easy to navigate. It provides a single interface but enables multiple users to gain access at any one time. The system allows real-time data analysis leading to more efficient management of collection environments. The setup has allowed the development of new analytical tools, including rate of change graphics as standard across all monitored spaces; the potential of these will be explored in future research. A key advantage of the new system is that it enables secure and automatic archiving of historical data. The Library can now demonstrate full compliance with UKRG and GIS standards and share this data easily and quickly with depositors, lenders and borrowers. The system also offers the potential for national networking and sharing of data across institutions in the heritage sector.

Another clear benefit for the Library of this new system has been the cost savings. From an initial investment of £35,000, an immediate saving of £351,000 was made on the cost of replacing all of the sensors across the estate. Utilising the benefits of the new system has also enabled the Library to become more energy efficient. During financial years 2017–2019, the Library achieved a 32% reduction in greenhouse gas emissions and a 9.24% reduction in energy consumption (against 2016–2017 baseline figures). Unfortunately, data analysis for 2019–2020 is not yet available, but other calculations show that total energy costs have fallen over the past year and that the Library is set to continue with its lower energy consumption trajectory. However, reductions are now harder to achieve, as the organisation has cut out wastage and employed a number of energy-saving techniques. The Library needs to make significant investment, including replacing several boilers, to make further savings. This is one of the main reasons academic partnerships are now being explored to undertake research to help the Library become even more energy efficient as an institution and a business.

BEGINNING AN ACADEMIC PARTNERSHIP

The Library has embarked on a collaborative academic and industry doctorate entitled "Applying ANN (or Artificial Neural Network) technology to determine acceptable microclimate parameters for the National Library of Scotland's Collections to enable significant energy efficiency improvements".

The research is being generously funded by the Library, Heriot Watt University and the Energy Technology Partnership (ETP). It is being hosted by the Library and the Institute for Sustainable Building Design at Heriot Watt University in Edinburgh. This is a first for the Library, as it has regularly hosted arts and humanities doctoral students but has never hosted a student from the STEM sector. The value of this successful funding bid through the ETP, in terms

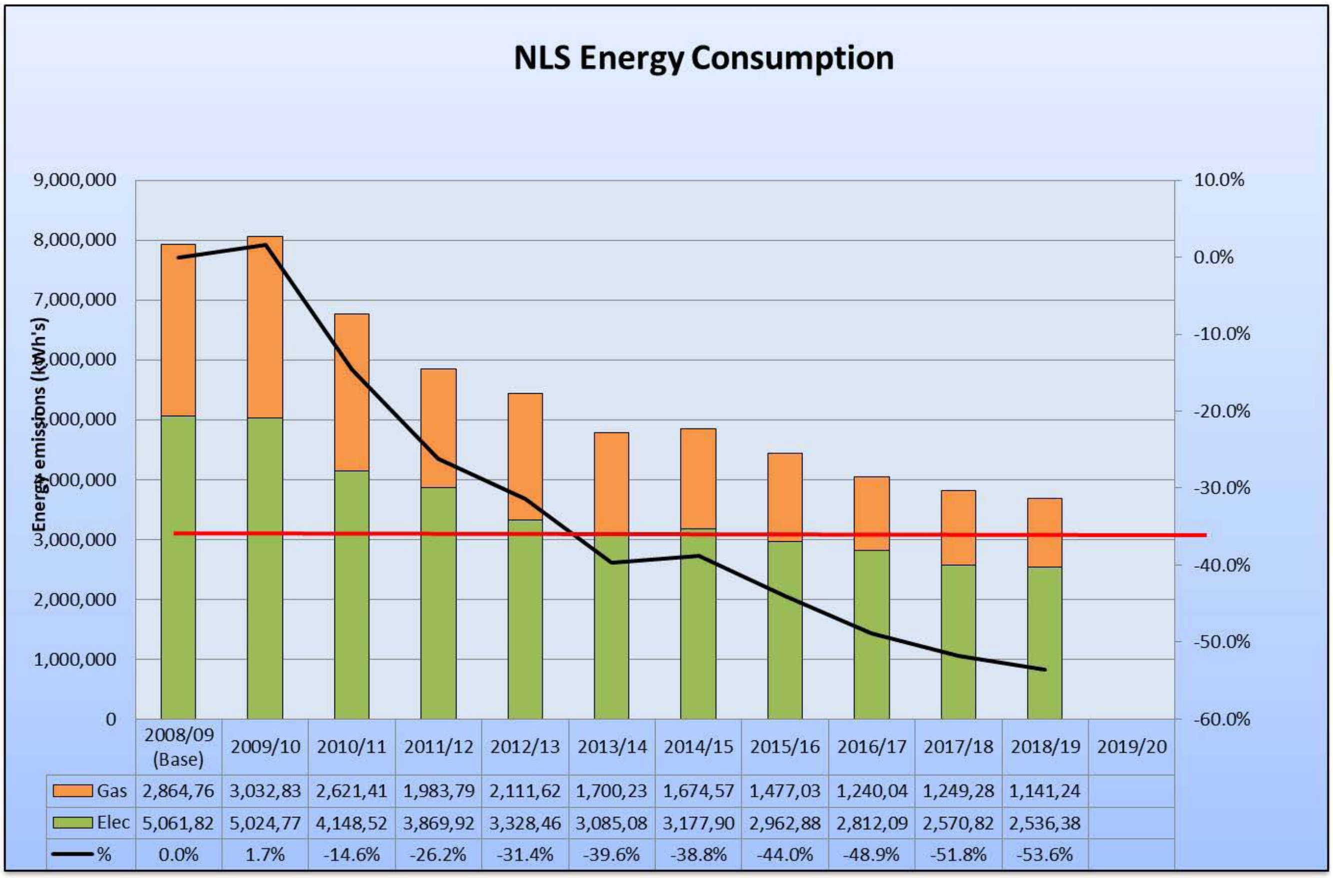


Fig. 2. Library energy consumption showing energy and cost savings. National Library of Scotland Estates department.

of internal advocacy for conservation and heritage science at the Library, has been immeasurable.

The ETP's established Energy Industry Doctorate Programme addresses

> [T]he strategic demands of industry and government for 'industry-ready', post-doctoral researchers to enhance energy industry innovation and knowledge exchange effectiveness. A defining characteristic of the programme is strong industry engagement where companies and co-investors support project specification and engage with the research directly. *(Energy Technology Partnership 2020)*

The ETP is a research pool drawing together energy knowledge, expertise and innovation from 13 Scottish higher-education institutions and is supported and co-funded by the Scottish Funding Council. The vision of this partnership is "to build on the existing areas of excellence and collaborative working to ensure that Scotland remains a globally competitive driving force in energy research and innovation" (Energy Technology Partnership 2020). The joint doctorate between the Library and Heriot Watt University fits the ETP research theme of *Energy Utilisation in Buildings* and aligns closely with the Scottish Government's *Scottish Energy Strategy* (The Scottish Government 2017). The two key drivers for this project are to further assist the Library in achieving legislative compliance with the Scottish Government's energy-efficiency targets for public-sector organisations, and to increase public access to the Library collections by running exhibitions in local properties that do not have sophisticated environmental control systems (The Scottish Government 2015).

The appointed doctoral student will use the real-time environmental and energy consumption data, that the Library's open protocol BMS can provide, to research the impact of microclimates on the preservation of Library collections. This will be done through the strategic placement of environmental monitoring sensors throughout the building and stack floors. Sensors will also be positioned within display cases and storage enclosures (a variety of boxes and enclosures used by the Library) to monitor the buffering effect of such enclosures. This data will be combined with data concerning the condition of collection items selected to form part of the study to develop optimum storage protocols for Library collections. The research student will then use ANN modelling, which simulates the way the human brain analyses and processes information, and mock-up tests to predict and examine the effect of environmental fluctuations in a room on the microclimate inside a number of typical storage and display cases to establish an acceptable level of fluctuation that would allow the Library to loosen current tight environmental controls and therefore reduce energy consumption.

Benefits of an Academic Partnership for the Library

The likely results of this research will help the Library manage energy consumption through the development of new environmental guidelines for stored and displayed collections (likely advocating a more pragmatic and less rigid approach to environmental control parameters). This would enable the Library to become more cost efficient through achieving further energy savings and would demonstrate its commitment to achieving Scottish Government energy use targets. The Scottish Government's *Climate Change Plan* sets out a trajectory to 2032 which requires 70% of nondomestic buildings' heat to be supplied by low carbon technologies and a reduction in nondomestic buildings' heat demand by 20% through improvements to the building fabric by 2032 (The Scottish Government 2018).

The research is also likely to inform decisions around enclosure design, and how best to prioritise the boxing of the Library's collections in storage. At the Library's in-house box-making facility, the Preservation Services Unit based in the west of Edinburgh, Library staff have been developing a new box, called a *cabinet box*, which is a cost-effective design because it uses limited card and provides protection for a number of collection items at once. It is hoped that the microclimate research will help refine the design and verify that this boxing methodology provides suitable protection for collections so that their production can be accelerated to get as many collections in storage boxed and protected as possible.

The research project will also provide benefits for the display of Library collections, as the results should lead to the development of a new strategy that will enable the relaxation of the tight environmental controls for both display and storage. In essence, this will allow the Library (and possibly other national organisations) to display collections in smaller libraries, museums and galleries that are currently unable to meet such parameters. Public access and engagement is a key driver for the entire heritage sector, so the academic rigour of this research and its findings, once disseminated, will help other institutions achieve this aim. The Library is already working with local museums, archives and schools on a variety of display and engagement projects, and the results of this research will allow an extension of this program. For instance, the Library is involved with the Art UK Masterpieces in Schools program, but until now, there has been a limit to what collections can be accessed in this way (Art UK 2020). The findings from this research will help the Library develop this partnership, and others, further.

An important aspect of this research project is dissemination and advocacy, and there is a strong schedule being put together to ensure that the findings of this research are shared widely across the heritage, building management and engineering sectors in the UK and further afield. This will allow other organisations to benefit from our research and spread the confidence to make changes to display parameters, growing the possibilities for lending collection items from national to non-national institutions. This is an area of increasing interest for the heritage sector and has been investigated, on the international scene, since the late 2000s (Atkinson 2014). It is hoped that the Library's research project, by combining the use of real-time environmental monitoring and energy usage data, as well as the developments in ANN modelling at Heriot Watt University, should help move the argument further towards an agreed relaxation of environmental parameters.

A final benefit of the proposed research is the internal and external advocacy that it will garner for the Library. It is hoped that the successful completion of this heritage science doctorate will be a stepping stone for the organisation to undertake further STEM-related studies. An important aspect of this has been the sector-wide recognition that our partnership work with industry and academia has gained, not least through recent success at the UK National Premises and Facilities Management Awards 2019 (Premises and Facilities Management 2019). The Library won the Partnership in Smart Facilities Management award (with CCL) and also won the overall winners award. This is a reminder that collections care success can spread across into other sectors and that awards can help bring this to the attention of those that make financial decisions in heritage organisations.

It is hoped that this research will also raise the profile of conservation within the organisation and demonstrate the value, through cost savings and innovation, it can bring. This advocacy has already started. Energy efficiency and sustainability is more prominent in the new Library strategy (2020–2025) which will be launched later this year (National Library of Scotland 2020). The possibility of extending the display opportunities for Library collections is also a key objective. This five-year strategy will take us through to the Library's centenary year in 2025. Internal advocacy on the value of taking a preventive approach to caring for our collections, of which this research project and the attractive funding it has brought with it has been an important part, has helped make the case for resourcing the newly appointed, first-ever Preventive Conservator post at the Library. Development of this project has also allowed the Collections Care team and the Estates team at the Library to work more closely together.

Fig. 3. Stack storage at the Library's George IV Bridge building. Courtesy of Joe Jackson.

CONCLUSION

The industrial partnership to develop and upgrade the Library's environmental monitoring system grew from a user-led demand for a bespoke product. This has led to a number of anticipated, and some unanticipated, benefits for the organisation as a whole. Immediate cost and energy savings were realised. Data analysis is now more straightforward, efficient, reactive and secure. The value of this data for the day-to-day management of buildings and collections has been demonstrated, but its potential for future research and development has only recently been identified. The Library is at the start of a journey to explore the potential of academic partnerships available within the STEM sector to utilise data, and develop modelling, to make predictions about future outcomes. The potential for this research is wide ranging, and the predicted benefits include future energy efficiency to comply with Scottish Government targets; data to support the refinement of box and enclosure design; opportunities to expand and develop the Library's exhibition lending activities; and internal and external advocacy for collections care and the value of preventive conservation. Through these different partnerships, the Library has demonstrated its commitment to energy efficiency and good collections care and management. It has also demonstrated an ambition and a will to push the envelope, in terms of industrial and academic opportunities, and has shown a forward-looking and responsible attitude towards the work involved in caring for important national collections.

ACKNOWLEDGMENTS

The author is indebted to Ian Symonds, head of Estates at the National Library for Scotland, for his support in writing this article and in developing the research proposal idea. Dr. Fan Wang, assistant professor at the School of Energy, Geoscience, Infrastructure and Society's Institute for Sustainable Building Design at Heriot Watt University, has been instrumental in identifying the potential for applying ANN modelling to environmental monitoring data. Thanks also to CCL staff Craig James, Kevin MacMillan and Neil Paterson, and to Charlie Sclater, buildings officer at the National Library of Scotland. Thanks also to Joe Jackson, icon preventive conservation intern at the National Library of Scotland, for the cabinet box image.

REFERENCES

Art UK. Masterpieces in Schools. Accessed September 18, 2020. https://artuk.org/learning/masterpieces-in-schools#:~:text=Art%20UK%20is%20excited%20to,a%20school%20for%20the%20day.

J. Kirby Atkinson. 2014. "Environmental Conditions for the Safeguarding of Collections: A Background to the Current Debate on the Control of Relative Humidity and Temperature." *Studies in Conservation* 59 (4), 205–12.

British Standards Institute. 2017. BS 4*971:2017 Conservation and Care of Archive and Library Collection.* London, UK.

Craigalan Controls Limited. Home Page. Accessed September 17, 2020. https://www.craigalancontrols.co.uk/.

Energy Technology Partnership. Home Page. Accessed September 17, 2020. https://www.etp-scotland.ac.uk/.

Historic Environment Scotland. 2019. *Scotland's Listed Buildings.* Edinburgh, Scotland.

National Library of Scotland. 2016. *Collections Environment Policy.* Edinburgh, Scotland.

National Library of Scotland. Strategy Consultation. Accessed September 18, 2020. https://www.nls.uk/strategy-consultation.

Premises and Facilities Management. 2019. PFM Partnership Awards 2019 Winners Announced. https://www.pfmonthenet.net/article/175617/PFM-Partnership-Awards-2019-winners-announced.aspx.

The Scottish Government. 2015. Policy: Energy Efficiency. https://www.gov.scot/policies/energy-efficiency/energy-efficiency-in-non-domestic-buildings/.

The Scottish Government. 2017. The Future of Energy in Scotland: Scottish Energy Strategy. https://www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/pages/1/.

The Scottish Government. 2018. Climate Change Plan: Third Report on Proposals and Policies 2018-2032 (RPP3)—Summary. https://www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018-9781788516488/.

Trend Control Systems Ltd. Why upgrade to IQVISION from 963? *Trend Controls*. Accessed September 17, 2020. https://www.trendcontrols.com/en-GB/Pages/IQVISIONvs963.aspx.

JULIE BON, ACR
Head of Collections Care
National Library of Scotland
Edinburgh, UK
j.bon@nls.uk

A Comparison of Fluids for Animal Glue Removal from Book Spines

INTRODUCTION

In book conservation, treatments involving repair of the binding can require removal of spine linings and adhesives. Removal of animal glue on book spines is often done by delivering water to the adhesive through a poultice, swelling and softening it enough so that it can be scraped away with a spatula. Possible additives in the adhesive, its proximity to covering materials like leather, and environmental conditions may encourage cross-linking in the adhesive over time, making it difficult to remove with conventional poultices like wheat starch paste or methyl cellulose. Even when it is possible to swell the adhesive, the combination of introducing moisture and the mechanical action required for removing the adhesive can cause fiber damage to the spine folds or create tide lines in the gutter of the text block.

Recent experimentations with new materials and techniques for cleaning have expanded treatment options in flat paper conservation, but their application to book spines has not been systematically tested. The multiple layers of paper and three-dimensionality of a book spine present challenges in adhesive removal that are not as prevalent in flat paper treatments, and solutions applicable for flat paper may not always be as successful for bound objects. Challenging spine adhesive removal treatments would benefit from an exploration of options presented by new and traditional methods and materials.

As there could be too many potential combinations of fluids and delivery methods to test, the project was divided into two parts: testing of fluids used for solubilizing adhesive on flat samples, and testing of delivery methods (e.g., gels) to apply the fluid to bound samples. Fluids and delivery methods to be tested were narrowed down based on affordability and ease of use, with a few novel materials added. This article focuses on identifying fluids that solubilize animal glue. Potential delivery methods will be tested in the future.

This article includes a review of the tests and results. For example, some techniques resulted in a more liquefied adhesive, whereas others softened the adhesive to a more granular consistency, affecting the ease of mechanical removal and risk of penetration into the substrate. Some treatment circumstances may allow a one-step approach, whereas others may require utilization of multiple techniques for the removal of thick or final layers of adhesive and to prevent depositing new undesirable residues. Although there will be variabilities in actual treatments and no single method is appropriate for all circumstances, experimental results can help the conservator predict reactions and select an appropriate treatment based on the object's tolerance to moisture, heat, mechanical manipulation, and chemical reactivity.

RESOLUBILITY OF ANIMAL GLUE

In general, animal glue without additives swells readily in cold water even after prolonged aging. On its own, animal glue can be solubilized by warm water or steam above 40°C (Cannon 2015). However, it has been common historically to adjust glue recipes with additives like glycerin and honey, as well as other sugars, alcohols, polysaccharides, and salts, to improve adhesive strength, elasticity, wettability, or working time. Modification of the animal glue with such additives can affect the resolubility of the adhesive. In her own experience, the author has observed difficulties with spine adhesive removal on occasions where the text block spine was in direct contact with the leather cover, particularly with rebacked books where the reback leather has become red rotted. It is possible that exposure of the adhesive to tannins in the leather may have been a factor in its resistance to water. Schellmann (2007, 63) notes that "resolubility of animal glues may be reduced in cases where the protein has come into contact with metal ions (e.g., metal foils, tools, pigments), or with certain organic pigments and tannins, either before, during, or even after their application," and that the lower the original concentration of the glue, the less it becomes resoluble.

The environmental conditions to which animal glue is exposed may also reduce solubility. After application, high internal stress and tensile forces develop in the glue matrix as it dries but relax over time under moderate relative humidity conditions. However, fluctuating environmental conditions

Independent Submissions

subject the glue matrix to further strains that can permanently impact the glue's stiffness and brittleness (Schellmann 2007, 62). Yannas and Tobolsky (1967) observed reduced solubility in gelatin after extended exposure to high temperatures and under vacuum. Gelatin also became partially insoluble over time under vacuum, even at temperatures as low as 25°C. They concluded that cross-linking in gelatin was a direct consequence of dehydration below a critical trace level (0.1–0.3 g water/100 g gelatin) rather than through pyrolytic decomposition at temperatures above 65°C.

EXPERIMENTAL DESIGN OF FLUID TESTS

Although the primary interest of this project is to identify successful techniques for animal glue removal from book spines, a decision was made to test the efficacy of selected fluids on animal glue solubility using flat paper samples. Conducting fluid tests on flat paper samples will reduce variables caused by three-dimensional surfaces such as the surface contact of a fluid with the adhesive, ease of mechanical removal, and vertical/lateral migration of a fluid into the substrate. Flat paper samples are also faster, easier, and cheaper to make than bound samples, and thus more flat samples can be tested within a limited time frame and budget. As such, using flat samples for the fluid tests will more efficiently pinpoint effective fluids for improving animal glue solubility. Using the more successful fluids from the fluid tests, different delivery methods can then be tested on the spine of bound paper samples to consider how they perform on three-dimensional surfaces.

Testing of different fluids was divided into two sections: studying the effect of selected fluids on the adhesive consistency over an extended period of time, and studying the influence of selected fluids on the ease of adhesive removal over different intervals of time. For both tests, five aqueous fluids were selected: deionized (DI) water, water adjusted with sodium chloride (NaCl) to boost conductivity, 3% w/v urea, 3% w/v citric acid, and a trypsin solution (see recipes in appendix 2). To test multiple fluids while controlling variables, low acyl gellan gum was selected as the only delivery method for the fluids. Both tests were conducted on samples of flat paper with artificially aged applications of animal glue.

Questions posed at the beginning of this research include:

- What can be used to improve solubility or swelling of the animal glue?
- Is there a way to reduce mechanical action during the adhesive removal?
- What are potential negative effects of the techniques used (e.g., mechanical damage, discoloration over time, impact on future treatments)?
- If the technique requires a clearing step, is there an adequate one?

Sample Preparation

Paper

The substrate for this experiment was chosen to represent the type of text block paper used in the 17th century. St Armand Old Master Papers in Frobisher (white) #57, a linen and cotton handmade laid paper, "reminiscent of the papers from the 17th century" (Talas 2020) was selected. The paper weight varies around approximately 90 g/m^2, an appropriate weight for text block use, and comes in sheets of 46 × 60.5 cm. The paper is semitextured and absorbent, making the paper challenging to work with for animal glue removal.

Animal Glue

Ground hide glue obtained from Talas was used in this experiment. The Talas catalog lists the Bloom strength of the adhesive at 222 g. The concentration of the glue was prepared as suggested by Talas, with 1 part glue to 10 parts water left to sit for half an hour. The glue was then heated on a hot plate until it reached a thick consistency. The temperature of the adhesive was monitored throughout preparation. It is often not recommended to allow animal glue to be heated beyond 60°C, as this can cause protein denaturation in the adhesive. In this circumstance, the animal glue was allowed to reach temperatures of 90°C to encourage the cross-linking that made animal glue removal on book spines difficult, with the additional reasoning that traditional bookbinders would likely have been less stringent in preparing their adhesives and may have likely let them overheat.

Sample Construction

Each sample was a piece of paper 5 cm square with a heavy layer of adhesive 2 cm square in the center. To prepare the flat samples, a polyester film template the same size as one full sheet of sample paper was made with a 2 cm^2 cutout per 5 cm^2. The template was then laid on top of a full sheet of the sample paper. A paint roller was dipped into the glue and rolled over the template to thickly coat the cutout area on the paper twice. After the sample sheets were dry, they were cut into 5 cm^2 squares. Samples underwent accelerated aging at the Library of Congress at conditions of 80°C and 65%RH for two weeks, with 10 of the flat samples retained and left unaged.

The conditions for accelerated aging were selected based on specifications used by Warda et al. (2007) and Van Dyke (2004).[1] After aging, the adhesive on the samples became noticeably harder, more brittle, and darker in color (fig. 1). Five-minute spot tests using droplets of water on samples before and after aging showed that adhesive on unaged samples quickly swelled, whereas that of aged samples remained hard.

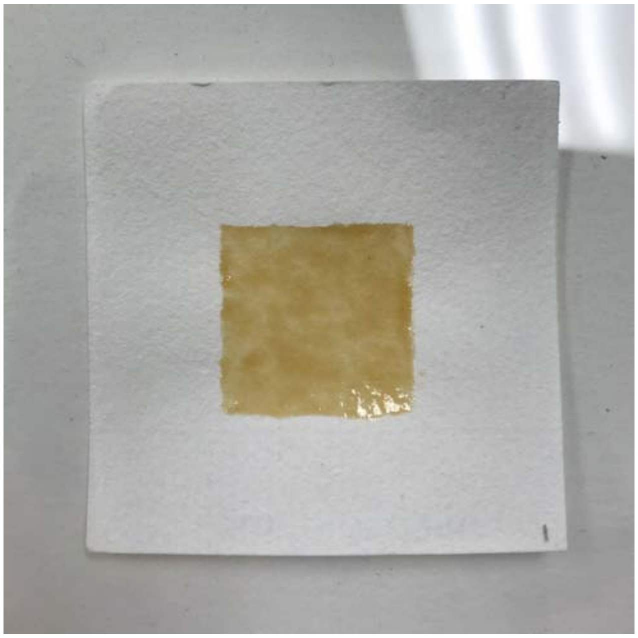


Fig. 1. Flat samples after accelerated aging.

Selected Fluids to Test

Appendix 1 presents suppliers and cost comparisons of selected fluids. All fluids have been made with DI water.

DI Water

In many cases, animal glue can be swelled with water and then mechanically removed. Environmental conditions or additives in the glue recipe can cause the adhesive to become less water soluble over time, making water insufficient for softening the adhesive.

NaCl-Adjusted Water

A solution with conductivity around 2.6 mS/cm^2 was tested. Tse (2001) notes that the addition of salt enhances the benefits of washing, as the higher ionic strength and conductivity of saline water allows it to draw out higher amounts of free acids from the substrate. Magee (2019) found success softening adhesive that was a mixture of animal protein and starch by raising the conductivity of water used in her recipe for high acyl gellan gum. She added NaCl to DI water, boosting the conductivity of the water up to 2 mS/cm^2.

Urea

A 3% w/v solution was tested. Hal Erickson (email to the author, November 22, 2018) first brought the use of urea as a small molecule surfactant for animal glue to the attention of the author. Structurally, urea molecules are very similar to protein R-groups, and following the concept of "like dissolves like," Erickson suggested that urea's wedge-shaped structure was optimal for opening up the surface area of

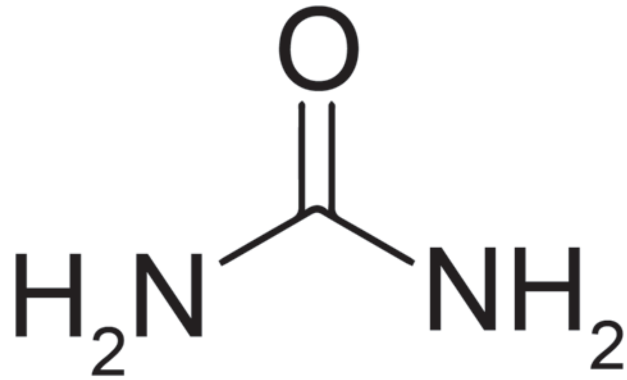


Fig. 2. Wedge-like structure of urea.

protein-based adhesives to water (fig. 2). Historically, urea has been added to animal glue to extend its open time or to make liquid glue at room temperature. Urea has also been commonly used to assess the stability of protein through chemical denaturation, and its ability to promote protein unfolding can be direct, by binding to the protein, or indirect, by altering the solvent environment (Bennion and Daggett 2003, 5142). Erickson (pers. comm., November 26, 2019) suggested applying a solution of 0.5 mol urea directly to the adhesive to improve swelling. Yasmeen Khan (pers. comm., January 28, 2019) also suggested applying a 2%–3% urea solution by brush to the adhesive for animal glue removal, but noted that urea is a hardener for animal glue and can make the adhesive layer more difficult to remove if it has been humidified with urea and allowed to dry. As the wedge-shaped structure of urea may also be capable of opening up the cellulose structure to atmospheric pollutants and oxidative-reductive reactions, Erickson recommended clearing urea after it comes into contact with the substrate, or to switch to another fluid as the adhesive layer becomes increasingly reduced.

Citric Acid

A 3% w/v solution was tested. Citric acid may help with the cleaning process as a chelating agent, binding calcium and metal ions. Besides urea, Khan (email to the author, January 28, 2019) also recommended using citric acid in low concentrations (approximately 3%) to open up the surface of hard, smooth animal glues, pointing out that although urea acted as a hardener for animal glue, the same issue was not found with citric acid. She suggested brushing a solution of either urea or citric acid onto the adhesive, which then breaks down into granules that can then be mechanically removed. As citric acid is acidic, she recommended against letting the solution come into contact with the text block substrate, switching to water when most of the adhesive has been reduced or clearing after use. Chris Stavroudis's Modular Cleaning Program has drawn recent interest in the use of citric acid and citrates for paper cleaning, which will likely produce further research on how to clear or neutralize these fluids after use.

Trypsin

Crystal Maitland notes that "since animal glues are not fully soluble (only swellable) unless enzymatically digested, no water-based system (even one with capillary pull like a gellan gum) is going to be able to fully remove the residues" (email to the author, July 23, 2019). Although enzyme use in cleaning and adhesive removal has been well documented for its efficacy, concerns about expense, ease of preparation and use, and negative impact of residues have often dissuaded conservators against its use. Clearing would be required after the use of enzymes. Although enzymes are often considered expensive, trypsin, a digestive endopeptidase commonly extracted from the bovine and porcine pancreas, was found to be surprisingly comparable in cost to other poultice materials and fluid solutions. Trypsin prefers to cleave adjacent to protonated lysine and arginine sites and can require high amounts of Ca^{+2} (approximately 0.02M) to retain activity (Erickson 2018). As specified by Sigma Aldrich, trypsin T0303 (lot #SLBX8983) contained 15,156 units/mg. A solution with a concentration of 400–500 activity units/mL, as recommended for use in gels by Van Dyke (2004), was tested.

Addition of Heat

When animal glue does not swell readily in room temperature water, the addition of heat can often increase its solubility, applied in the form of steam, heating pads, or through heated rigid gels. However, application of heat may be undesirable on parchment text blocks, where it may denature the parchment. On degraded paper text blocks, heat may also cause the substrate to absorb humidification unevenly or too rapidly, causing potential tide lines, or in conjunction with mechanical action cause fiber disruption.

Other Fluids Considered but Not Included in the Experiment

The addition of alcohol (often ethanol or isopropanol) has sometimes been suggested when working with animal glues that do not swell readily in water (Munn 1989). Saliva, which contains amylase and protease as two of the primary active ingredients, is also sometimes suggested where alternate fluids are unsuccessful for adhesive removal. Quandt (1991) describes using saliva with swabs to remove residual adhesive from a parchment text block spine. These fluids were not selected for the experiment due to the difficulty of incorporating them into various delivery methods.

Delivery Method of Fluid

Gellan gum was selected as the delivery method for the testing of the fluids due to its compatibility with all five of the fluids selected, as well as for its ease of preparation and removal. As gellan gum leaves minimal residue when removed, the characteristics of the animal glue in reaction to the fluid can be observed clearly. A 2% w/v gel was selected, as lower concentrations can be too wet for the substrate, whereas higher concentration gels may be too dry to properly swell the adhesive, and can restrict delivery of fluids with larger molecules such as enzymes. Gellan gum with a thickness of approximately 3 mm was prepared with each of the five fluids selected, and cut into 2.5-cm^2 squares. Recipes for gellan gum prepared with each fluid are presented in appendix 2.

Although the delivery method may influence the efficacy of the fluid, consideration of optimal delivery methods will be conducted in the next phase of experimentation.

TEST 1: FLUID EFFECT ON ADHESIVE CONSISTENCY

Goal

This part of the experiment aimed to observe the reaction of animal glue to each of the tested fluids over the duration of an hour.

Experiment

(1) Preparation of test samples and fluids in gellan gum have been previously described in section 3 (also see appendix 2).
(2) For each sample, a fluid-impregnated piece of gellan gum was placed on top of the animal glue area on flat paper samples. A piece of polyester film and a small acrylic slab were placed on top of the gel. The gel was pressed lightly with fingers to ensure contact with the animal glue was being made and remained in place for an hour. At intervals of 2, 5, 10, 15, 20, 30, and 45 minutes and at the end of the hour, the gel was lifted off at one corner to check the consistency of the animal glue visually and by touch with a microspatula.
(3) The introduction of heat was also tested for most fluids. Trypsin was tested only at room temperature (RT), as enzymatic response is not optimum at temperatures around 60°C. Heated samples (HT) utilized an 11-cm^2 gel bead heating pad, heated in the microwave until it reached 60°C and placed on top of the gel in lieu of the acrylic slab. Every 15 minutes, the heating pad was reheated to maintain its temperature.
(4) This experiment was repeated on two samples for each of the fluid and heat combinations to confirm observations. Although a continuum, the phases of adhesive consistency were identified and described.

Observations

Test 1 demonstrated that the fluids affected the consistency of animal glue adhesive in different but predictable ways.

The duration of contact and increased temperature were significant variables. As moisture was introduced, the adhesive moved from a solid to viscous liquid state. While passing through phases resembling those related to rheology and glass transitions, existing terminology is not specific to situations with increased moisture content. As such, terminology specific to this experiment was devised (fig. 3). Each phase presented risks and benefits to adhesive removal. For example, some fluids resulted in pliable softened phases that were not liquid, suggesting that removal may be possible with reduced risks of tide lines for those fluids. Others rapidly moved to a liquid phase that appeared easy to remove with minimal pressure, suggesting that less fiber damage may result. Not all experiments went through all phases of adhesive consistency change (fig. 4).

DI Water, RT

The surface of the adhesive began swelling at 10 minutes, with a granular consistency forming. At 15 minutes, the animal glue appeared mostly swelled. At 20 minutes and onward, the adhesive appeared swelled throughout. Paper fibers in contact with the gel appeared damp and swelled but without a harsh wet-dry interface forming. After one hour, the gel was slightly discolored, but no visible reduction in the adhesive layer was observed. The consistency of the adhesive remained granular throughout the hour.

DI Water, HT

The surface of the adhesive began swelling at 2 minutes. At 5 minutes, the adhesive appeared mostly swelled. At 10 minutes, some parts of the adhesive began to lose their granular consistency. The adhesive became slippery and could be pushed around with a microspatula at 15 minutes, and started spreading laterally at 20 minutes. At 25 minutes and onward, the adhesive continued to spread laterally, gaining a slightly gloppy consistency. The substrate became visibly damp and swelled, with noticeable lateral migration of water from the gel into the substrate at the end of the hour, but with no hard wet/dry interface formed. After an hour, the gel was more discolored in comparison to the one used at room temperature. There was no significantly visible reduction in the adhesive.

NaCl-Adjusted Water, RT

The surface of the adhesive began swelling at 5 minutes, and appeared swelled throughout by 20 minutes, with a granular consistency. By 30 minutes, the adhesive could be pushed into easily when prodded with a microspatula. The adhesive began to look less granular in consistency around 45 minutes. Where the gel was in contact with the substrate, paper fibers were damp and swollen, but there was no formation of a harsh wet-dry interface. There was no significantly visible reduction in the adhesive.

NaCl-Adjusted Water, HT

After 1 minute, the surface layer of the adhesive began swelling, and appeared swelled throughout by 5 minutes, being easily pushed into with a microspatula. It had a partially granular consistency. Around 10 minutes, the adhesive lost its granular consistency, becoming tacky. The adhesive began spreading laterally around 15 minutes. At 30–45 minutes, spreading of moisture beyond the edges of the gel was observed, although no sharp wet-dry interface was observed. The adhesive started to become gloppy at 45 minutes. After one hour, some amounts of adhesive clung to the gel as it was removed, and the gel was very discolored. After drying, a faint tide line was observed, indicating that some adhesive had solubilized and sunk into paper fibers.

3% w/v Urea, RT

At 5 minutes, the adhesive was mostly swelled, with a granular consistency. At 10 minutes, the adhesive appeared swelled throughout, beginning to lose its granular consistency. At 15 minutes, it gained a slightly more slippery consistency and moved easily when prodded with a microspatula. At 25 minutes, there was visible swelling and humidification of paper fibers where the substrate was in contact with the gel, but no hard wet-dry interface. When the gel was removed, it was only minimally discolored. There was no significantly visible reduction in the adhesive. Although the adhesive became less granular in appearance throughout the hour, it did not fully lose its granular consistency.

3% w/v Urea, HT

The adhesive surface layer began swelling after 1 minute, and appeared almost swelled throughout by 5 minutes, with a partially granular consistency. At 10 minutes, the adhesive appeared swelled throughout. The substrate area in contact with the gel was also visibly swelled and humidified, but without a harsh wet-dry interface. The adhesive began losing its partially granular consistency after 15 minutes, moving easily when prodded with a microspatula and gaining a tacky quality. At 30 minutes and onward, the adhesive became increasingly slippery in consistency. There was visible lateral migration of water beyond the gel area. The adhesive became increasingly wet and gloppy around 45 minutes. After one hour, some adhesive clung to the gel, which was slightly discolored, when it was lifted.

3% w/v Citric Acid, RT

The gellan gum turned opaque and more brittle on addition of the citric acid after heating—it behaved more like a sponge than a gel, and on applying pressure, fluid could be pressed out of the gel (fig. 5). At 1–2 minutes, the surface layer of the adhesive began to soften. Where the gel was in contact with the substrate, the paper was visibly swelled. At 10 minutes,

Term and Color Key	Image	Definition
Hard		The adhesive was considered "hard" if the adhesive felt solid or glassy when touched with a microspatula. Complete penetration of the adhesive layer was not possible. The adhesive remains a solid.
Swelled/ Granular		While the adhesive was considered "swelled" when the microspatula could be inserted all the way to the bottom of the adhesive and no part of the adhesive felt hard, the adhesive could continue to swell further and change in consistency. The adhesive is considered "granular" when it is a brittle, rigid gel. When prodded with a microspatula, the adhesive tends to break up into granules.
Partially Granular		As the adhesive continues to swell, it can begin to lose its granular consistency and become more rubbery. Adhesive fragments became smooth or rounded, and bounced back when indented with a microspatula. At this stage it is described as "partially granular."
Tacky/ Slippery		Sometimes, the adhesive becomes "tacky" or "slippery" with longer exposure to a fluid. In both cases, the adhesive consistency becomes more coherent and gains elasticity. When the adhesive is "tacky," it often appears sticky and clings to the microspatula when touched. When the adhesive is "slippery," it has more stringy and wet consistency, feeling less sticky than when "tacky."
Gloppy		As the adhesive becomes even more wet and loses coherence as a gel, some parts become watery while other parts remain semi-solid. The adhesive is described as "gloppy" at this stage, and smears easily when pressed into the substrate.
Runny		When there are no more semi-solid components to the adhesive and it takes on the consistency of a viscous liquid, it is considered "runny."

Fig. 3. Phases of adhesive consistency.

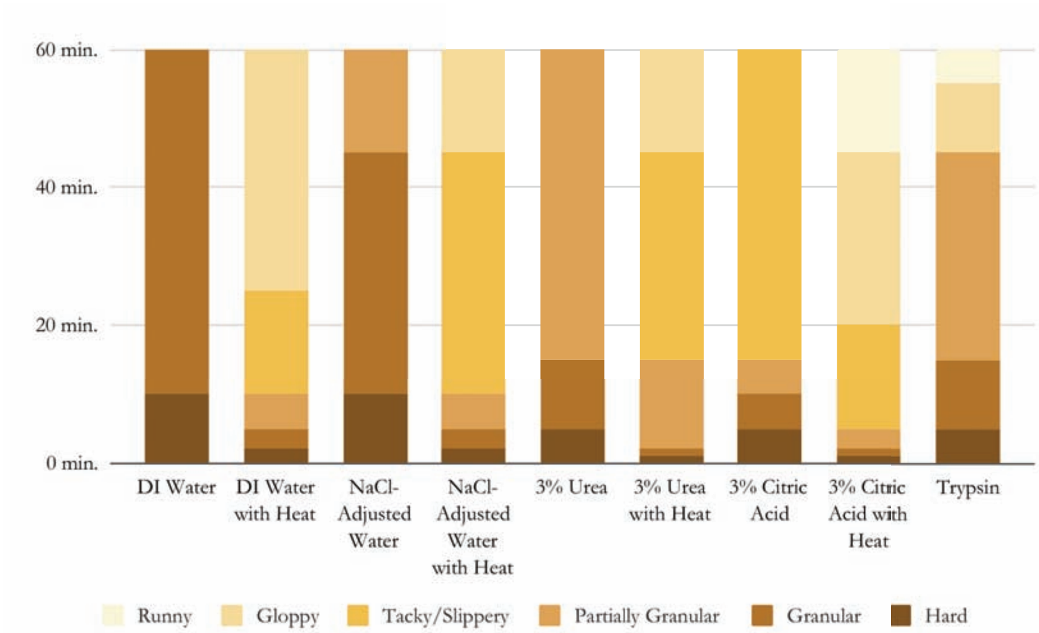


Fig. 4. Comparison of fluid effect on adhesive consistency.

the adhesive appeared mostly swelled but still with a granular consistency. At 15 minutes, the adhesive appeared swelled throughout and lost its granular consistency, becoming tacky. Liquid appeared to be pooling on the top of the gel. At 20 minutes, the adhesive continued to swell and remained tacky when prodded with the microspatula. Lateral spreading of the fluid on the paper increased. From 25 minutes onward, the adhesive continued to swell and become more slippery and could be easily slid around when prodded with a microspatula. Lateral spreading of the fluid on the substrate continued. By one hour, small areas of the adhesive clung to the gel when it was removed, and the gel was quite discolored.

Fig. 5. Gellan gum made with DI water (left) vs. with 3% citric acid (right).

3% w/v Citric Acid, HT

The adhesive began swelling at 1 minute and appeared mostly swelled by 5 minutes, after which moisture began spreading laterally on the substrate beyond the gel area. By 10 minutes, the adhesive had swelled further and gained a tacky consistency. It continued to swell, and at around 20 minutes, the adhesive became gloppy in consistency, sliding around when prodded with a microspatula. It began to become runny around 45 minutes, spreading laterally. When the gel was removed after one hour, the adhesive clung to the gel in several areas. The gel was noticeably discolored, and residual adhesive on the substrate was a viscous liquid (fig. 6). A harsh wet-dry interface was noticeable and dried into a tide line.

Trypsin Solution, RT

Results between samples were inconsistent—some samples showed minimal adhesive reduction, and some samples showed significant adhesive reduction after one hour. Trypsin may not have been distributed evenly when the gellan gum was cast, as the gel was beginning to set when it reached appropriate temperatures to add in the enzyme. The following description is of the sample most noticeably affected by the gel. The adhesive began swelling at 1 minute, and appeared mostly swelled by 5 minutes, at which point it had a granular consistency. By 15 minutes, the paper fibers in contact with the gel area were noticeably swelled, and it appeared that moisture had deeply penetrated into the paper fibers. The adhesive continued to soften and gradually became less granular in consistency; by 45 minutes, parts of the adhesive became gloppy and almost runny. After

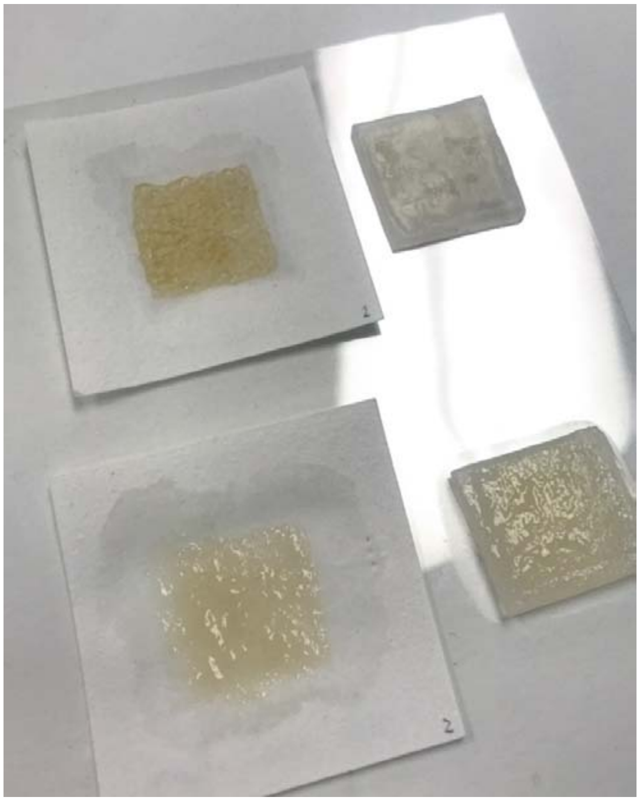


Fig. 6. Samples treated with citric acid at room temperature (top) vs. with heat (bottom).

one hour, some adhesive remained on the paper, but a large portion had been removed. Of all of the fluids tested, it was most clear that the gel with trypsin had absorbed some solubilized adhesive rather than simply having adhesive cling onto the surface of the gel (fig. 7). After drying, there

Fig. 7. Gellan gum with trypsin with visible adhesive absorption.

was a faint tide line where the gel had been placed on the substrate, indicating that some adhesive had solubilized and sunk into paper fibers (fig. 8).

TEST 2: FLUID EFFECT ON ADHESIVE REMOVAL

Goal

In the previous test, the changes in adhesive consistency suggested that the difficulty of adhesive removal and risks such as fiber disturbance and formation of tide lines may not be linear or the same for all fluids. Building on that information, this test attempts to discover what stage of adhesive consistency was the easiest to remove and with the least risk for the object for each fluid/heat combination.

Experiment

This experiment simulates removal of adhesive when multiple cycles of poultice are used. The initial heavy layer of adhesive is often removed after the first poultice (P1), and then a thinner, residual layer is removed in a second poultice (P2). Durations of each poultice have been expressed here in parentheses after the poultice abbreviation—for example, P1 (5 min.) indicates a first poultice with a duration of 5 minutes:

(1) Preparation of test samples and gellan gum prepared with each fluid have been previously described in section 3 (also see appendix 2).
(2) Various fluids were applied via gellan gum placed on top of the animal glue area of flat paper samples. The fluid/gum was left in place undisturbed for different durations of time (5, 10, 15, 20, 30, and 45 minutes). Where noted, heat was applied with an 11-cm^2 gel bead heating pad, heated in the microwave until it reached 60°C and placed on top of the gel. Where applicable, the heating pad was reheated every 15 minutes to maintain its temperature. At the designated time interval, adhesive removal was attempted using a microspatula.
(3) The ease of removal after P1 was observed and rated on a scale from 0 to 6, which indicates how much adhesive was removed, the type of residue left, how much pressure was required, and other risks (fig. 9).
(4) After the initial adhesive removal phase, P2, a second, fresh application of the same fluid/gel/heat combination was applied for a standard 15 minutes to half of the cleaned adhesive area, and removal was attempted with a microspatula. This meant that samples that had adhesive cleaned after P1 (5 min.) had the remaining adhesive exposed to an additional 15 minutes (P2), and that samples cleaned after P1 (45 min.) also had an additional 15 minutes (P2).
(5) After drying, the half of the adhesive sample that had only been treated with P1 was compared with the half that had been further treated with P2.

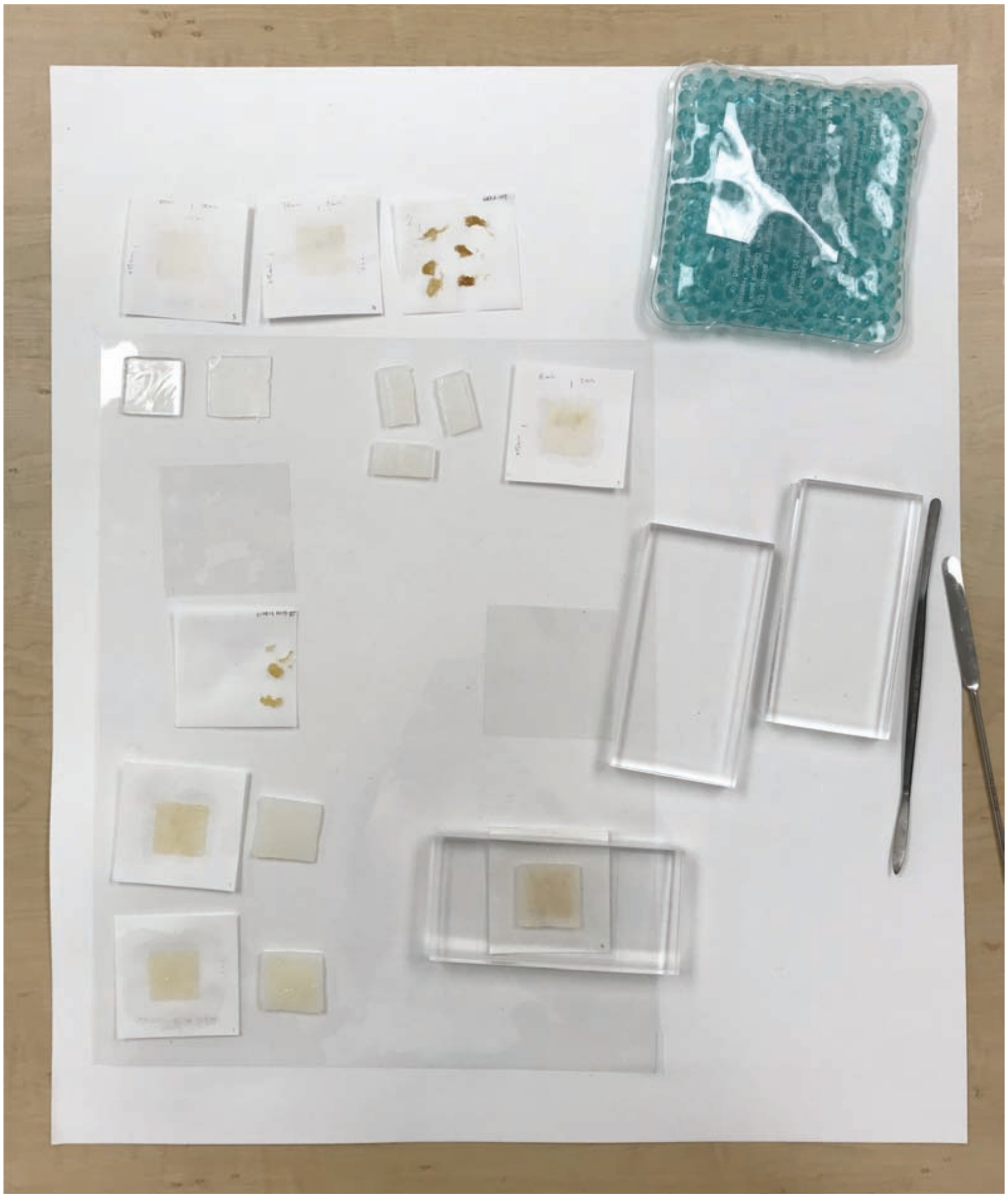


Fig. 8. Test 1 and 2 fluid experiments.

0		No adhesive could be removed
1		Small amounts of adhesive could be removed, high pressure required
2		Majority of adhesive layer was removed with some solid residue, high pressure required
3		Majority of adhesive layer was removed with some solid residue, slight pressure required
4		Majority of adhesive layer was removed with minimal residue, slight pressure required
5		Majority of adhesive layer was removed with minimal residue, no pressure required
6		Paper was too wet or the adhesive became too messy to remove, increasing risk of tidelines, adhesive sinking, and paper fiber damage

Fig. 9. Scale for ease of P1 adhesive removal.

Observations
At room temperature, the optimal time for adhesive removal after P1 with each fluid appeared to range between 20 and 30 minutes. The addition of heat accelerated the swelling of the adhesive so that 5 minutes of P1 with any fluids was adequate for easy adhesive removal. Given adequate time, all fluids were able to swell the adhesive enough for removal of the distinct adhesive layer on top of the substrate, but discoloration remained in the substrate where the adhesive had been, indicating that some adhesive had sunk into the paper fibers either on application, during aging, or while being softened.

At room temperature and with heat, continued exposure of fluid to the adhesive after it became swelled changed adhesive consistency in ways that affected ease of removability. Several of the fluids were so successful during P1 that the majority of the adhesive layer was already removed and P2 was not necessary for further adhesive removal. With some fluids, although a distinct adhesive layer was no longer present after P1, P2 helped in reducing the residual adhesive discoloration. With other fluids, P2 was detrimental to the treatment after the majority of adhesive had already been removed—the sample rapidly became too wet and potentially damaged with the additional poultice.

The ease of adhesive removal after P1 was observed and rated on a scale from 0 to 6, and color coded based on the ease of removal from dark red (most difficult to remove) to dark green (easiest to remove). Where damage occurred due to tide lines, adhesive sinking, or paper fiber damage, gray was used as the color code (see fig. 9). These observations are recorded in figure 10.

DI Water, RT
After P1 (5–20 min.), significant amounts of adhesive residue remained that could not be removed even when pressure was applied with a microspatula. P2 swelled remaining adhesive residue, which could be removed without pressure after 15 minutes. As the majority of adhesive had been removed after P1 (30, 45 min.), P2 did not further remove significant amounts of adhesive. No visible tide lines or adhesive sinking was observed after P2 for all durations.

DI Water, HT
After all application durations of P1, most of the adhesive had been removed with a microspatula. In all tests with P2, lateral migration of moisture created tide lines. Especially after P1 (30, 45 min.), the paper was so wet that even light pressure with a microspatula after P2 could damage paper fibers.

NaCl-Adjusted Water, RT
Significant amounts of adhesive that remained after P1 (5, 10 min.) were not sufficiently swelled after the P2 to be easily removed. After P1 (15, 20 min.), some amounts of adhesive residue remained. These were able to be removed after P2 with slight pressure. Most of the adhesive layer was removed after P1 (30, 45 min.), and P2 did not further remove significant amounts of adhesive. After drying, where the adhesive had been exposed to P1 for durations of 15 minutes or longer, P2 appeared to reduce the discoloration on the substrate left by the adhesive. No tide lines were observed after P2 for all durations.

NaCl-Adjusted Water, HT
After all application durations of P1, the majority of the adhesive had been removed with a microspatula. For P1 (5 min.), a small amount of adhesive was further removed with a microspatula using light pressure after P2. In all other instances, no significant adhesive layer existed to remove after P2. After drying, where the adhesive had been exposed to the

	DI water, RT	DI water, HT	NaCl-adjusted water, RT	NaCl-adjusted water, HT	3% Urea, RT	3% Urea, HT	3% Citric acid, RT	3% Citric acid, HT	Trypsin solution, RT
5 min	1	4	1	4	2	5	2	5	2
10 min	1	4	1	5	3	5	2	5	3
15 min	2	5	2	5	3	5	3	5	3
20 min	3	5	2	5	4	5	3	5	3
30 min	4	6	4	5	4	5	5	6	4
45 min	4	6	4	5	4	5	5	6	5

Fig. 10. Ease of adhesive removal with a microspatula after P1.

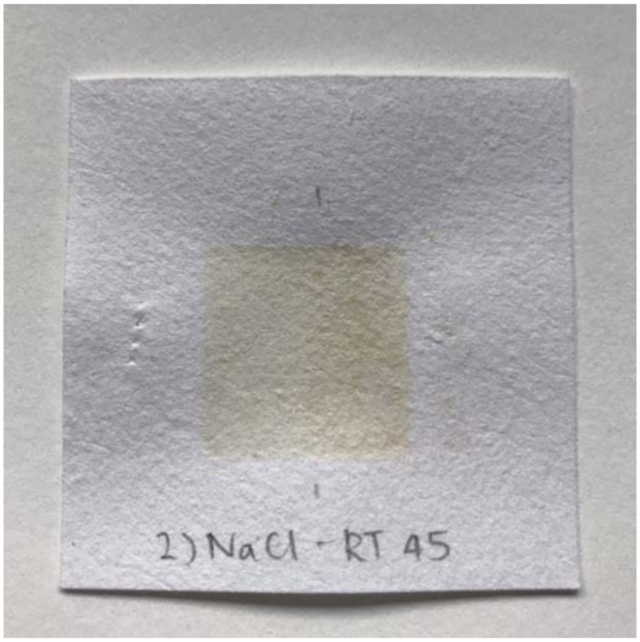


Fig. 11. Slight reduction in discoloration after P2 (45 min.), on the left side of sample, from P1 (45 min.), on the right side of the sample, using NaCl-adjusted water at room temperature.

P1 for durations of 15 minutes or longer, P2 appeared to reduce the discoloration on the substrate caused by the adhesive (fig. 11). No tide lines were observed after the application of P2 for all durations.

3% w/v Urea, RT
Small amounts of adhesive residue that could not be removed after P1 (5, 10 min.) were removed after P2, although pressure was required to remove areas with heavier adhesive residue. For P1 (15 min.) samples, remaining adhesive residue was fully softened with P2 and could be removed easily. As the majority of adhesive had been removed after P1 (20–45 min.), P2 did not further significantly reduce adhesive amounts. After drying, where the adhesive had been exposed to P1 for durations of 10 minutes or longer, P2 appeared to reduce the discoloration on the substrate caused by the adhesive. No visible tide lines were observed after the application of P2 for all durations.

3% w/v Urea, HT
After all application durations of P1, the majority of the adhesive had been removed with a microspatula, and no significant amount of adhesive was further removed with P2. After drying, where the adhesive had been exposed to P1 (5–20 min.), P2 appeared to reduce the discoloration on the substrate caused by the adhesive. For samples exposed to P1 (30, 45 min.), P2 did not appear to reduce discoloration on the substrate. No visible tide lines were observed after the application of the P2 for all durations.

3% w/v Citric Acid, RT
Small amounts of adhesive residue that could not be removed after P1 (5, 10 min.) were removed after P2, although pressure was required to remove areas with heavier adhesive residue. Adhesive residue left on the samples after P1 (15, 20 min.) were further reduced after P2 with less pressure. For P1 (5–20 min.), no visible tide lines were observed after P2. After exposure to P1 (30, 45 min.), the majority of adhesive had already been removed. In these samples, there was no significant distinct adhesive layer to remove after P2, and a faint tide line was visible beyond gel areas after drying.

3% w/v Citric Acid, HT
After all application durations of P1, the majority of the adhesive had been removed with a microspatula, and no significant adhesive layer existed for removal after P2. Lateral migration of moisture beyond gel areas was observed for all durations with P2, resulting in tide lines. Where P1 had been applied for 15 minutes or longer, the paper was so moist after P2 that slight pressure with a microspatula could cause fiber damage (fig. 12). After P1 (30, 45 min.), the adhesive sunk into the paper, and P2 may have absorbed some of the sunk adhesive as the substrate appeared slightly less discolored after drying.

Trypsin Solution, RT
Small amounts of adhesive residue that could not be removed after P1 (5, 10 min.) with the first poultice were removed after P2, although slight pressure was required to remove areas with heavier adhesive residue. In all other instances, the adhesive layer was mostly removed after P1, with negligible

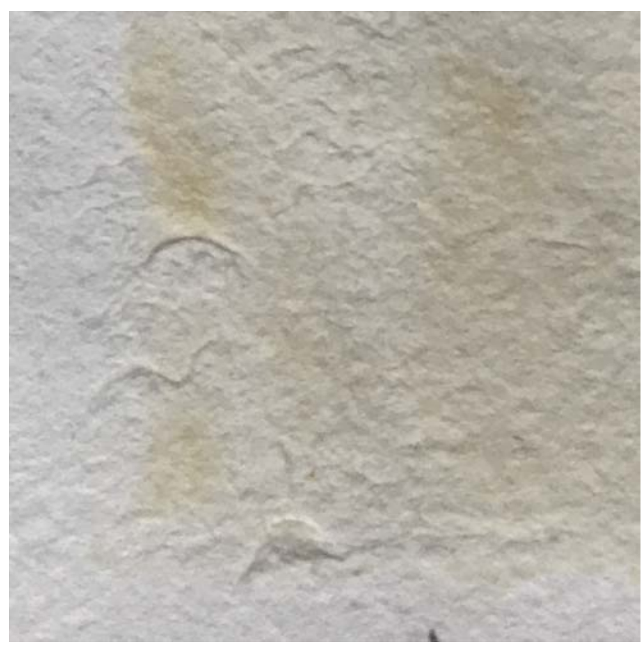


Fig. 12. Fiber damage from overwetting.

amounts of residue remaining for P2. Lateral spreading of moisture and/or sinking of adhesive resulting in tide lines occurred after P2 for all samples.

CONCLUSION

Speed of Adhesive Swelling

At room temperature, adhesive poulticed with DI water and the NaCl-adjusted water were the slowest to reach a removable state. Adhesive was difficult to remove until around 20 minutes and at that point still required high pressure and left significant residues. At room temperature, citric acid, urea, and trypsin were easy to remove at around 10–15 minutes, requiring light or minimal pressure and leaving minimal residues. For all fluids, the speed of adhesive swelling was significantly increased with the addition of heat, reducing the necessary poultice duration down to 5–10 minutes. It should be noted that the length of time required for swelling the adhesive increases in relation to the thickness of the adhesive, so the recorded times for these experiments may not correlate exactly with actual treatments.

Effect of Fluid on Adhesive Consistency and Absorbance in Gellan Gum

Except with trypsin, adhesive on test samples retained a mostly cohesive structure (granular or tacky/slippery) even with prolonged exposure to all room temperature fluids. With the addition of heat to all fluids, the adhesive became increasingly liquid-like after prolonged poultices. For instance, DI water at room temperature was the least successful at solubilizing the adhesive, which even when swelled throughout remained brittle and granular. With the addition of heat to DI water, the adhesive began losing its granular consistency after 10 minutes and became increasingly gloppy from 25 minutes onward. Urea and citric acid improved the rate of solubility in similar ways, although citric acid appeared to be slightly more successful at solubilizing the adhesive. It is interesting to note that adhesive exposed to urea took longer to dry and reharden than with other fluids. Although exposure to urea may reduce the resolubility of adhesive once it has dried after poulticing, there is a longer working time for adhesive removal while it remains softened. Although results between samples were inconsistent, trypsin was the only fluid capable of making the adhesive runny at room temperature.

As the duration of gel to adhesive contact increased in Test 1 experiments, the gel became increasingly discolored, indicating that some solubilized components of the adhesive had been absorbed by the gel. After prolonged poulticing, significant discoloration in gels at room temperature containing NaCl and citric acid, as well as where heat was applied, suggest that these fluids and the addition of heat increase the success of solubilizing components of the adhesive. For Test 1 experiments, DI water at room temperature resulted in the least adhesive reduction without mechanical action, and trypsin at room temperature resulted in the highest reduction, with heated citric acid coming in second (fig. 14). In Test 2 experiments, P2s with NaCl-adjusted water and urea were more successful than other fluids in reducing the discoloration of the substrate after the majority of adhesive had been removed in P1. This suggests that the addition of NaCl or urea may also increase the success of solubilizing the adhesive, as more of the adhesive has been absorbed by the gel after poulticing.

Effect of Fluid on Substrate

With both Test 1 and 2 experiments at room temperature, no harsh wet-dry interfaces or lateral migration of the fluid occurred with DI water, NaCl-adjusted water, or urea. Lateral migration of the fluid beyond gel areas occurred with citric acid at room temperature, as well as with the addition of heat to other fluids. This suggests that lateral spread of water into the paper occurs faster and more extensively with heat than at room temperature, which can increase tide line risks and damage to paper fiber during mechanical removal of adhesive. Trypsin also had adverse effects on the substrate—although no lateral migration of the fluid beyond gel areas was observed, the fluid and solubilized adhesive penetrated deeply into paper fibers, resulting in visible tide lines where the gel was placed. And although minimal tide lines were observed on samples treated with urea, a noticeable precipitate formed on dried pieces of gellan gum after use, further suggesting that clearing is necessary after any direct contact of urea with the substrate.

In some samples for Test 2 experiments with DI water, HT, citric acid, RT and HT, and trypsin, RT, most of the adhesive layer was removed after P1. For these samples, P2 was more likely to make the substrate too wet for safe mechanical manipulation, develop tide lines, or become discolored. More fluid was introduced to the substrate with less adhesive to absorb the bulk of the moisture, and it is likely that remaining adhesive residues after P1 were solubilized during P2 and sank into the substrate. However, at both room temperature and with heat, P2s with NaCl-adjusted water and urea reduced the discoloration of the substrate after the majority of adhesive had been removed in P1, suggesting that these fluids allowed the gel to absorb small amounts of further-solubilized adhesive residue rather than depositing them further into the substrate, reducing the risk of tide lines and improving discoloration.

Ease of Adhesive Removal vs. Risk of Damage

Test 1 and 2 results suggest that in different treatment circumstances, some fluids may be more suitable than others. Although more pressure is required during mechanical removal of adhesive in a granular state and less pressure is required as the adhesive progresses toward the more liquid, runny state, removal of adhesive at both ends of the spectrum presents pros and cons. Where the adhesive remains in a more cohesive, gelatinous state throughout poulticing, such as with DI water and NaCl-adjusted water at room temperature, there appears

Fluid (in Gellan Gum)	Speed of Adhesive Swelling	Effect on Adhesive Consistency/Gellan Gum	Effect on Substrate	Additional Comments
DI water, RT	Slowly swelled, ~20 minutes	• Remained granular throughout poulticing • Gel became slightly discolored	• Pressure mostly required with mechanical removal • Low risk of over-wetting and tidelines	• The slowest method tested, may be appropriate for removal of final residues, when overwetting is most likely
DI water, HT	Softened quickly, ~5-10 minutes	• Became gloppy after prolonged poultices • Began spreading laterally after 20 minutes • Gel became more discolored than at room temperature	• Minimal pressure required with mechanical removal • Lateral migration of fluid beyond gel area • Risk of over-wetting and tidelines after prolonged poulticing	• More prone to tidelines than at room temperature
NaCl-adjusted water, RT	Slowly swelled, ~20 minutes	• Remained partially granular throughout poulticing • Gel became slightly discolored	• Pressure mostly required with mechanical removal • Low risk of over-wetting and tidelines	• Not significantly different from DI water (RT)
NaCl-adjusted water, HT	Softened quickly, ~5 minutes	• Became gloppy after prolonged poulticing • Began spreading laterally around 15 minutes • Clung to gel after an hour • Gel became very discolored	• Minimal pressure required with mechanical removal • Lateral migration of fluid beyond gel area • Risk of tidelines and adhesive sinking into paper fibers after prolonged poulticing	• More discoloration in gel indicates more solubilization of adhesive
3% Urea, RT	Softened at moderate pace, ~10 minutes	• Remained partially granular throughout poulticing • Gel became slightly discolored	• Slight pressure required with mechanical removal • Low risk of over-wetting and tidelines	• May require clearing • Adhesive retains moisture after swelling for an extended period of time, but will become less resoluble after drying
3% Urea, HT	Softened quickly, ~5 minutes	• Became gloppy after prolonged poulticing • Easily removed after about 5 minutes • Gel became slightly discolored	• Minimal pressure required with mechanical removal • Lateral migration of fluid beyond gel area • Slight risk of tidelines	• May require clearing • Adhesive remained swelled for an extended period of time, but will become less resoluble after drying
3% Citric acid, RT	Softened at moderate pace, ~15 minutes	• Became tacky/slippery after prolonged poulticing • Clung to gel after an hour • Gel became very discolored	• Slight pressure required with mechanical removal • Lateral migration of fluid beyond gel area • Risk of tidelines	• May require clearing
3% Citric acid, HT	Softened quickly, ~5 minutes	• Became runny after prolonged poulticing, spreading laterally • Clung to gel after 1 hour • Gel became very discolored	• Minimal pressure required with mechanical removal • Lateral migration of fluid beyond gel area • Risk of tidelines, over-wetting, and adhesive sinking	• May require clearing • Most effective at solubilizing the adhesive, but also the most risks
Trypsin, RT	Softened at moderate pace, ~10-15 minutes	• Some areas became almost runny after prolonged poulticing • Gel absorbed some adhesive after 1 hour • Gel became slightly discolored	• Slight pressure required with mechanical removal • Risk of tidelines, over-wetting, and adhesive sinking	• Only fluid at room temperature to significantly solubilize the adhesive • May require clearing • Gellan gum may have impacted mobility of enzymes

Fig. 13. Summary of fluid experiments.

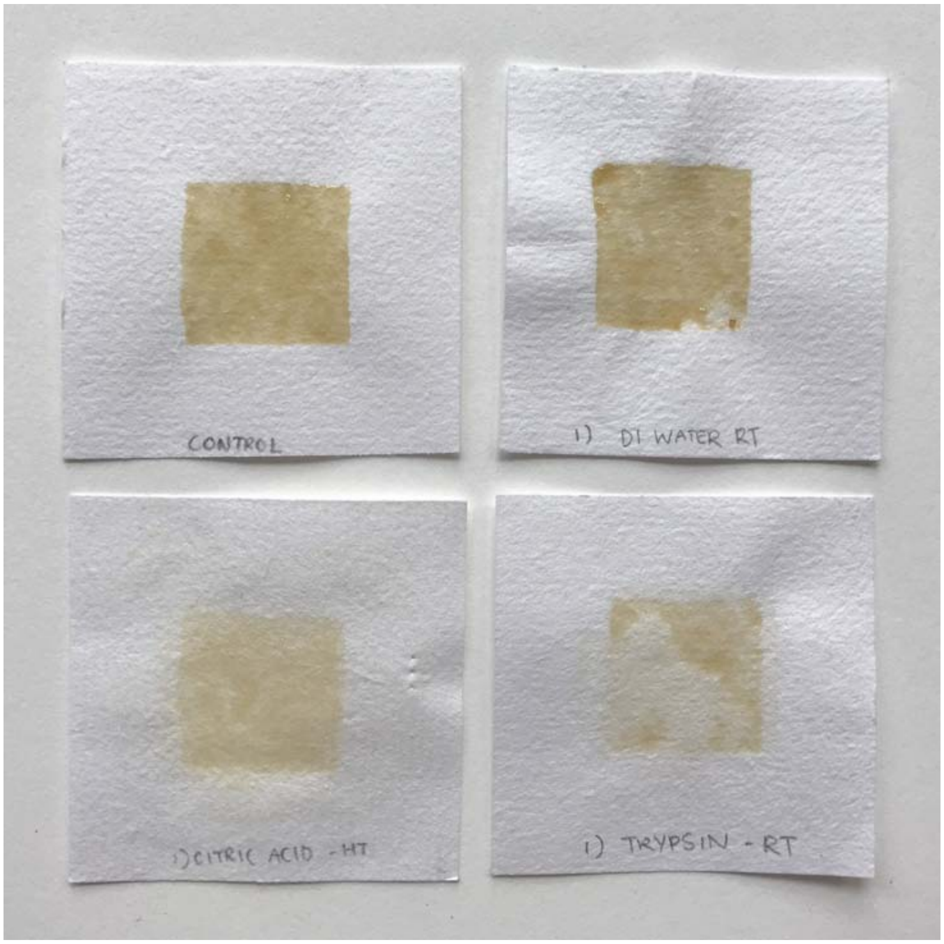


Fig. 14. Comparison of adhesive reduction after Test 1 experiments (clockwise): control; DI water, RT; trypsin, RT; and citric acid, HT

to be less risk of adhesive sinking, lateral migration of the fluid resulting in tide lines, or risk of damage to paper fibers through overwetting in combination with mechanical removal. As such, although more pressure is required when using these fluids, they may be preferable for working with thinner layers of adhesive, as well as with substrates that are heat or water sensitive, or have poor wet strength.

Urea, citric acid, and trypsin at room temperatures, and the addition of heat to all fluids, were more successful at solubilizing the adhesive and rendering it to a more liquid state. This makes the adhesive easier to remove mechanically with little to no pressure on the spatula, reducing the risk of paper fiber disruption. As the adhesive became gloppy, it became possible to gently wipe away the adhesive rather than using a scraping motion. However, the more solubilized the adhesive, the more risks of tide lines and adhesive sinking. Furthermore, when the adhesive became too runny, as with prolonged exposure to citric acid with the addition of heat, mechanical removal became more challenging, as the adhesive smeared into the substrate very easily. Although less pressure is required with the addition of heat or when using urea, citric acid, and trypsin, they may be preferable for working with thicker layers of adhesive, as well as with substrates that are more highly sized or less hydrophilic.

Although no single fluid excelled above all others with consideration to different treatment circumstances, experimental results have guided the formation of a fluid selection approach when removing animal glue. Poulticing with DI water should be tested first to see if water alone is sufficient to swell the adhesive. If the adhesive is not sufficiently swelled and the substrate is not heat sensitive or severely degraded, the addition of heat should then be considered. The tests confirm that heat will dramatically speed the softening process and reduce the need for mechanical manipulation. However, the conservator should keep in mind that heat will also increase the risk of tide lines and adhesive sinking, especially when used on residual adhesive.

When removing particularly heavy adhesive layers, using one of the faster working, heated fluids is most expedient—heated citric acid was the fastest. If heat cannot be used on the treatment, urea and citric acid should be tested, as they were the most successful poultices at room temperature.[2] To prevent urea or citric acid from contacting the substrate and leaving potentially harmful residues, room temperature NaCl-adjusted water may be used to remove the final adhesive layer. Removing the final adhesive layer and adhesive that has sunk into the paper requires a slower acting fluid—NaCl-adjusted water was seen as the best option for that because it was slow and the gel was discolored, implying that it drew more adhesive out of the paper than did DI water. The sodium component may also help in neutralizing citric acid residues in the substrate. These fluids, used in combination, should maximize efficiency of bulk adhesive removal while providing the safest and most complete cleaning option for the residual adhesive layer.

Through the fluid experiments, it became clear that mechanical removal is necessary to successfully reduce animal glue softened with each of the tested fluids in gellan gum. The next step in experimentation would be to test different delivery methods to see if there are application methods where the solubilized adhesive is more successfully absorbed into the delivery method, therefore requiring less mechanical action. Sequentially applying heated citric acid and room temperature NaCl-adjusted water in gellan gum was the most successful for removing heavy adhesive layers on flat paper in the fluid experiments. To maximize the efficacy of this combination, further examination of the fluid's delivery method, as well as working on the sculptural form of a book spine, is needed. As such, delivery method experiments should be tested on bound samples to determine the success of each delivery method on a three-dimensional surface.

FURTHER STUDY: TESTING OF DELIVERY METHODS

Although further studies could not be undertaken at this time due to the Covid-19 pandemic, future testing of delivery methods will optimize the ease of adhesive removal and reduce risk of damage to the substrate during adhesive removal. These risks, identified during the fluid experiments, include adhesive sinking, tide lines, and paper fiber damage caused by overwetting in combination with mechanical action. Clearing of potential residues from the adhesive removal process will also be examined.

Bound samples for experimentation with delivery methods were prepared using the same paper and animal glue and then aged at the Library of Congress at the same time as the flat fluid experimentation samples (fig. 15). As the limited quantity of bound samples and time constraints make testing of delivery methods in combination with each of the fluids from the fluid experiments impractical, fluid choices for this part of the experiment will be narrowed down to DI water and citric acid. DI water was selected because it is the most common and routine poultice fluid for animal glue removal. Citric acid was selected because it was the most successful in the fluid experiments for reducing thick adhesive layers.

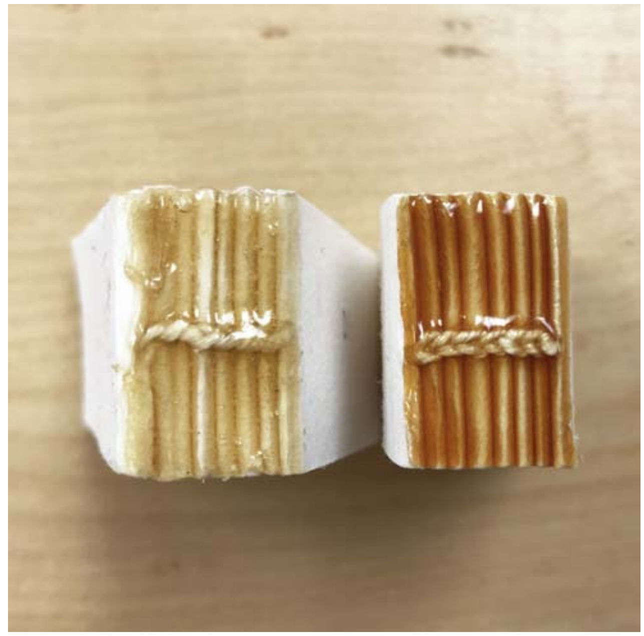


Fig. 15. Bound samples before (left) and after (right) accelerated aging.

Delivery methods currently considered for testing include wheat starch paste, methyl cellulose, rigid gels including low acyl gellan gum, agarose, and Nanorestore Peggy 6, and application of a neat solvent by brush. Although wheat starch paste and methyl cellulose are perhaps the most commonly used poultice materials for spine adhesive removal, the range of fluids that can be incorporated into paste is limited, and methyl cellulose may sometimes be too wet, risking tide lines and overwetting the substrate. The use of rigid gels including gellan gum, agarose, and Peggy 6 are particularly appealing for cleaning treatments, as they absorb solubilized degradation products into the gel network via capillary action so that theoretically no mechanical action is required (Hughes and Sullivan 2016). Reduction of mechanical action during spine adhesive removal would reduce risk of spine fold damage, especially if the text block paper is deteriorated or has poor wet strength. Peggy 6, a poly(vinyl) alcohol gel, is of particular interest for spine adhesive removal, being flexible and elastic with good adherence to very rough and irregular surfaces, as well as stable at high temperatures. Both Erickson (pers. comm., November 22, 2018) and Khan (pers. comm., January 1, 2019) recommended application of urea and citric acid by brush in combination with mechanical action using a microspatula or swab for animal glue removal, noting that these two fluids work on the surface of the adhesive.

In combination with the results of the fluid experiments, delivery method experiments should provide conservators with direct comparisons between these materials and techniques that should help the conservator predict potential treatment issues and results during removal of animal glue on book spines.

ACKNOWLEDGMENTS

The author would like to thank the following individuals, who generously gave their expertise and support to this project: Susan Russick (chief conservator), Roger Williams (book and paper conservator), and the Preservation Department at Northwestern University Libraries; Hal Erickson; Yasmeen Khan (head, Paper Conservation Section), Fenella France (chief, Preservation Research and Testing Division), Andrew Davis (chemist), and Chris Bolser (preservation technician) of the Library of Congress; Crystal Maitland (conservator, Works of Art on Paper) of the Canadian Conservation Institute; Olivia Primanis; and Abigail Bainbridge.

Appendix 1. Fluid Suppliers and Cost Comparisons

Fluid	Supplier	List Price	Cost/L
DI water	Northwestern University Libraries Conservation Lab	N/A	N/A
NaCl, CAS 7647-14-5 (ACS reagent grade)	Calbiochem, via Sigma Aldrich	$34.20/500 g	For a conductivity of approximately 2.6 mS/cm^2, $0.068/L
Trypsin T0303	Sigma Aldrich	$125/g	For 0.033 g/L, $4.125/L
Urea 99.5% for analysis	Acron Organics, via Fisher Scientific	$52.15/1 kg	For a 3% solution, $1.56/L
Citric acid monohydrate	Sigma Aldrich	$75.5/1 kg	For a 3% solution, $2.265/L

Appendix 2. Recipes for Fluid Experiments

Fluid	2% Gellan Gum Recipe	Cooking Instructions/Additional Notes
DI water	• 100 mL DI water • 0.04 g calcium acetate • 2 g gellan gum	Dissolve the calcium acetate in DI water. Add the gellan gum to the water while whisking. Heat in the microwave until fully dissolved. Pour into a tray to cool and set.
NaCl- adjusted water	• 100 mL DI water • 0.04 g calcium acetate • 0.1 g NaCl • 2 g gellan gum	Follow the preceding instructions, dissolving NaCl in the DI water before adding in the gellan gum.
3% w/v urea	• 100 mL DI water, divided • 0.04 g calcium acetate • 3 g urea • 2 g gellan gum	Dissolve urea in 10 mL of DI water and put aside. Prepare gellan gum with the remaining water as usual. After the gellan gum has been dissolved and removed from heat, stir in the urea solution. Pour into a tray to cool and set.
3% w/v citric acid	• 100 mL DI water, divided • 0.04 g calcium acetate • 3 g citric acid • 2 g gellan gum	Follow instructions for the urea gellan gum, replacing urea with citric acid. The formed gel is opaque, white, and more brittle than other gels. The gel feels more like a sponge than a true gel—when pressure is applied, liquid is expelled from the gel, pooling up at the top or bottom of the gel.
Trypsin	• 100 g DI water adjusted with calcium hydroxide to pH 7.5, divided • 0.04 g calcium acetate • 0.0065 g Trypsin • 2 g gellan gum	Dissolve the trypsin in 10 mL of pH-adjusted DI water. Prepare gellan gum with the remaining water as usual. After the gellan gum has been dissolved and removed from heat, stir the gel until it cools to 40°C. Stir in the trypsin solution. Pour into a tray to cool and set.

NOTES

1. During discussions with Fenella France, chief of the Preservation Research and Testing Division, France (email to the author, April 30, 2019) noted that 80°C was a high temperature, with practices at the Library of Congress tending toward lower temperatures to reduce generating samples dissimilar to real-life circumstances. Nevertheless, a decision was made to continue with these parameters after Andrew Davis (email to the author, April 30, 2019) pointed out that they were what would be used for the aging of standard Library of Congress ISR/CLASS paper samples.

2. Although at room temperature trypsin showed the most success at solubilizing animal glue, it also created the most tide lines and adhesive sinking, and effective clearing of enzymes is debated. As such, trypsin is not recommended except as a last resort.

REFERENCES

Bennion, B. J., and V. Daggett. 2003. "The Molecular Basis for the Chemical Denaturation of Proteins by Urea." *Proceedings of the National Academy of Sciences of the United States of America* 100 (9): 5142–47.

Cannon, A. 2015. "Water-Resistant Adhesives for Paper, 1870–1920." *Journal of the Institute of Conservation* 38 (1): 92–106.

Erickson, H. "Proteolytic Enzymes Relevant to Conservation Benchwork, distributed by Hal Erickson." (unpublished manuscript, November 28, 2018), typescript.

Hughes, A., and M. Sullivan. 2016. "Targeted Cleaning of Works on Paper: Rigid Polysaccharide Gels and Conductivity in Aqueous Solutions." *Book and Paper Group Annual* 35: 30–41.

Magee, C. 2019. "High Acyl Gellan Gum for Parchment Conservation." *Book and Paper Group Annual* 38: 112–19.

Munn, J. 1989. "Treatment Techniques for the Vellum Covered Furniture of Carlo Bugatti." *Book and Paper Group Annual* 8: 27–38.

Quandt, A. 1991. "The Documentation and Treatment of a Late 13th Century Copy of Isidore of Seville's Etymologies." *Book and Paper Group Annual* 10: 64–195.

Schellmann, N. C. 2007. "Animal Glues: A Review of Their Key Properties Relevant to Conservation." *Reviews in Conservation* 8: 55–66.

Talas. St Armand Old Master Papers. Accessed June 12, 2020. https://www.talasonline.com/St-Armand-Old-Master-Papers.

Tse, S. 2001. "Effect of Water Washing on Paper and Cellulosic Textiles: An Overview and Update of CCI Research." *Book and Paper Group Annual* 20: 35–39.

Van Dyke, Y. 2004. "Practical Applications of Protease Enzymes in Paper Conservation." *Book and Paper Group Annual* 23: 93–107.

Warda, J., I. Brückle, A. Bezúr, and D. Kushel. 2007. "Analysis of Agarose, Carbopol, and Laponite Gel Poultices in Paper Conservation." *Journal of the American Institute for Conservation* 46: 3: 263–79.

Yannas, I. V., and A. V. Tobolsky. 1967. "Cross-Linking of Gelatine by Dehydration." *Nature* 215: 509–10.

SOURCES OF MATERIALS

Old Master Papers in #57, Frobisher (White)
St Armand, via Talas
330 Morgan Ave.
Brooklyn, NY 11211
212-219-0770
https://www.talasonline.com/St-Armand-Old-Master-Papers
Gellan Gum and Ground Hide Glue
Talas
330 Morgan Ave.
Brooklyn, NY 11211
212-219-0770
https://www.talasonline.com/

Citric Acid Monohydrate (CAS 5949-29-1) and Trypsin from Porcine Pancreas (CAS 9002-07-7)
Sigma Aldrich Corp.
St. Louis, MO 63178
800-325-3010
https://www.sigmaaldrich.com/

OmniPur Sodium Chloride (CAS 7647-14-5)
Calbiochem, via Sigma Aldrich Corp.
St. Louis, MO 63178
800-325-3010
https://www.sigmaaldrich.com/catalog/product/mm/7710op?lang=en&region=US

Urea, 99.5% for Analysis (CAS 57-13-6)
Acros Organics, via Fisher Scientific
300 Industry Dr.
Pittsburgh, PA 15275
724-517-1500
https://www.fishersci.com/shop/products/urea-99-5-analysis-acros-organics-3/AC140750010

KIMBERLY KWAN
Conservation Fellow
Northwestern University Libraries
Evanston, IL
kimberlykwan831@gmail.com

JULIA POIRIER

The Samaritan Book: A Study of the Wooden Endband Plate Structure

INTRODUCTION

Samaritan texts continue to be studied extensively for their scriptures; however, relatively little is known about Samaritan bookbinding history. In recent years, scholarship on Samaritan binding history has gained momentum, but much more remains to be fully understood (for a discussion of the current literature, see Bardenstein [2016] and Poirier [Forthcoming]).

The development of the codex by the Samaritans cannot be considered without an awareness of contemporary bookbinding traditions in the Mediterranean region, particularly Jewish, Byzantine, Islamic and Syriac books. The structural component of the Samaritan bindings includes the use of an unsupported link-stitch sewing which owes greatly to earlier binding traditions from which it developed, namely the Coptic binding tradition. The Samaritan binding tradition has evolved and developed independently from others to create a limp parchment binding which uses unique structural characteristics for the text block and wooden endband sewing.

The Samaritan community separated from the larger Jewish population as early as the fifth century BCE, and although they share a common history, the liturgical texts and the letterforms of both the Samaritan and Jewish communities evolved separately from that date.

Crown (1987, 451) suggests that the Samaritans adopted the codex structure as early as the third century, but with no surviving examples of folios from codices before the ninth century (Crown 2001, 14; Bardenstein 2016, 70), it is difficult to ascertain an exact date. However, the history of the Samaritan codex is closely linked to that of the region in which it was made, the Eastern Mediterranean, or the Levant. With local Byzantine rule from 476 CE came a large diaspora, with Samaritans emigrating throughout the empire, as far as Rome and Sicily in the West and Syria in the East. By this time, the Byzantines were using parchment codices to write their scriptures. Their production methods and bookbinding technology were already established.[1] This period was followed by Islamic rule from 636 CE after the Early Muslim conquests under the Rashidun Caliphate, which saw the Samaritans assimilating the Arabic language (Bardenstein 2016, 67) and eventually incorporating the different bookbinding technologies they brought with them.

Throughout their history, the Samaritans were persecuted, leading to the eventual loss of their culture, including the loss of precious technical information about their bookmaking tradition. Although historical Samaritan bindings do survive, many have been rebound over the centuries, either during restoration projects or upon entering Western collections. The small number of Samaritan manuscript collections which have survived to this day and are available to be studied in more detail are mainly located in Europe, North America and Israel, where some manuscripts have survived in both public and private libraries, whereas others are still owned by the remaining Samaritan community.

Looking at the small number of surviving Samaritan manuscripts, it is essential to address the following questions: What exactly is a Samaritan binding? How can research into these examples help us advance our knowledge of bookbinding history? How can we better preserve these little-known structures? This article endeavours to examine a specifically Samaritan binding structure, which is characteristic of the Samaritan bookbinding tradition. It is hoped that this research will contribute to future efforts to identify and classify these interesting historical structures.

PRE-16TH-CENTURY PARCHMENT PENTATEUCH

Historical Bindings

The earliest extant Samaritan manuscripts preserved in a codex form date to the 9th century (Crown 2001, 14; Bardenstein 2016, 70), with the earliest surviving full copies dated to the early 12th century (Cambridge University Library CUL Add.1846 is believed to be the earliest Samaritan codex dating to the early 12th century, no later than 1149). These manuscripts are all copies of the Samaritan Pentateuch and were handwritten onto prepared parchment quires by Samaritan scribes who were also bookbinders (Crown 2001,

Papers presented during the Book and Paper Group Session, AIC's 48th Virtual Annual Meeting, May 21-September 2, 2020

Fig. 1. CBL Heb 751. Large format manuscript with extensive parchment repairs, (H) 356 × (W) 330 × (D) 120 mm. Before conservation. © The Trustees of the Chester Beatty Library.

329). These manuscripts were often large and heavy with a characteristic squarish format (fig. 1), although there are also smaller copies (fig. 2), which may suggest a range of usage from personal to ceremonial. In the early 16th century, the parchment Pentateuch stopped being produced for reasons that will be discussed later in this article.

Samaritan bookbinding and manuscript production was evidently well established by the 12th century. However, only a small number of these early codex manuscripts preserve evidence of a historical—or perhaps original—binding structure. Three manuscripts, of which two are extant, Dibner Library, MSS 001674 B (13th century CE, Pentateuch, Smithsonian Libraries, Washington) and Haverford RH 22 (14th century CE, Pentateuch, The J. Rendel Harris collection, Haverford) (fig. 3), and one preserved in the form of a drawing by Mary Eliza Rogers (fig. 4), are—in the author's opinion—the earliest examples of original Samaritan binding structures. To this list can be added BnF Samaritain 1 (undated, Pentateuch, Bibliothèque nationale de France, Paris) (fig. 5). The manuscript was rebound and repaired in the 17th century prior to the sale that eventually brought it to collection of the Bibliothèque nationale de France (BnF) (Rothschild 1985); however, the binding style is similar and will help draw comparisons with the earlier examples.

The drawing by Mary Eliza Rogers represents a Samaritan parchment Pentateuch binding she was shown in Nablus, Palestine. The drawing, which was made in 1856, is the oldest known reference to this binding style (Rogers 1868; Bardenstein 2016; Poirier, Forthcoming). Rogers describes the binding as using a "strong cord or twist . . . [the spine was] strengthened by two rather clumsy blocks of polished walnut tree wood … [and each block was] pierced with 6 holes through which the cords were passed and neatly secured." The binding she describes and draws is nearly identical to that of BnF Samaritain 1 and exhibits features in common with Smithsonian MSS 001674 B and Haverford RH 22.

Sewing Structure

With close observations of BnF Samaritain 1 and the preceding manuscripts, the Samaritan codex sewing can be described as follows. The Samaritan sewing style uses an unsupported link-stitch and the use of an integrated wooden plate at the head and tail of the spine to create an integral endband. The thread used on BnF Samaritain 1 is a thick off-white thread and is consistent with Rogers' description.[2] Both Smithsonian MSS 001674 B and Haverford RH 22 have also been sewn with a thick off-white thread using an unsupported link-stitch sewing.

The sewing uses a single length of thread which links the quires of the text block at between three and five stations. The integrated wooden plates act primarily as endband cores and secondly as spine stiffeners to ensure the spine profile remains flat. The wooden plates are therefore part of both the

Fig. 2. CBL Heb 753.5. Small format bifolio of the Samaritan Pentateuch. © The Trustees of the Chester Beatty Library.

text block sewing and the endband sewing (Génévois 1974; Crown 1987 and Szirmai, 1999, 6). The wooden plates are slightly wider than the text block by a few millimetres to a centimetre on either side, and their height is equal to the distance between the head or tail and the first sewing station.

The first stage of sewing the quires and wooden plates together (fig. 6) starts with a length of thread inside the quire at the first station. The thread attaches the first and the second quires together with a figure of eight movement. When the thread reaches the last sewing station of the second quire, it

Fig. 3. Haverford RH 22. Spine profile of manuscript. Courtesy of Quaker & Special Collections, Haverford College, Haverford, PA.

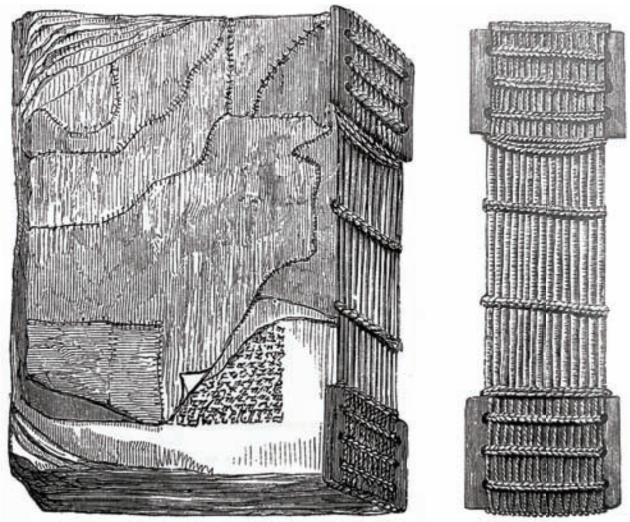


Fig. 4. Drawings by Mary Eliza Rogers of a Samaritan binding, published in 1868.

is taken around the wooden plate, over the edge of the text block, and back inside the quire to emerge at the same sewing station. The thread then drops down to the first quire and enters the sewing station to loop over the wooden plate and re-enter at the same point. The thread then repeats this sewing pattern around the centre of the first and second quires and around the wooden plate on the opposite side of the spine.

Before entering the third quire, the thread hooks underneath the sewing threads linking the first and second quires to form a link. The thread is taken around the wooden plate, emerging from the same station, and from then on, the thread goes across one quire at a time, using a link-stitch to join with the quire below. There is no linking at the first and last stations, only a loop around the wooden endband plate. This sewing pattern is a combination of overhead long-stitches on the wooden plates and link-stitches in the centre of the text block.

At this stage of sewing, the wooden plates are loosely held in place; however, they could fall and be lost through handling (fig. 7). The secondary twining threads seen on the back of the plates are therefore structural as they tighten the primary endband sewing around the wooden plates. Using the same thread that was used for the sewing of the text block, the thread is twined, creating a chevron around the weft formed by the long-stitch on the wooden plates.

In the Smithsonian manuscript, the sewing thread is extended at either end of the spine by threads looping around each quire at the head and tail, but no wooden plates or twining have survived. Haverford RH 22 also preserves an unsupported link-stitch sewing structure which is in poor condition. It retains evidence of the weft thread created around the wooden plate, as well as twined chevron, but only one wooden plate.

The wooden plates were prepared prior to binding with two or three sets of drilled holes on either side. BnF Samaritain 1 features a chevron pattern formed by weaving the sewing thread through the weft threads on the wooden plates. The thread twines down the front of the wooden piece and exits through a hole; it moves along the spine behind the wood and re-enters the next hole along before twining around the weft, over the spine (figs. 8, 9). This square movement of the needle uses four passages of thread to obtain a chevron along the width of the spine and creates a buildup of threads alongside the spine between the drilled holes. On BnF Samaritain 1, the twining on the wooden plates created chevrons which are parallel to each other (see fig. 5).

Fig. 5. BnF Samaritain 1. Spine profile of manuscript showing the wooden plates at head and tail, and the card liner in the centre. Courtesy of the Bibliothèque nationale de France.

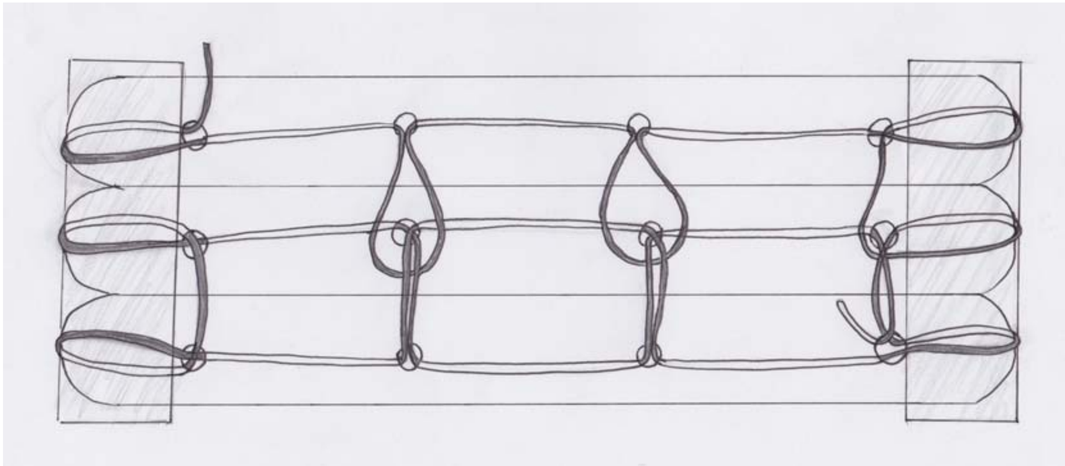


Fig. 6. Diagram of sewing incorporating the wooden plates. Drawing by the author.

The twining on the wooden plates forms a V-shape chevron in two examples (Haverford and Rogers), whereas in BnF Samaritain 1, it forms two parallel chevrons. As yet, there is no evidence to determine whether the twining styles (V-shape or parallel) and the number of holes on the wooden plates (four or six) are linked to specific locations, binders or time periods. However, this initial examination is useful as we start describing and categorising individual features.

Fig. 7. Detail of the endband on book model after integral sewing is complete.

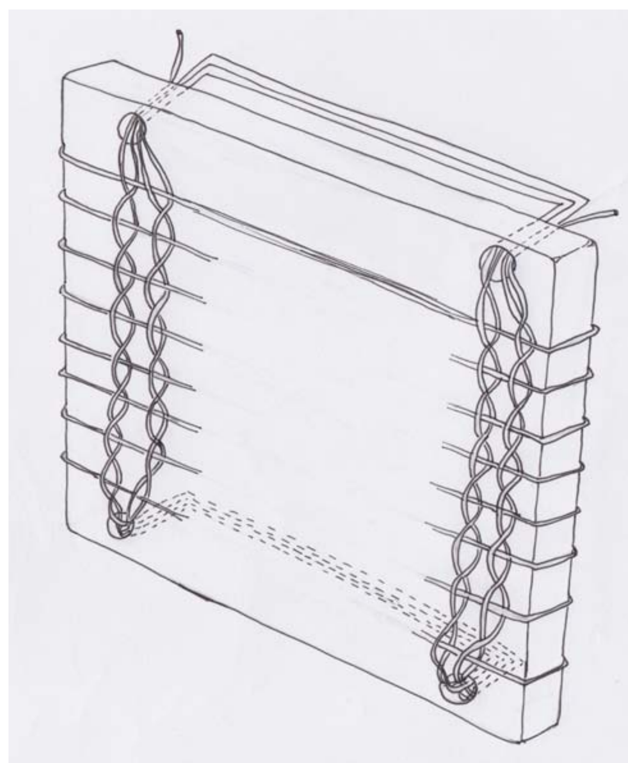


Fig. 8. Diagram of secondary endband sewing. Drawing by the author.

Fig. 9. Detail of secondary endband sewing on book model.

The wooden plate on Haverford RH 22 is a smooth and polished dark wood. It is similar in style to that of JER NLI Sam. 81=1 (15th century CE, Pentateuch, The National Library of Israel, Jerusalem) (fig. 10), and possibly to Rogers' drawing, although she mentions walnut wood, which is not the case for the Haverford manuscript. These three bindings show wooden plates with three sets of holes on either side. The plates are smoothed and polished and their production appears to be refined, whereas in BNF Samaritain 1, the wooden plates seem to be shaped in a slightly coarser manner with only two sets of holes at either side. This could suggest an earlier period of manufacture.

Finally, a tertiary endband is formed using a length of thread wrapped several times around the top of each wooden support where it meets the spine. This is tied off, further securing the wooden plate to the text block sewing and finishing the endband.

The binding was considered complete at this stage, and these structures were left unprotected by boards or covering materials. This process is likely to be an insight into earlier Samaritan binding traditions.

An Adhesive-Free Limp Structure

The Samaritan parchment Pentateuch bindings are likely to have been non-adhesive structures (Poirier, Forthcoming). A patina created from dust and handling as well as dirt is commonly observed on the exposed spine of these manuscripts and is not present underneath the wooden plates. Rogers makes some comments about the lack of glue or paste being used in the example she was shown. With no adhesive evidence on the parchment spine-folds of extant manuscripts, it is unlikely that a spine lining or a leather covering were ever directly adhered to the text block (Poirier, Forthcoming). The lack of clear board attachment options, combined with the fact that the uppermost folio of the first quire seems to be left completely blank (Poirier, Forthcoming) (see fig. 1) on many examples, suggests that these blank folios acted as a protective cover for the manuscripts and that these bindings never had rigid boards (Rogers 1868; Poirier, Forthcoming). However, as parchment requires applied pressure to avoid extensive distortion through changes in environmental conditions, the use of heavy boards, toggles, straps and clasps is often expected on such bindings. Nevertheless, there is no evidence of such features in these Samaritan bindings.

Fig. 10. JER NLI Sam. 81=1. Spine profile showing integrated wooden plates at head and tail. Courtesy of the National Library of Israel, Jerusalem.

It must be considered that it is not known exactly how these manuscripts were kept. The common practice for protecting Samaritan Torah scrolls used for ceremonies was to wrap them in cloth and store them in wooden or metal containers (Yaniv 2000). It is well documented that holy texts and precious Samaritan manuscripts were stored using a similar method of wrapping with cloth (Crown 2001, 347). Wrapping those codices in cloth would provide some protection from their environment and is still a common practice today within the Samaritan community.[3] An additional storage system may have provided further protection to the parchment text block, such as wooden or metal boxes. Only a handful of manuscript boxes, or *oren* in Samaritan, have been mentioned in the literature to this date (Crown 2001, 351–54). *Oren* is the technical name for the box in which a codex was stored, but it could also refer to a collective noun for boards. These boxes may have only been used sporadically or have been separated from their manuscripts over time, hence a lack of evidence.

Nonetheless, the sole protection of the parchment text blocks with a cloth wrapping could explain why these manuscripts have suffered damage, and were frequently rebound whether in the Levant or upon entering Western collections.

REBINDINGS AND REPAIRS

The Samaritan parchment Pentateuch manuscripts, often in poor condition for reasons explored earlier, were frequently subject to repairs or rebindings by Samaritan bookbinders. The need to repair these manuscripts indicates that these books were valued and perhaps still used centuries after they were initially created. Repairs may have been carried out as a pious act to preserve a holy text or simply to prepare these items for sale. However, the specific binding style selected for repair can act as a window to the past and give clues as to these manuscripts' historical binding structures.

17th-Century Rebinding

The two parchment Pentateuch manuscripts, BnF Samaritain 1 (undated, Pentateuch, Bibliothèque nationale de France, Paris) (see fig. 5) and BnF Samaritain 5 (13th century CE, Pentateuch, Bibliothèque nationale de France, Paris), were rebound and repaired in the 1620s (Rothschild 1985). The two text blocks were sewn using the wooden endband structure described previously with one notable difference: the thread used to sew BnF Samaritain 1 is a thick off-white thread and dark wooden plates which look like they have been hand shaped, whereas on BnF Samaritain 5, a 3-mm woven tape has been used to resew the text block and thin light-coloured wooden plates have been used. Although the characteristic twinning on the spine is present, the chevron directions could not be determined, as the leather spine obstructed visual access. The difference in material used for these two rebindings is interesting because this work was probably carried out by the same binder, as described in the following paragraph. This could suggest that the binder was using a combination of 17th-century materials, as well as some elements reused from previous bindings.

Both manuscripts were bound using the wooden endband structure but were then given red leather covers, with the addition of sewing cords attached around a card liner to the existing unsupported sewing structure to allow a laced-in board attachment through pasteboards and the inclusion of endpapers and 13th-century medieval parchment guards (Rothschild 1985, 36) which were not pasted onto the inner boards. This Western binding style appears to be a modification that the 17th-century Samaritan binder used on these Pentateuch codices whilst keeping the integral sewing and the wooden plates at the head and tail. The reasons for these modifications are unclear but suggest a hybrid binding technique incorporating an older binding tradition and a contemporary Western influence.

19th- and 20th-Century Rebinding

This tradition of rebinding parchment Pentateuch using the wooden endband structure seems to continue in the 19th and 20th centuries. CBL Heb 752 and JER NLI Sam. 81=1 have undergone full rebinding of the parchment quires including the resewing of the text block between the mid-19th century and early 20th century.

CBL Heb 752 (14th century CE, Pentateuch, Chester Beatty, Dublin) (fig. 11) was purchased in the 1920s by Sir Alfred Chester Beatty, through his Near Eastern manuscript adviser, Dr Abraham Yahuda, based in Cairo. There are several sale deeds recorded throughout the manuscript. Some of them date from the late 15th century and two from the 19th century, one dated 1890 and the other one dated 4 March 1891. This information combined with thread remnants (bright red tie-downs and a thick off-white sewing thread) found in the manuscript suggest that the sewing of the wooden endband plate structure was at least the third resewing of this manuscript. The author suggests that the manuscript was rebound between 1890 and Chester Beatty's purchase in the 1920s.

JER NLI Sam. 81=1 (15th century CE, Pentateuch, The National Library of Israel, Jerusalem) (see fig. 10) displays a similar list of purchase dates at the end of the manuscript. One date of 1865 and the other of 1893 suggest a rebinding date in the late 19th century.

The sewing of CBL Heb 752 and JER NLI Sam.81=1 follows the sewing pattern of BnF Samaritain 1. The sewing threads of both bindings are brightly coloured and of medium thickness. Although no analysis was carried out, this may suggest the use of a synthetic dyestuff.

The varying quality of the selected wood and the different levels of attention to detail in the preparation of the wooden plates suggests that JER NLI Sam. 81=1 possibly reused original plates (these wooden plates are very close in style to Haverford RH 22 and Rogers' drawing), whereas in the case of CBL Heb

Fig. 11. CBL Heb 752. Spine profile showing integrated wooden plates at head and tail. Before conservation. © The Trustees of the Chester Beatty Library.

752, newly manufactured plates were used. There is a lack of understanding of the details in CBL Heb 752 (see fig. 11), which can be seen from the presence of unnecessary extra holes and uneven shaping of the wood when the plates were prepared.

Various degrees of dexterity are observed with the twining on the plates as well; CBL Heb 752 appears to be rushed (see fig. 11), whereas JER NLI Sam. 81=1 has a neater but not exact finish (see fig. 10). The uneven twining of the chevron on the wooden plates are indications either that hand skills were lost over time or the binders adapted their methods in favour of a less time-consuming binding process. However, it seems noteworthy that through the centuries, a decision has been made to retain the wooden endplate structure during the rebinding of larger Samaritan parchment manuscripts.

Rebinding of parchment Pentateuch in Islamic structures are also known and can be seen in CW2478a and CW2484 (both 15th century CE, Pentateuch, Chamberlain Warren Collection, Michigan State University Library) and NYPLMs. Heb. 228 (13th century CE, Pentateuch, New York Public Library). Due to their size, smaller parchment manuscripts were probably more commonly rebound in Islamic binding structures, possibly losing earlier wooden plates during the restoration process. One such example, Gaster Ms 1133 (14th century CE, Pentateuch, The John Rylands Library, The University of Manchester), has retained—or was given—new wooden plates at the head and tail underneath the new leather cover.

PAPER TEXT BLOCKS FROM THE 14TH TO 20TH CENTURIES

Adoption of Paper as a Writing Support

From the 14th to the end of the 15th centuries, a drastic shift occurred in Samaritan book production. Parchment, which had been employed since at least the 9th century by the Samaritans (Crown 2001, 14; Bardenstein 2016, 70), started to be replaced with paper. The shift from parchment to paper is radical: the medieval parchment Pentateuch, large or small, disappeared from production by the mid-16th century.

Crown suggests that the earliest known Samaritan liturgical paper manuscripts date from the early 14th century (Crown 1994, 74) and were made using Islamic paper. Although Crown acknowledges that there may be earlier paper fragments in collections such as the Cairo Geniza, this statement seems to remain valid for most 15th-century paper manuscripts.

The Samaritan settlements were on the trade route between Damascus and Cairo, both centres of paper production from the early 10th century and the centre of Samaritan diaspora communities. Paper was undoubtedly available. Therefore, the adoption of paper at such a late date for the region, in the 14th century, could be explained either by a religious preference for parchment over paper or because within the Mamluk empire (1250–1517), paper remained an expensive commodity (Bloom 2017), which the Samaritan community could not afford. With the import of cheaper Italian paper (Bloom 2001, 56) from the late 14th century, the fall of the Mamluk empire in the early 16th century, and the return of the Samaritan diaspora from important centres of book production such as Damascus and Cairo, it is possible that paper was made more widely available to the community and therefore largely adopted from then on (fig. 12).

Adoption of Islamic Bookbinding Structure

This shift to paper from parchment as the primary writing support also coincides with the adoption of the Islamic bookbinding structure for book production. It is clear that all aspects of Islamic bookbinding were adopted by the Samaritans over a short time: page preparation such as sizing and burnishing paper before applying the ink, the link-stitch sewn text block, the use of pasteboards as binding boards, the presence of an envelope flap extending from the lower board, the use of a textile spine lining for the board attachment, and the full leather covering with or without tooling were all adopted. However, no extant study of Samaritan "Islamic" style bindings has been carried out to date, and the differences and similarities between the two traditions remain to be studied.

Simplified Wooden Endband Plate

Samaritan bookbinders started using the Islamic-style chevron patterned endbands on leather cores at the head and tail of their paper manuscripts, as was typical of the Islamic bookbinding tradition. However, in some cases, instead of using the characteristic chevron endbands, the bookbinders used a different endband structure. This endband was made of a thin wooden plate sewn at the head and tail along the spine of the text block to form an endband core. This form of endband is by no means common on Samaritan bindings, but it is encountered

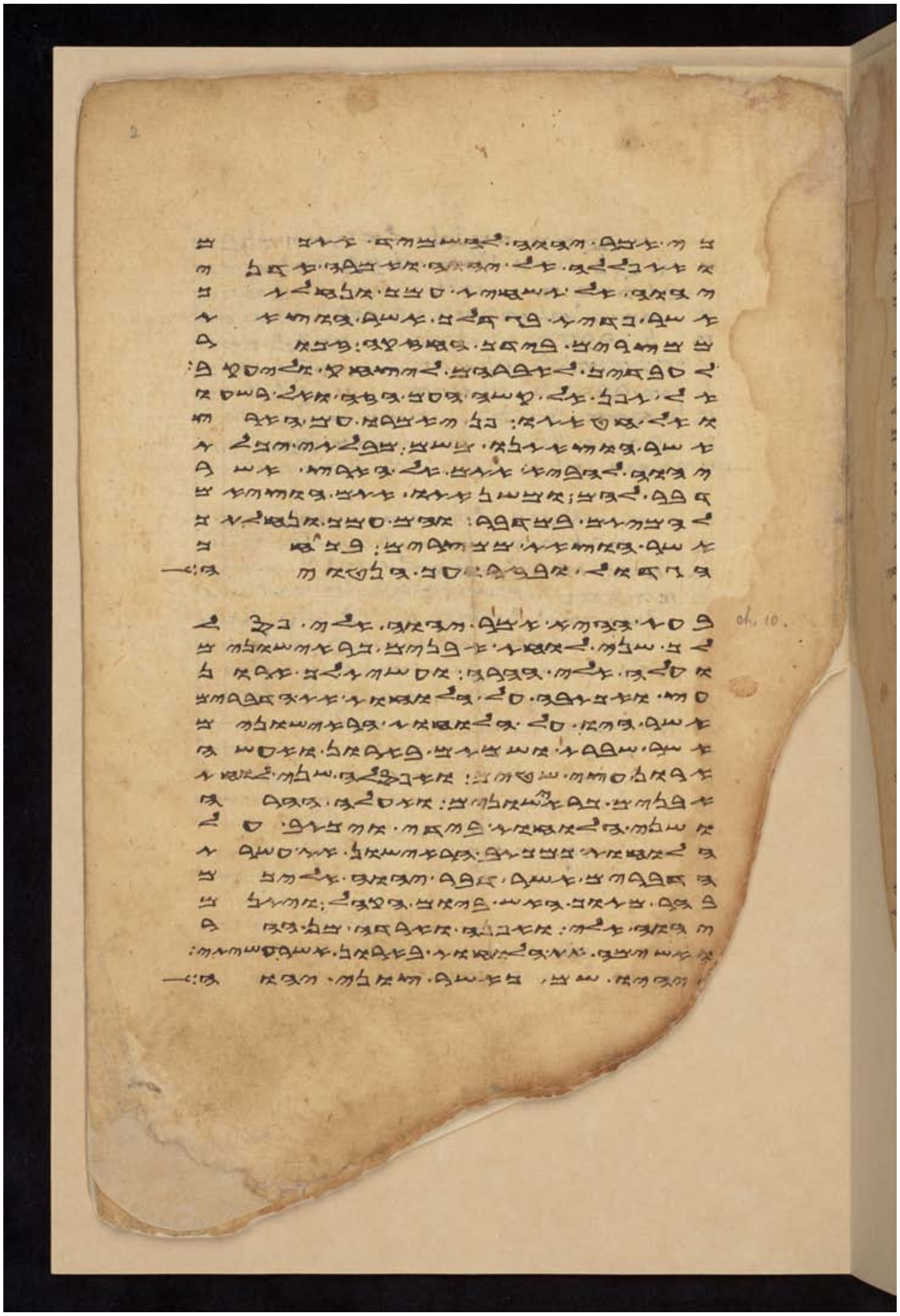


Fig. 12. CBL Heb 755. Partial 17th-century paper Pentateuch manuscript. © The Trustees of the Chester Beatty Library.

periodically across different collections and time periods. The author knows of nine bindings from the 19th to the 20th century displaying this endband style (fig. 13).

Much like the wooden endband plate discussed earlier, this wooden plate appears to act both as an endband core and spine stiffener. However, they are not integral to the unsupported link-stitch sewing of the paper text block and are sewn independently. The plates are sometimes glued directly onto the spine before sewing (Bardenstein 2016) or sewn through a textile spine lining as seen on JER NLI Sam. 81=2 (20th century CE, Pentateuch, The National Library of Israel, Jerusalem) (fig.14), which gives the endband sewing some stability.

Date of manuscript	Manuscript shelfmark	Text/material	Endband	Holes per wooden plate	Twining	Possible binding date
Unknown	Mary Eliza Roger's drawing	Pentateuch/ Parchment	Integral	6	3 rows, V chevron	Original or prior to 17th century
Undated	BnF Samaritain 1	Pentateuch/ Parchment	Integral	4	2 rows, parallel chevron	17th century at the latest with possible contemporary elements (wood)
13th Century	CBL Heb 751	Pentateuch/ Parchment	N/A	N/A	N/A	N/A
	Smithsonian MSS 001674 B	Pentateuch/ Parchment	N/A	N/A	N/A	Possibly contemporary elements (sewing thread)
14th century	CBL Heb 752	Pentateuch/ Parchment	Integral	Over 15 (only 5 and 2 holes used respectively)	1 row, no chevron formed	Late 19th century to early 20th century
	Haverford RH 22	Pentateuch/ Parchment	Integral	6	1 row still preserved, V chevron	Possibly contemporary elements (sewing thread and wood)
	Gaster MS 1133	Pentateuch/ Parchment	Separate wooden endband	No access	No access	20th century spine repair on Islamic binding, possibly contemporary elements (wood)
15th century	Sassoon Ms 404	Pentateuch/ Parchment	Separate wooden endband	0	1 row, no chevron formed	19th or 20th centuries
	BnF Samaritain 5	Pentateuch/ Parchment	Integral	6	2 rows, chevron formed	17th century at the latest
	BnF Samaritain 9	Lexicus/ Islamic paper	Separate wooden endband	4	2 rows, chevron formed	17th century at the latest
16th century	JER NLI Sam 81=1	Pentateuch/ Parchment	Integral	6	5 rows on plate and 3 on the other. No chevron formed	19th or 20th centuries
17th century	BnF Samaritain 8	Fragmentary Defter/ Islamic paper	Separate wooden endband	4	2 rows, chevron formed	17th century - Contemporary
18th century	CW2483	Book of Exodus / Islamic paper	Separate wooden endband	0	0	Late 19th century to early 20th century
	CW26349	Menar Marqah / Western paper	Separate wooden endband	0	0	Late 19th century to early 20th century
	CW10311	Book of Leviticus / Islamic paper	Separate wooden endband	0	0	Late 19th century to early 20th century
19th century	Gaster MS 805	Pentateuch / Paper	Separate wooden endband	0	0	20th century
20th century	JER NLI Sam 81=2	Pentateuch / Paper	Separate wooden endband	4	2 rows, no chevron formed	20th century, possibly older elements (wood)
	Gaster MS 2060	Pentateuch / Paper	Separate wooden endband	0	0	20th century
	CW2482	Pentateuch / Machine-made paper	Separate wooden endband	0	0	20th century
	HUCC Sam MS 42	Prayer book for the Day of Atonement / Machine-made paper	Separate wooden endband	0	0	20th century
	Ryl. Sam 28	Samaritan-Arabic glossary / Paper	Separate wooden endband	0	0	20th century

Fig. 13. Table of extant Samaritan manuscripts with wooden plates.

The primary sewing of this Samaritan wooden endband structure consists of a thread exiting the first quire, looping around the wooden plate to exit at the same station, before going up into the second quire and looping over the plate. This sewing pattern continues until the plate is fully sewn to the spine, effectively echoing the Islamic primary endband sewing. Often omitting the secondary sewing on the spine, the primary is followed directly by the tertiary endband which uses the same continuous length of thread. The thread is wrapped a number of times around the wooden supports, along the spine and around all sides of the plate. The boards are then built on as is seen in the Islamic bookbinding tradition (Scheper 2015, 100), and the text block is fully or partially covered with leather, paper or cloth, only showing the very edge of the wooden plate and endband threads.

In BnF Samaritain 8 (17th century CE, Fragmentary Defter, Bibliothèque nationale de France, Paris) and BnF Samaritain 9 (15th century CE, Lexicus, Bibliothèque nationale de France, Paris) (fig. 15), two paper manuscripts rebound in the 17th century, the wooden endband plates are sewn onto the text block independently. A thin woven tape is used in lieu of thread to sew the wood to the text block. In these cases, the wooden plates have been predrilled with two sets of holes on either side of each plate. The same woven tape tightens the thin tape looping around the wooden plates by forming two chevrons across the spine through two sets of holes as seen on the parchment

Fig. 14. JER NLI Sam. 81=2. Spine profile showing sewing over a spine lining. Courtesy of the National Library of Israel, Jerusalem.

Fig. 15. BnF Samaritain 9. Angled profile of the manuscript's tail, showing the wooden endband plate and chevron twining. Courtesy of the Bibliothèque nationale de France.

manuscript bindings. This feature on the outside on the wood is barely visible underneath the leather spine (see the binding description for BnF Samaritain 1 and BnF Samaritan 5, which are similar in style). The wooden plates appear to be thin and shaped with rounded corners and the woven tape is wrapped around the wooden plates at the spine to create the tertiary endband sewing.

On bindings from the 19th to 20th century, the wooden plate is much simpler (fig. 16). It is a thin squarish piece of wood, of varying quality and finish with no holes and no twined chevron across the back. The chevron securing the wooden plates in place seems to disappear when the protection given by a full covering is introduced. All wooden plates found on bindings in the Chamberlain Warren Collection as described by Bardenstein (2016) have been shaped at the head and tail to create large central notches for the primary thread to sit on and reduce movement of the thread. This way of shaping the wooden plates has not been observed on older parchment manuscript rebindings. In most cases, a brightly coloured thread is preferred, and the endband wrapping or secondary endband remains in use in all known examples.

Fig. 16. Gaster Ms 805. Detail of wooden endband. Courtesy of The John Rylands Library, The University of Manchester.

In some examples (BnF Samaritain 8 and JER NLI Sam. 81=2 [see fig. 14]), the threads of the endband wrapping on each wooden plate are tied together along the spine rather than knotting them individually. In her 1856 description of a Samaritan binding, Rogers (1868) writes, "I was surprised to find that the mode of finishing off the edges, at the top and bottom of the back of the book, very nearly resembled the method now in use" (43). This method in use in the 19th century most likely refers to the endband wrapping. Rogers' comment suggests that she has seen other bound books using the wooden plate endbands and the wrapping at the head and tail. This wrapping of the plates is a feature which remains consistent throughout all periods of Samaritan binding tradition.

One ingenious example from the early 20th century, HUCC Sam MS 42 (20th century CE Prayer Book from the Day of Atonement, The Klau Library, Hebrew Union College, Cincinnati, Ohio), pushes this construction further by twining a different colored thread through the wrapping, a chevron-patterned endband is formed at the head and tail of the text block (Bardenstein 2019).

CONCLUSION

The wooden endband plate binding structure is unique to the Samaritan manuscript tradition. This binding structure exhibits a complex sewing pattern which integrates the wooden plates as part of its construction.

This structure has evolved from its earliest use on parchment manuscripts between the 12th and the early 16th centuries as an adhesive-free, uncovered binding structure with spine reinforcement to an endband-only feature with the introduction of paper manuscripts in the 15th century. Bookbinders showed an awareness of the book tradition by replicating this historical binding structure during repairs and rebindings of parchment Pentateuch manuscripts. Despite hardship that fell on the community (Montgomery 2006), this bookbinding tradition has continued to be used well into the 20th century.

The lack of extant bindings to draw evidence from has prevented the history of Samaritan bookbinding from being written until recent years. The precise origins and developments of the Samaritan binding structure are still unknown. However, this research has allowed the author to take a fascinating dive into early bookbinding production. Understanding similarities between Samaritan bookbinding and influences from early and contemporary bookbinding traditions of the region—particularly Coptic, Byzantine and Islamic—can reveal more about this evolving bookbinding tradition. Continuing this investigation if and when early Samaritan binding fragments come to light in the future will in turn bridge a gap in Samaritan binding history and help to better understand book production in the Levant.

ACKNOWLEDGMENTS

The author would like to thank her colleague Kristine Rose-Beers, head of conservation at the Chester Beatty Library, Dublin, for generous support and valued editorial time throughout this research project.

NOTES

1. The earliest known Greek codices are Codex Vaticanus (early fourth century) and Codex Sinaiticus (mid-fourth century). These are large manuscripts, and although their bindings have not survived, they were technologically sound to hold together such large quantities of quires.
2. A thick off-white sewing thread remnant was found during conservation of CBL Heb 752.
3. Michigan State University. 2018. Archive 2.0: Imagining the Michigan State University Israelite Samaritan Scroll Collection as the Foundation for a Thriving Social Network. https://mcleodm3.com/wp-content/uploads/2018/10/wide_archive20_whitepaper.pdf

REFERENCES

Bardenstein, Ruth. 2016. "Historical Bindings of the Chamberlain-Warren Samaritan Collection." In *Suave Mechanicals, Essays on the History of Bookbinding*, vol. 3, edited by Julia Miller. Ann Arbor, MI: Legacy Press. 62-159.

Bardenstein, Ruth. 2019. "Samaritan Manuscript Bindings from Four Collections in the United States." In *Suave Mechanicals, Essays on the History of Bookbinding*, vol. 5, edited by Julia Miller. Ann Arbor, MI: Legacy Press. 30-65.

Bloom, J. M. 2001. *Paper Before Print: The History and Impact of Paper in the Islamic World*. New Haven, CT: Yale University Press.

Bloom, J. M. 2017. "Papermaking: The Historical Diffusion of an Ancient Technique." In *Mobilities of Knowledge.* Knowledge and Space 10, edited by H. Jöns, P. Meusburger, and M. Heffernan. Cham: Springer. 51-66.

Crown, Alan D. 1987. "Studies in Samaritan Scribal Practices and Manuscript History V. Samaritan Bindings: A Chronological Survey with Reference to Nag Hammadi Techniques. *Bulletin of the John Rylands Library of Manchester* 69 (2): 425–91.

Crown, Alan D. 1994. "Samaritan Literature and Its Manuscripts." *Bulletin of the John Rylands Library* 76 (1):21–50.

Crown, Alan D. 2001. *Samaritans, Scribes and Manuscripts*. Tubingen: Mohr Siebeck.

Montgomery, J. A. (1907) 2006. *The Samaritans, the Earliest Jewish Sect: Their History, Theology and Literature*. Eugene, OR: Wipf & Stock.

Génévois, A. 1974. "Études des reliures et histoire des bibliothèques." In *La paléographie hébraïque médiévale/[Colloques internationaux] du Centre national de la recherche scientifique*, no. 547, Paris 11–13 Septembre 1972. Paris: Centre national de la recherche scientifique. 163–66 et pl. CXIX–CXXXIII. 96.

Poirier, Julia. Forthcoming (2021). "A short review of on Samaritan binding practices: A closer look at the wooden endband plate structure." Care and conservation of manuscripts 17 (Copenhagen, April 2018).

Rogers, Mary E. 1868. "Books and Book-Binding in Syria and Palestine. Part I and Part II." *Art Journal* 30: 41–43, 113–15.

Rothschild, Jean-Pierre. 1985. *Catalogue des Manuscrits Samaritains*. Département des Manuscrits, Bibliothèque nationale de France BnF.

Scheper, Karin. 2015. *The Technique of Islamic Bookbinding: Methods, Materials and Regional Varieties*. Leiden: Brill.

Szirmai, J. A. 1999. *The Archaeology of Medieval Bookbinding*. Burlington, VT: Ashgate.

Yaniv, Bracha. 2000. "The Samaritan Torah Case." In *Samaritan Researches*, vol. 5, edited by V. Morabito, Alan D. Crown, and L. Davey. Sydney: Mandelbaum Publishing. 4.04–4.13.

JULIA POIRIER
Book and Paper Conservator
Chester Beatty
Dublin, Ireland
jpoirier@cbl.ie

KAREN VIDLER AND PETER MITCHELSON

Conservation Treatment of a Leather Binding: The Louise Hanson-Dyer *Book of Autographs*

INTRODUCTION

Due to the fragile state of its spine, the Louise Hanson-Dyer *Book of Autographs* came to the Grimwade Centre for conservation treatment in 2017. Louise Hanson-Dyer (1884–1962) was significant for her patronage of culture and the arts in Australia and known internationally for her publication of finely printed music scores such as the *Editions de I'Oiseau-Lyre* of the 1930s (Davidson 1994).

Her *Book of Autographs* (fig. 1) is one of the most important cultural artifacts within the University of Melbourne collections, containing personalized inscriptions, art works and poems by prominent Australian and international artists. Notable entries include a handwritten poem by James Joyce and paintings by artists such as Arthur Streeton and Dora Meeson (fig. 2). Louise Hanson-Dyer commissioned the *Book of Autographs* from Wal Taylor who was a prominent bookbinder active in Sydney in the 1930s (*Art in Australia* 1925). The book is currently housed in the Music Library of the University of Melbourne (Tregear 2008).

PHYSICAL DESCRIPTION OF THE ALBUM

The album has been bound in vegetable tanned goat skin leather with an enhanced natural grain pattern, typical of Moroccan leather (fig. 3). The front board has been highly decorated with tiny gemstones, intricate leather onlays and gold leaf tooling. The panels between the raised bands on the spine are gilded with a laurel leaf pattern and a single gold line each side of the bands. The text block has gilt edges with a repeated floral motif gauffered pattern on all three edges. This is a large bookbinding, measuring 38 cm high, almost 30 cm wide and 6 cm in depth. A decorative art object in its own right, the binding both reflects and protects the rich cultural content between its covers.

The book is thought to have been originally bound blank with the dedications, illustrations and poems specially inscribed to Louise Hanson Dyer added over time. In terms of the binding style, the content suggests a classification of the book as an album despite not having an albums' typical structural features such as stub guards and other compensators to allow for inclusions. This book was used as an autograph book for visitors to sign in whatever manner they chose, in keeping with the definition of a type 1 blank book as an album structure (Horton 1999). In this instance, the spine is treated in the tight-back style, revealing five raised sewing supports beneath the spine leather which are used to attach the boards using laced-on return board attachments.

The text block comprises 32 sections, sewn on five raised hemp cords that are 'laced-on return' through the boards. The various dedications and illustrations have been created using pen, ink, watercolour and gouache. More recently, sheets of interleaving tissue have been inserted to protect the friable media from abrasion and loss. The album leaves are protected by endpapers constructed from gray watered-silk doublures inlayed within a border of gray and blue goat skin leather with matching gray silk flyleaves lined with handmade paper. The corners of the leather frame of each doublure are decorated with a floral motif of mauve and blue goatskin onlay pieces.

CONDITION ASSESSMENT OF THE ALBUM

Given the significance of both the bookbinding and inscriptions, the conservators hoped their initial examination would support their desire for introducing the least amount of new material during the conservation treatment. The aim was to conserve the integrity of the original binding and ensure the book could be safely handled within the reading room of the Music Library, as well as occasional display.

The inscriptions and artworks in the text block were examined thoroughly, and all appeared in good condition. These pages would only require dry-cleaning with a soft brush and smoke sponges to remove surface dirt. The condition of the binding was essentially sound, as both boards were mostly attached to the text block and the album could be opened with care onto book supports. However, as the inscriptions and artworks were mostly located in the first third of the volume,

Independent Submissions

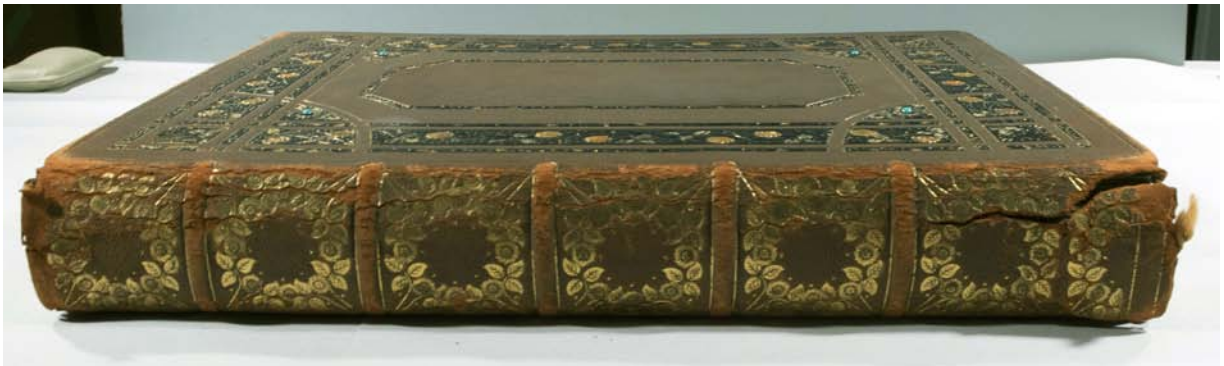


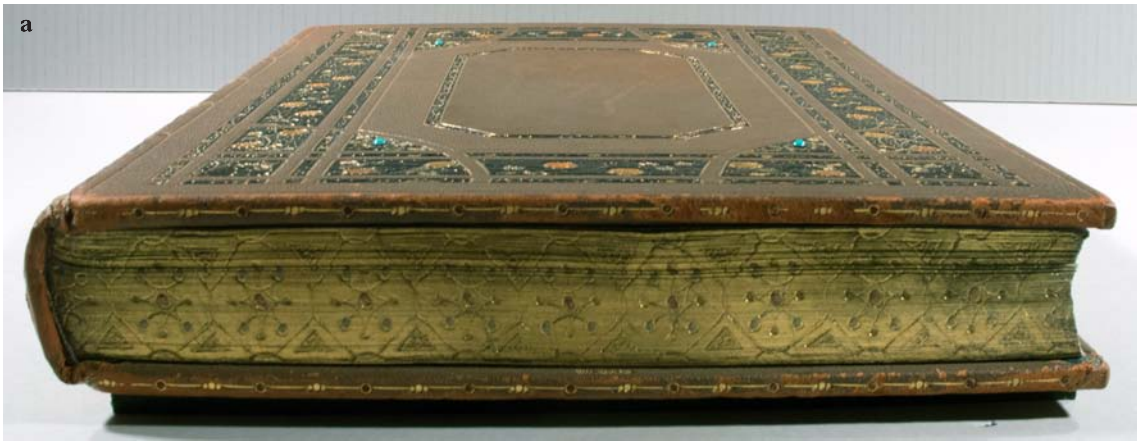
Fig. 1. The Louise Hanson-Dyer *Book of Autographs*, before conservation treatment.

this is where much of the structural damage to the binding was concentrated that required conservation treatment.

The sewing was broken in several places from the front endpaper through the first five sections of the text block. This damage along with further areas of weak sewing had caused a disturbance of the decorative gauffered gilt-edge pattern (fig. 4), as several sections were no longer in alignment. Along with the sewing damaged, the front board was no longer attached, as the laced-on sewing supports were broken and only held on by the covering leather. The watered silk front flyleaf had 'shattered' promoting tears and losses to the silk and would continue to be damaged if left untreated and not resewn into the text block.

Of concern also was the degradation of the decorated covering leather. This damage appeared typical of acid decay combined with poor handling practices of the album. The signs of acid decay here included the weak, shortened or powdered leather fibers; a red colour change within the corium layer of the leather from the highly reactive phenol groups in this condensed tanned leather; and a distinct smell of sulphate contamination (Wouters and Claeys 1996). The leather

Fig. 2. (a) Pen and ink and gouache sketch by Arthur Streeton. (b) Watercolor by Dora Meeson.



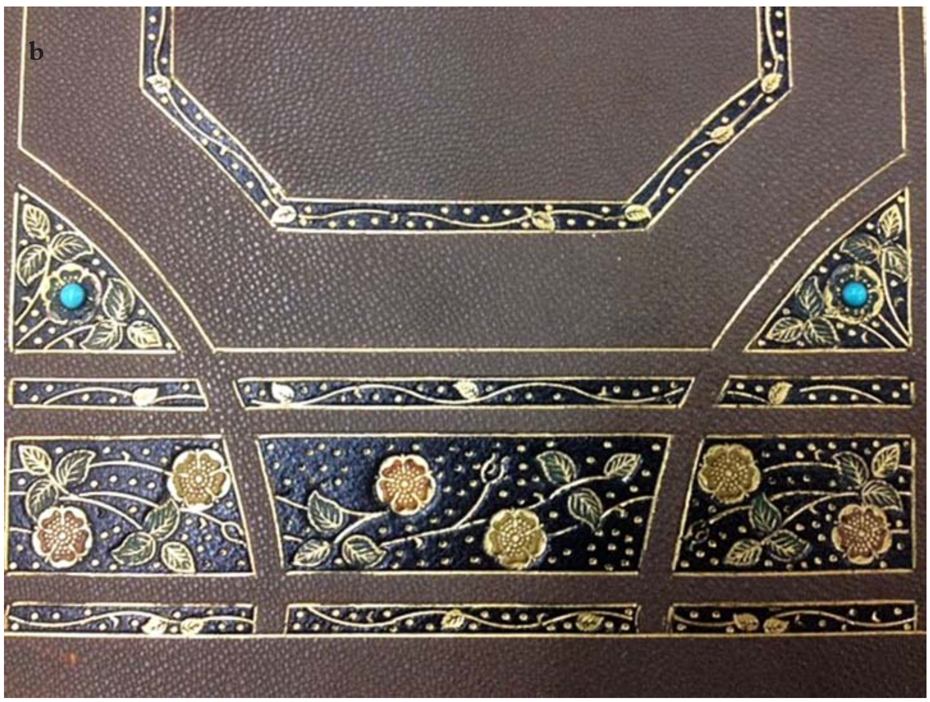


Fig. 3. (a) Front board decoration and gauffered tail edge. (b) Detail of onlays and gemstones.

along the first third of the spine had lateral cracks that were pronounced when the book was open and the spine placed under tension. Acid decay and poor handling practices also promoted areas of delamination of the grain-corium junction layer of the leather (fig. 5) at the board joints and tears at the head and tail caps.

Examination of the Covering Leather

Samples of fibers were taken from the locations in need of repair and tested using a Fiber Cohesion Assessment (FCA) (Larsen, Vest, Poulson and Kejser 1996; Ruzicka, Zyats, Reidell and Primanis 2006). This test was used to determine the strength of the leather deep within the fiber structure for an indication of the level of intervention required to stabilise the damage at the test sites. The conservators chose the FCA technique because it requires only a very small sample of leather fibers from the corium layer for examination and does not require specialist equipment. Rankings were given corresponding to the following framework of using the published rating scale and actions developed by one of the authors[1]:

- *Rank 1*: Fibers very coherent, few loose fibers and little powder when scraping
    - *Action*: Clean, box, return to suitable storage, monitor
- *Rank 2*: Fibers are coherent and slightly powdery when scraping
    - *Action*: Can be safely repaired without consolidation treatment

Fig. 4. Gauffered edge misalignment and damaged tailcap leather.

- *Rank 3*: Fibers loosely coherent and powdery when scraping
  - *Action*: Can be repaired only with consolidation treatment
- *Rank 4*: Fibers not coherent and very powdery when scraping
  - *Action*: Will not respond to treatment, replace.

Each fiber set was teased apart using the blunt side of a scalpel blade and a dissecting needle onto a white ceramic tile (fig. 6). Individual fibers were then examined under a light microscope and the condition compared to the ranking characteristics listed previously. Of interest to the conservators was the degree of damage to the leather fibers at the head and tailcap and board joints where conservation treatment was required. Samples taken from the board joints were rated 2, whereas the endcaps were rated 3.

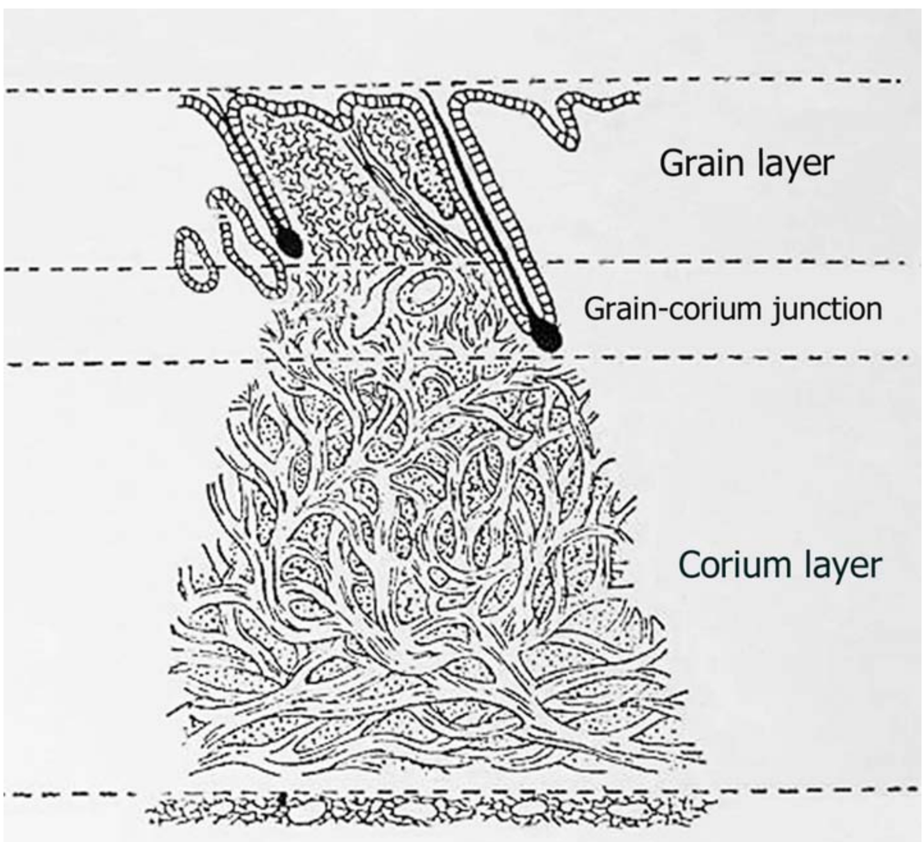


Fig. 5. Fiber structure of mammalian animal skin used for bookbinding leather showing main fibre layers. Adapted from Sharphouse (1971).

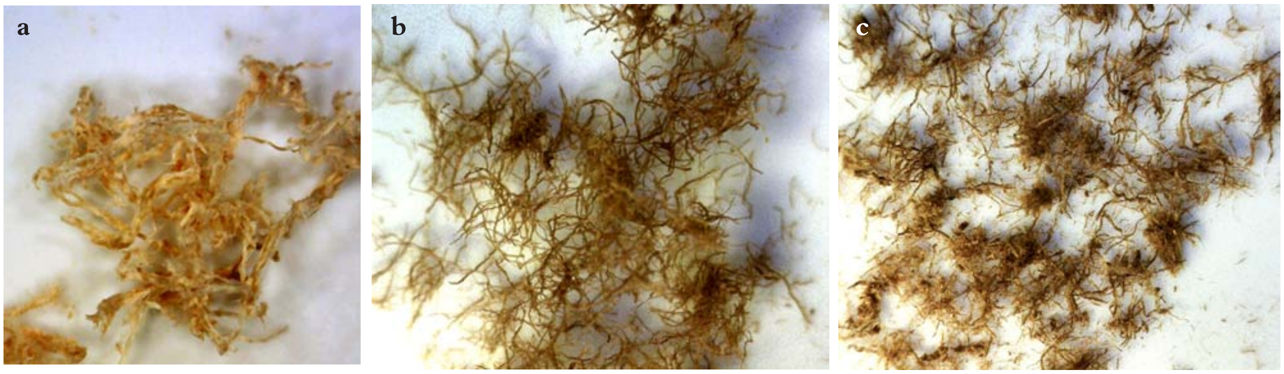


Fig. 6. (a) Ranking 1: new leather. (b) Ranking 2: board joint leather. (c) Ranking 3: tailcap leather.

Results of the FCA examination revealed that the leather on both the board joints and spine retained enough coherence and would therefore respond to consolidation and mechanical repair. This meant that rebacking of the spine was not necessary. The conservators now felt confident in focusing the conservation treatment of the leather to only the most degraded areas of leather on the spine and board joints. The proposed conservation treatment of the leather included the following:

- Consolidating flaking and powdery areas of leather on the spine
- Consolidating weakened leather fibers in areas needing repair
- Re-adhering lifted areas of the leather along the spine to ensure correct tight-back flexing when book is opened
- Attaching sutures to consolidate split areas of the spine leather
- Replacing losses to the endcaps with infills of new archival leather.

The proposed treatment of the leather minimised the introduction of new material and avoided subjecting the structural and decorative elements to unnecessary risk presented by the traditional rebacking process.

Examination of the Text Block Sewing

Due to the broken sewing and damaged spine leather, the leaves of the book were carefully opened on a book support during the examination. The sewing through the front endpaper and first five sections were found to be either broken or loose and at risk of becoming completely detached over time. As these sections had slipped forward, the gauffered edge decoration had also become disrupted.

In addition to the broken sewing shown in figure 7, numerous sections throughout the text block were starting to slip forward. This was due to the deterioration of the adhesive layers between the leather, spine lining and back folds of the sections. This resulted in the flesh side of the spine leather being revealed between certain gutters and a loosening of the sewing creating a 'slumping' forward of some sections. This was significant at the gutters between sections 4 and 5 and 5 and 6 with prominent gaps showing between pages 61 and 62 and 77 and 78. These are all areas containing important illustrations or inscriptions, and frequent poor handling may have contributed to this damage.

From the visual examination, it was evident that the sewing structure did not require full replacement. The conservators judged that only the broken sewing needed replacing, the front board reattached and any loose sewing could be strengthened in situ provided safe access could be gained to the back folds. Consideration was given to the reduction of risk by ensuring no strain was placed on the board attachments or sewing during the treatment by constructing an adjustable cradle to support the book during all stages of the treatment.

CONSERVATION TREATMENT OF THE ALBUM

Consolidation of the Leather

Before proceeding with the treatment, the leather covers were cleaned with a soft brush under vacuum to remove fine deposits of degraded leather fiber dust. Only areas of the leather with signs of acid decay were consolidated with a 2% solution of hydroxypropyl cellulose in isopropanol (Knight 2016; Steere 2017) applied with a fine brush under magnification. This was left to dry overnight before a temporary facing tissue was applied around the repair areas of the spine by brushing a 3% solution of hydroxypropyl cellulose in isopropanol directly through 7.3 g/m^2 *Tengu* tissue. This was reversed at the end of the treatment with the same 3% solution.

Repairing the Sewing and Board Attachment

Prior to undertaking the repairs to the original supported sewing structure, the pages were cleaned with smoke

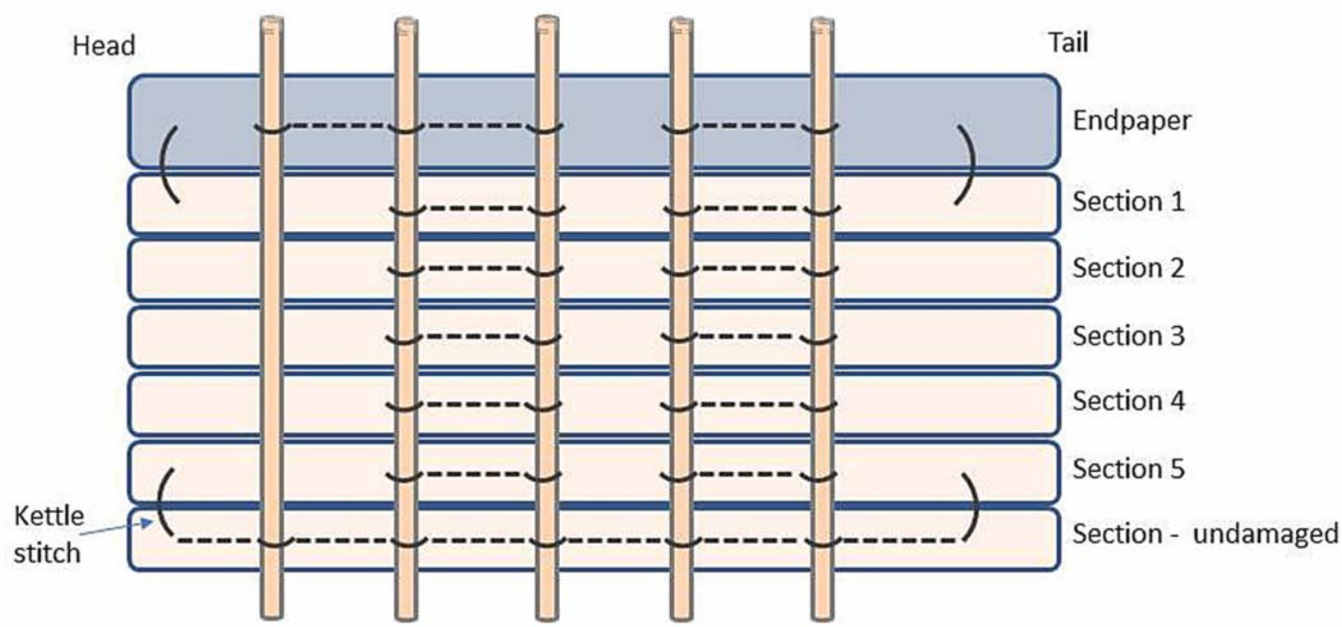


Fig. 7. Configuration of broken sewing to first third of the text block.

sponge (avoiding the friable media) and gutters brushed out with a soft brush under vacuum. Access to the back folds of the sections was required to address the damage to the sewing, and this was achieved by releasing the remaining sewing along the first five sections while ensuring the front board remained well supported. (fig. 8) Loose debris from the degraded areas of the original spine lining was also cleared from the exposed area of sewing with a soft brush and vacuum.

The conservators found that some of the raised cords were de-plying and detaching from under the spine leather. When the book was opened, they noted the degraded adhesive attaching the raised cords to the leather was pulling the cords and causing them to unravel. Where available, the cords were retensioned by twisting and consolidating the cords with wheat starch paste, then, when dry, adhered back into place to the flesh side of the spine leather using Lascaux 498 HV acrylic adhesive. This adhesive was chosen for its low moisture content that prevents the leather from blackening during repairs (Sturge 2000).

To repair the sewing and structurally reattach the front board, cord extensions were added to the five original hemp cord sewing supports. Three cord extensions were threaded around all five of the supports and constructed of Coats Barbour 18/3 waxed linen thread and secured using reef knots (figs. 9, 10) onto which a drop of Evacon-R adhesive was added to lock them into place. To form the final cord extension or slips, each set of three extensions was twisted to form a single cord, trimmed and sized with wheat starch paste, and dried under tension using a light weight.

At this point, loose guards of 16 g/m^2 Japanese kozo fiber paper toned with Golden Acrylic paints were attached to the back fold of the first and fifth sections to close the gaps at the gutters on each side of these sections once the resewing was completed. The loose guards were first attached to the back folds using small beads of wheat starch paste before being resewn around the cord extensions using Coats Barbour 40/3 waxed linen thread following the original sewing configuration.

Finally, the cord extensions where trimmed and flattened to form the new slips. This was done by fanning them and sizing with paste to dry and stiffen. Each slip was then passed over the front board joint and 5 mm under the front doublure to lock the reattachment. In doing this the original board attachment was not disturbed. The new slips were then adhered with a 50:50 mixture of Lascaux 498 HV and Evacon-R and left to dry overnight in an open position. The board reattachment was stress tested the following morning by opening and slightly pulling on the front board.

Repairing the Leather Spine Damage

The leather was examined under 16x magnification using a Leica M651 microscope and identified as Moroccan goat skin. For the repairs, the conservators chose undyed, vegetable-tanned goat skin leather from J. Hewit & Sons, UK. This leather was chosen for its excellent internal strength and being tanned with hydrolysable vegetable tannins which have proven long-term durability when housed in stable storage conditions (Vidler 2015). The natural grain pattern of the

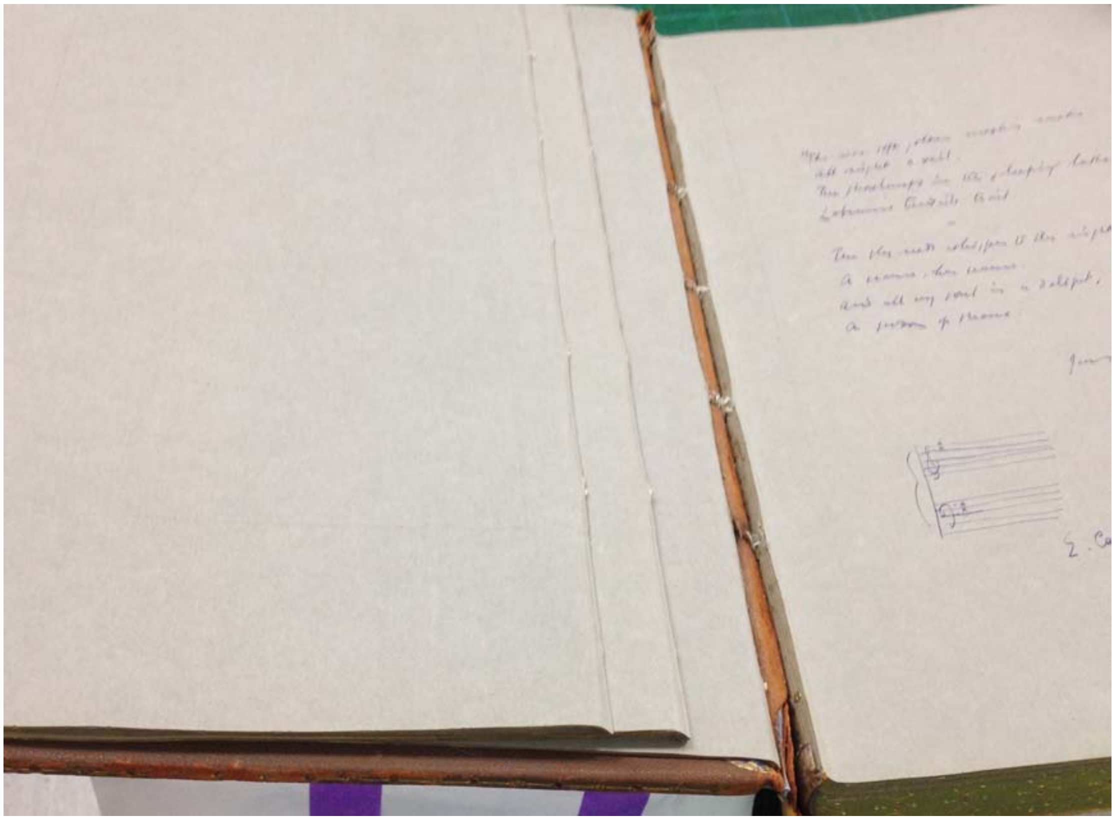


Fig. 8. Releasing the first few sections while supporting the front board attachment.

goat skin proved sympathetic to the enhanced grain pattern of the original leather covering the album. The leather was pared by hand and dyed to suit using conservation standard Selladerm tri-chromate leather dyes.

During the repair process, Lascaux 498 HV was used for attaching new leather directly onto aged leather due to its lower water content. This is more suitable in comparison with wheat starch paste and Evacon-R, whose high water content can promote staining and blacking. Unbound components within aged leather (e.g., tannins, nontannins and previous dressings) are easily solubilized in water, leaving a dark deposit on the surface of the leather as the adhesive dries (Kite, Thomson and Angus 2006).

The repairs to the leather began by applying reversible small sutures of 2.5 g/m^2 *Tengujo* repair paper to the flesh side of the splits in the spine leather. These repairs were attached using a 3% solution of hydroxypropyl cellulose in isopropanol. These realigned and consolidated the splits in the leather. The exposed flesh side of the spine leather was then lined with a 19 g/m^2 Japanese kozo fiber paper and adhered with Lascaux 498 HV as a reversible barrier layer. During this process, the degraded areas of the spine lining along the back folds of the text block were also replaced with a reversible barrier layer of the same paper. The incorrect profile of the spine in this area was then adjusted with a layer of Hahnemuelle 150 g/m^2 paper using a 50:50 mixture of Lascaux 498 HV and Evacon-R for strength and flexibility. This profile correction would also improve the flexing along the spine when the album was opened.

The leather repairs were made to both endcaps using a three-stage process (fig. 11):

(1) Leather repair pieces were placed between the original spine leather and back folds, then tacked in place against the original leather using Lascaux 498 HV.
(2) Linen cord was placed inside the new leather cap pieces and adhered into place using wheat starch paste.
(3) The grain side of the new leather cap repairs were softened using wheat starch paste before a 1:3 mix of wheat starch paste, and Evacon-R was applied to adhere the turn-ins and set the caps in their final positions. The repair areas were then wrapped in a bandage and left to dry overnight under tension.

The next stage was repairing the large lateral split that extended from the final panel to the tailcap of the spine. By observing the mechanical action of the split when opening and

Fig. 9. Creating sewing extensions with unbleached linen thread.

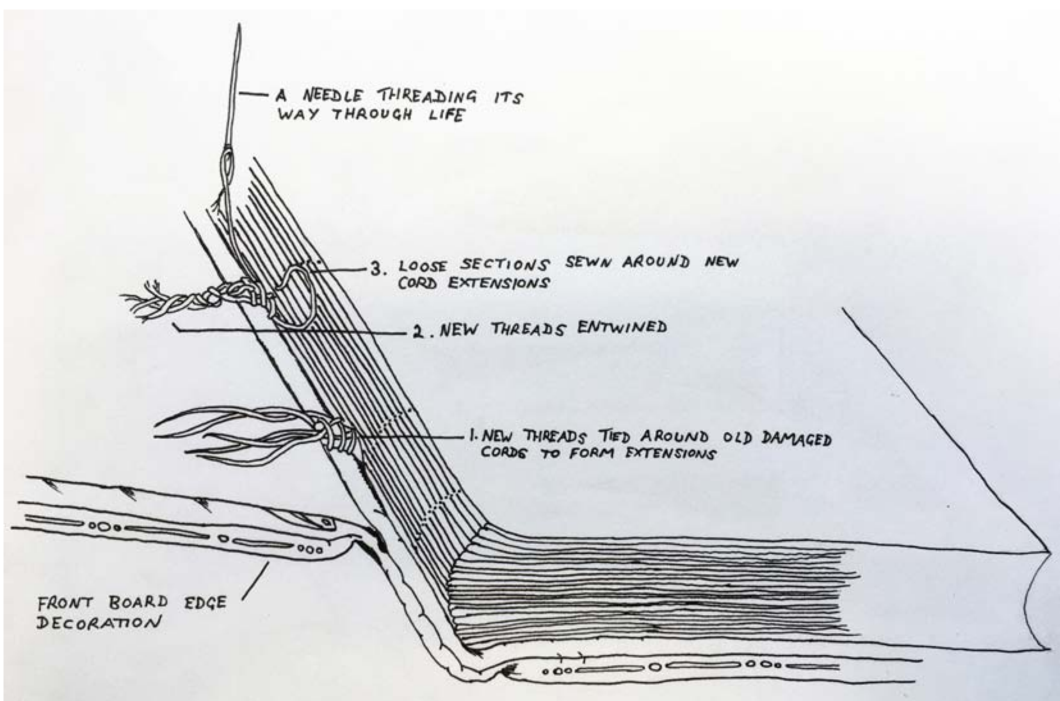


Fig. 10. Sequence of operations for cord extensions board reattachment. Diagram by Peter Mitchelson.

Fig. 11. Replacing missing headcap leather.

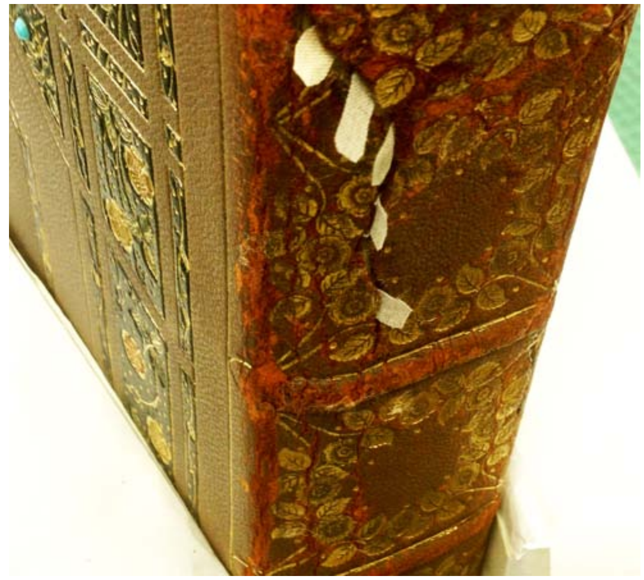


Fig. 12. Inserting aero linen sutures.

closing the book, it was determined that eight small reinforcing sutures could be inserted using unbleached aero linen and Lascaux 498 HV to realign and strengthen this area (fig. 12). Once the split was aligned and the sutures adhered in place, the area was kept under tension by wrapping in a crepe bandage with a Bondina barrier and left for 24 hours for the adhesive to dry.

Initially, this repair seemed stable; however, when the book was closed during a subsequent stage of the treatment with four sheets of Mylar inside, these inserts created too much swelling as the book was closed, which added pressure on the spine, popping the repairs open. Although undesirable, this demonstrated that the initial leather rating was correct, as the original leather did not split further and retained its internal strength, whereas the new repair was the first to fail, leaving the original material undamaged. Nevertheless, this incident was a reminder of the fragility of the binding and the limits to which it could be subjected to stress when opened. By reapplying the repair in the same way, but with the joint under slightly less tension, a greater degree of movement was achieved for the spine when opening the book.

The original binding style was a tight back, and over time, small voids developed where the leather had separated from the backs of the sections in the spaces between the raised bands. To address this, approximately 4 mL of Lascaux 498 HV was injected by syringe into these areas and then bandages were wrapped around the book and left under tension overnight to set.

Numerous minor lateral splits remained visible along the spine with hollow spaces or adhesive voids beneath. Small strips of 25 g/m^2 Japanese kozo paper were applied with Lascaux 498 HV and worked into these spaces, then shaped before leaving to dry (fig. 13). Small lengths of toned 5 g/m^2 *Tengu* paper were also applied at a few sites along the joints and endcaps bridging areas of minor splitting. These repairs were later toned using SC7400 tinted with a mix of burnt sienna and burnt umber-light Golden Heavy Body acrylics (Bennett 2018) to reduce the visibility of the repairs on such a highly decorative leather cover. The conservators chose to use the Golden acrylic for toning all of the repairs due to their proven stability within 100 years of gallery lighting conditions.

Repairing the Silk Flyleaf

Initially, the silk endpapers and detached front corner piece of the shattered silk was carefully cleaned with a soft brush to reduce surface dirt. Further cleaning was not possible due to the brittleness and fragility of the shattered silk. When deciding on the conservation treatment of the silk, the conservators sought advice from in-house textiles conservator Marion Parker.

Being unable to source a similar material, Parker suggested repairing the silk using pre-prepared adhesive film on Stabiltex with 20% 1:1 Lascaux 303-498 HV in deionised water. The Stabiltex was applied as a lining to each of the damaged flyleaves using a heated spatula at 80°C. Those areas where the original silk had been lost were infilled by applying toned paper to the Stabiltex using a heated spatula. The paper used was a 7.3 g/m^2 *Haini Tengucho* tissue toned with Golden Acrylic paints to achieve a suitable color match (figs. 14 and 15).

Fig. 13. Inserting Japanese repair paper infills.

CONSERVATION HOUSING

The realigned gilt edges of the text block were gently dry-cleaned again using smoke sponge to remove deposits of surface dirt before the book was rehoused in a cloth-covered,

Fig. 15. Watered silk front flyleaf, after conservation.

drop-spine box (fig. 16). The specifications of the box included the use of conservation standard adhesives and materials such as an internal lining of 9-mm-thick, chemically inert, Plastazote foam. The lining in the base of the box has a cutaway which allows for a hand to be safely inserted beneath the book. This facilitates easier removal of the album, reducing future damage when handled. Before housing, the box was left open to dry and off-gas to remove any residue volatile compounds created by the combination of construction materials and adhesives used in the boxmaking.

CONCLUSIONS

The success of this conservation treatment depended upon two factors: being able to access the broken sewing structure and knowing the condition of the original leather. The conservators

Fig. 14. Watered silk front flyleaf, before conservation.

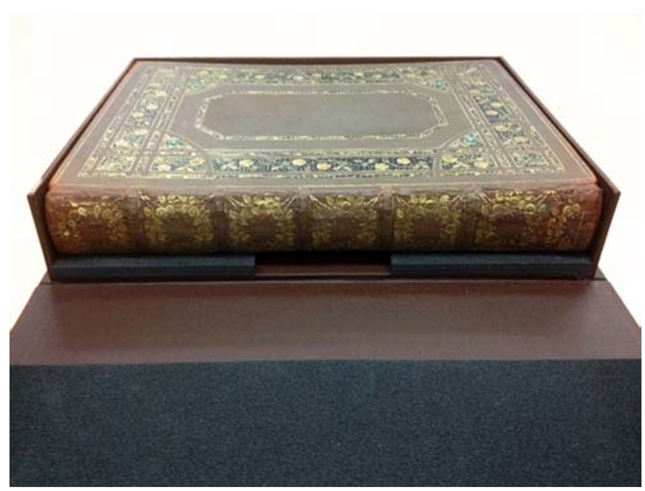


Fig. 16. Housed in drop-back box.

Fig. 17. Realignment of the gauffered edge.

were able to safely access the underside of the spine behind the back folds of the first five sections to perform the sewing repairs in situ. This was achieved by releasing these sections while supporting the front board and allowed the following:

- Extending the sewing slips to reattach the front board
- Attaching guards to the back folds to close gaps in the gutters
- Repairing the sewing in situ while realigning the decorative gauffered edges (fig. 17)
- Attaching reversible barrier layers to the flesh side of the spine leather to realign the torn spine decoration
- Correcting the spine profile to accommodate the dimensions of the spine leather when the book is open and under the most stress.

An understanding of the condition of the original leather at the repair sites informed the choice of different treatment options available to the conservators. Significantly, the FSA indicated that the original leather was sufficiently strong and

Fig. 18. Completed conservation of the leather spine.

meant that a full rebacking of the spine was not necessary. This averted the potential risk of damaging the highly ornate decoration on both the spine and boards during the conservation treatment (fig. 18).

Finally, the use of small structural repairs took into consideration the future handling and significance of this book. The album is housed in a special collection reading room within the Louise Hanson-Dyer Music Library and always handled under the supervision of trained staff using book supports and not subjected to high use, so more robust repairs were not required. Given the significance of this book as a protective and decorative object, the conservators were satisfied that they chose the most ethical approach, conserving the integrity of the original binding by minimising the introduction of new materials, retaining the original decorative elements for the enjoyment of future readers.

ACKNOWLEDGMENTS

The project was initiated by Louise Hanson-Dyer librarian Dr. Jen Hill, and the Miegunyah Fund generously provided the funding for this conservation treatment.

The team of conservators who assisted or consulted on this project include Karen Vidler, Peter Mitchelson, Libby Melzer, Marion Parker, Jordi Casasayas, Adele Barbara, Lois Waters, and Danielle Woodward. Editing help was received from Talia Eilon.

NOTE

1. Karen Vidler recently developed this framework of treatment actions for the FCA based on her ongoing research into leather deterioration and treatment methods. She passes on this framework in her teaching practice.

REFERENCES

Bennett, S. 2018. Personal communication. Materials Specialist, Golden Artists Colors, Williamsburg, Virginia.

Davidson, J. 1994. *Lyrebird Rising: Louise Hanson-Dyer of Oiseau-Lyre, 1884–1962*. Carlton: Melbourne University Press at the Miegunyah Press.

Horton, R. W. 1999. "Historical Photo Albums and Their Structures."In *Postprints of the Book and Paper Group. Photographic Materials Group Joint Session at the American Institute for Conservation of Historical and Artistic Works 27th Annual Meeting.* St. Louis, MO: AIC. 13–14.

Kite, M., R. Thomson, and A. Angus. 2006. "Materials and Techniques: Past and Present." In *Conservation of Leather and Related Materials*. London: Butterworth Heinemann. 121–29.

Knight, E. 2016. Assaying Klucel-G Recipes, Application Methods in the Surface Consolidation of Tanned Bookbinding Leathers. https://www.culturalheritage.org/docs/default-source/annualmeeting/68-assaying-klucel-g-recipes-application-methods-in-the-surface-consolidation-of-tanned-bookbinding-leathers.pdf?sfvrsn=4.

Larsen, R., M. Vest, D. V. Poulsen, and U. B. Kejser. 1996. "Fiber Assessment." In *Deterioration and Conservation of Vegetable Tanned Leather: The Environment Leather Project*, edited by R. Larsen. Copenhagen: Royal Danish Academy of Fine Arts. 113–20.

Ruzicka, G., P. Zyats, S. Reidell, and O. Primanis. 2006. "Conservation of Leather Bookbindings: A Mosaic of Contemporary Techniques." In *Conservation of Leather and Related Materials.* London: Butterworth Heinemann. 230–32.

Sharphouse, J. H. 1971. "Types of Hides and Skins and Principal Uses." In *Leather Technician's Handbook*. Northampton UK.: Leather Producers Association. 20–34.

Steere, P. 2017. "What Is Cellugel?" *Journal of Paper Conservation* 18: 67–70.

Sturge, T. 2000. "Materials." In *The Conservation of Leather Artefacts: Case Studies from the Leather Conservation Centre*. Northampton: Leather Conservation Centre. 24–32.

"The Bookbindings of Wal. Taylor." 1925. *Art in Australia* 12: 73–74.

Tregear, P. 2008. "Never a Place Out of Notes: A Brief History of the University of Melbourne Music Library. *Continuo* 37: 33–51.

Vidler, K. 2015. "How to Read Bookbinding Leather." *Skin Deep* 39: 2–8 http://www.hewit.com/skin_deep/?volume=39&article=1.

Wouters, J., and J. Claeys. 1996. "Analysis of Tannins, Sulphate, Fat, Moisture and Ash: Evolution and Significance of Parameters to Be Followed for Measuring the Degradation of Vegetable Tanned Leather." In *Deterioration and Conservation of Vegetable Tanned Leather: The Environment Leather Project*, edited by R. Larsen. Copenhagen: Royal Danish Academy of Fine Arts. 87–94.

SOURCES OF MATERIALS

Airplane Linen (Unbleached) 200 g/m^2, Klucel G (Hydroxypropylcellulose), Lascaux Acrylic Adhesives 303 HV and 498 HV, SC7400 Sold as SC6000 (Acrylic Polymer and Wax Emulsion), and Stabiltex
Talas
https://www.talasonline.com

Fair Goat Skin (Restoration) Grade II
J. Hewit & Sons Ltd., UK
https://www.hewitonline.com

Golden Heavy Body Acrylic Paints
Golden Artists Colors
https://www.goldenpaints.com

Japanese Repair Papers and Tissues
Hiromi Paper Inc.
https://hiromipaper.com

Natural Linen Thread (Waxed) 18/3, 40/3
Ratchford Ltd., UK
https://ratchford.co.uk/product-category

Selladerm Leather Dyes
Leather Conservation Centre, UK
https://www.leatherconservation.org

KAREN VIDLER FIIC
Senior Book and Paper Conservator
Book Conservation Services
Adelaide, Australia
bcsbindery@gmail.com

PETER MITCHELSON
Book and Paper Conservator
Grimwade Conservation Services
The University of Melbourne
Melbourne, Australia
mitchelson.p@unimelb.edu.au