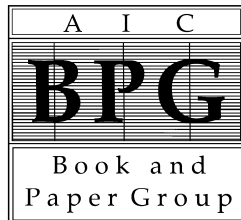


The Book and Paper Group ANNUAL

VOLUME FORTY 2021

The American Institute for Conservation of Historic and Artistic Works



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**Preserving Cultural
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2021

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Changing Practices: Reviewing the Evolution of Treatment Approaches for the Collection of the Board of Trade and Design Registers 1839–1991 at the National Archives, UK

INTRODUCTION

This article aims to share developments in the work of the conservation treatment team at the National Archives (TNA) in London, UK, in relation to a collection of volumes forming the Board of Trade Representations and Registers of Design, commonly referred to as the BT Design Register. The changing approach to conservation of this very popular collection over the years reflects both evolving trends in conservation and the focus and business priorities of the Collection Care Department (CCD) at TNA.

The collection includes challenging objects that present the conservator with an array of problems to address including size, format, usage, and context, not dissimilar to the issues found in the conservation of scrapbooks, photo albums, and other composite volumes. Examples of past and present interventions will be discussed to give a historical perspective of the conservation of the BT Collection, also referring to the data collected by different generations of conservators and kept in the CCD's database. The collection, with its complexity and richness, has proved invaluable to describe a shift in approaching its conservation, while also reflecting on the changing roles of conservators, and hopefully present a working model that can be replicated in other institutions and specifically archives.

THE COLLECTION AND ITS HISTORY AND DEVELOPMENT

The British Board of Trade Registers Collection contains nearly three million designs that were registered between 1839 and 1991 and is one of TNA's most visually captivating collections, with a stunning array of designs used for textiles, glasswork, metalwork, ceramics, furniture, wallpaper, and other decorative arts and manufactured objects. The registers

include details of each proprietor who submitted a design and a representation in the form of a drawing, photograph, or three-dimensional sample—anything from straw hats (fig. 1) to inflatable corsets can be found hidden among the pages of these volumes. This wealth of information contributes to making this collection a popular resource for researchers, with its objects being regularly requested for access.

The Board of Trade, originally known with the impossibly long title of “The Lords of The Committee of the Privy Council Appointed for the Consideration of all Matters

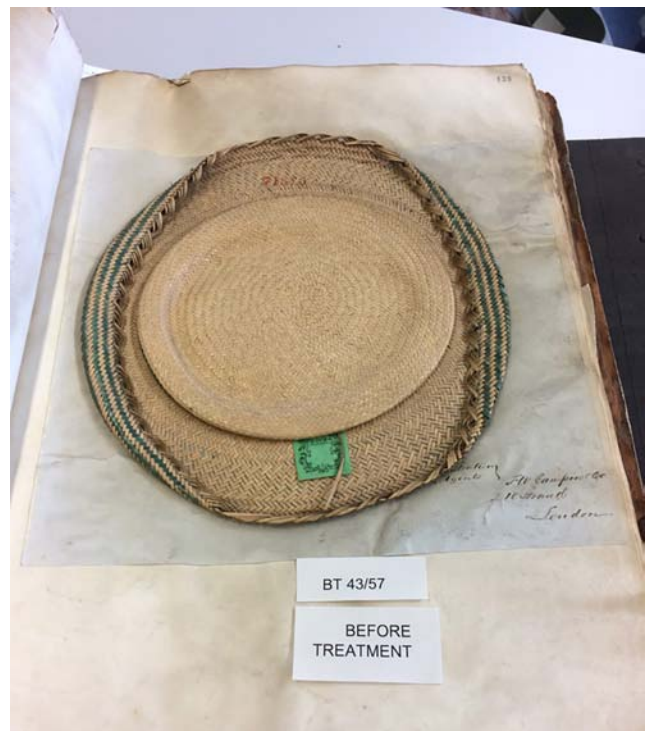


Fig. 1. BT 53/57, a straw hat before conservation. Reproduced with permission from The National Archives. For permission to reuse, please contact The National Archives' Image Library.

Papers presented during the Book and Paper Group Session, AIC's 49th Virtual Annual Meeting, May 10–June 25, 2021

Relating to Trade and Foreign Plantations,” was established in the 17th century. The board was meant as a temporary committee to advise on colonial matters and eventually evolved into a government department with considerable power and functions including regulation of domestic and foreign commerce; the development, implementation, and interpretation of the Acts of Trade and Navigation; and the review and acceptance of legislation passed in the colonies.

Until 1839, most areas of the decorative arts, such as glass, metalwork, ceramics, and wallpapers, were not protected by copyright, with the exception of textiles. The situation changed in 1839 when the Designs Registration Act was introduced, providing protection for all “ornamental” designs. At this point, the Design Registry was created for designers to submit their work and apply for copyright. The Design Registry was part of the Board of Trade and moved later under the jurisdiction of the Patent Office. The system used to register designs continued to be modified, although from 1842 it always involved two elements that formed a record: the representation and the registers. Today, designs are registered with the Intellectual Property Office.

Designs were submitted from Britain, mainland Europe and the British Empire, with the aim of protecting the owners of original designs from commercial piracy (note 1).

The collection includes just under three million designs, contained mainly within volumes, in varying formats with some weighting as much as 25 kg (55 lb.). Later registrations, when the convention of pasting designs into volumes had been abandoned, are contained in folders and files grouped in boxes.

There are various series identified by the BT prefix, followed by a number indicating a different class of designs, covering the period from 1839 to 1991.

Often described as a “museum within a book” by TNA record specialists and in internal TNA presentations, the Design Register is a unique resource of public value and an underexplored resource for historical research and design innovation. Over the years, the significance of the resource has been evaluated in various ways, including designing and carrying out value assessment exercises with support from internal and external focus groups. One of the questions to answer was “Who uses the collection?” Using data available through a user’s inquiries and analyzing academic output through literature reviews, conservators established that the BT Design Register has been used mainly by historians, particularly scholars researching textiles and dressmaking history, ceramics, and business history. Their scholarly output confirms that it is an important primary source for understanding economic and social history, as well as commerce and copyright developments. The collection provides textual and material evidence of trade and innovation throughout the world, particularly the role of the UK. Researchers at TNA also initiated consultation events with existing archive

users, including historians, archivists, and curators, and potential users, such as artists and designers. These meetings confirmed the very high research value of the BT Design Registers for established users but also opened a conversation on the potential benefits of widening the reach to underrepresented audiences with better outreach programs.

The collection provides a documentary connection to Britain’s manufacturing past, with strong links to particular towns and their manufacturing and industrial heritage. Material evidence of these past industries exists now only in the BT Volumes.

BACKGROUND

Starting in early 2000, the role and competencies of conservators in the department have seen a shift from a bench-based treatment-focused structure to a framework developed around the “conservation practitioner-researcher” approach (Bell and Eastop 2020, 141–154). Based on a model proposed by Emily Pringle (2018) relating to the role of research within a museum context, the conservation practitioner-researcher in TNA undertakes research-led practice integrating objects with their context and value and makes treatment decisions that consider research outputs on the same level as other more traditional decision-making markers. Following this approach, concepts traditionally utilized to describe the degree of intervention, primarily focused on quantifying a treatment decision, can become inadequate. In fact, when research and practice merge to become integral to the intervention, a new lexicon needs to be adopted to better describe and justify the decision-making process. Later on, this article will explore how value and impact have an equivalent weight in the treatment decision-making process and how this has changed the way conservators interact with the BT Collection.

CHALLENGES AND OPPORTUNITIES

The scale of the collection is daunting, whether considering the potential cost of digitization or the difficulty of simply locating a design within a volume. Each sample has a unique number linking the registration with the representation. Although *Discovery*, TNA’s public catalog, describes the collection at the item level, users have to request potentially several volumes before finding the right item unless they know the number of the desired representation. In the series BT43 and BT44 for example, the design samples were filed idiosyncratically according to 14 material “classes.” Without knowing both the unique design number and material class, it is time consuming to identify the required volumes, making accessibility a real issue (note 2). In addition, the volumes are large and heavy (fig. 2), and therefore are physically difficult to handle without risking damage to both the item and the user. Some classes of volumes, given the materiality



Fig. 2. BT 50/536, one of the volumes for textiles representations. These volumes are among the most challenging because of their weight and size. Reproduced with permission from The National Archives. For permission to reuse, please contact The National Archives' Image Library.

of the representation, are particularly complex and vulnerable; they might contain drawings, tracings, photographs, textile samples, lace, and/or 3D objects, all contributing to the instability of the binding and the deformed shape that characterize most of the collection. Although TNA recognizes that accessibility is the final goal, one potential disadvantage of increasing public awareness of the Board of Trade series is the risk of greater numbers of people coming into the archives to access the physical representation volumes. Under the current system, without transcribed versions of the registers and image availability of each design, production is very resource intensive, requiring unnecessary handling of the representations. For this reason, there needs to be the right balance between greater public engagement and resource availability.

One of the approaches trialed during the years to provide more accessibility to the collection has been through the exploitation of ad hoc funding opportunities to create pilot projects, to eventually inform further efforts. For instance, one such project was carried out in 2012 with funds made available by the Arts and Humanities Research Fund (AHRC). The project aimed at enhancing the preservation of the BT Design Register while making it more readily accessible, and it was underpinned by research carried out in 2010–2011 with funds from the Clothworkers' Foundation. A key objective was to make it easier to link the written records in the registers in one

of the series (BT44) with the corresponding designs in Series BT43. To achieve this goal, the BT44 registers were transcribed and cataloged, and the resulting records were made available online. This huge task resulted in more than half a million records released in total and facilitated the search of the BT Design record for the period from 1842 to 1884.

One additional challenge that has hindered TNA's ability to develop a coherent strategy for the development of the collection is that some of the designs were registered by companies that still exist and make commercial use of their archives. These companies, when approached about the possibility of digitizing and including their designs as available resources, expressed reservations. Even though legal advice confirmed that TNA would be able to go ahead without being in breach of copyright law, it has remained a controversial issue and one that has not yet been addressed.

As highlighted repeatedly, the Design Registers have significant research potential, but given the scale of the series, the cost of comprehensive conservation (note 3) to prepare the collection for digitization and digitization itself is prohibitive. Estimated to run in the millions, TNA has not been in a position to take this cost on and carry out the project, without any scope to exploit the images and monetize the effort.

In striking that balance, it is crucial to consider the benefits of increased public engagement.



Fig. 3. BT 43/413. This volume received basic stabilization interventions, allowing it to be handled and viewed by readers. Reproduced with permission from The National Archives. For permission to reuse, please contact The National Archives' Image Library.

THE EVOLUTION OF PRESERVATION APPROACHES TO THE BT COLLECTION

One of the by-products of the past failure to implement a plan based on a strategic vision to enhance access to this collection has been a rather patchy approach to their conservation and preservation through their history. A systematic campaign of intervention has never been in the cards, as it would have demanded a financial commitment that at no point was going to be balanced by institutional priorities and desired outcomes. A range of options to improve standards of preservation and access have been explored, but no single, affordable intervention available to conserve this collection has ever been identified. Among the realistic approaches championed in the past, the easiest options supported the reduction of physical handling of the volumes; the mitigation of the risk of significant or complete loss of the collection information through a range of measures, both preservation and conservation; and the investigation of technological opportunities to allow visual search of the collection in ways that are meaningful to new audiences, thus reducing handling and physical change.

As a result, volumes have been conserved “on demand,” generally only undergoing minimal treatment—the basic intervention that would allow a user to safely access the resource (fig. 3). Most of these interventions, especially the early ones, were either never recorded or bulk records were created with only basic information included. Often these bulk records proved unreliable for research and data-gathering purposes, as they contained dates and names relating to the conservator creating the record, sometimes a different person from the one who had actually performed the treatment. The implications of having little access to the treatment history of these volumes means that conservators have to make assumptions based on historical knowledge of treatments common at



Fig. 4. Treatment cards, created before switching to digital record-keeping, are now kept in storage and in the process of being digitized and added to TNA's database. Reproduced with permission from The National Archives. For permission to reuse, please contact The National Archives' Image Library.

different times in archives and, in some lucky cases, rely on memories shared by colleagues (fig. 4).

One positive aspect of the relatively untouched structures of the majority of these items is that they present many opportunities for studying the original context, which in many cases has been left undisturbed. This allows researchers to understand elements of the history of this collection and trace changes in practices throughout their history, including the manner in which these designs were registered.

Besides data on treatments available on analog or digital databases, another hint at the changes in condition and status of the collection is given by surveys conducted in the department at various stages and for different purposes. Condition assessments surveys were often a preliminary condition to funding applications or pilot projects. Extrapolating and interpreting data from these sources can be complex, given the heterogeneous nature of the datasets, but nonetheless conservators at TNA are exploring novel ways to make use of historic data and include it in any future work done on the collection.

Besides the obvious issues these volumes present due to their large, heavy, and fragile state, the most interesting aspect that warrants attention is the multimateriality of the representations. Conserving these objects requires paper and book conservators to move out of their specialty and embrace a multidisciplinary approach to their task. This has created opportunities for dialog and collaborations with professionals from other institutions as well as different interest groups that can inform the decision-making process.

VALUE AND IMPACT: THE CONSERVATOR AS PRACTITIONER-RESEARCHER

Starting around a decade ago, the approach to conservation treatment in the CCD shifted, and conservation research came to be more embedded in the decision-making process leading to treatment, preservation, and display of collections. Whereas before this shift treatment conservators were vested with the practical aspects of collection care and were passive receivers of scientific outcomes, research started to move at the center of the conservation intervention, therefore becoming an integral part of the intervention. Conservators, whose professional identity had, up to that point, a strong foundation in practice were able to ask research questions and use emerging skills to find the answers. This new identity was later to find a name and a model when Pringle (2008) proposed her description of practice-led research, practice-based research, and practice as research applied to the art museum context. Practice-led research places emphasis on recognizing that the processes and methods of inquiry can be constructed as forms of research (Pringle 2018). This approach lends itself perfectly to legitimize the practitioner-researcher identity that conservators had been developing and perfecting within TNA and elsewhere in other collection care contexts. Rather than acting as end users of research outcomes, conservators use their practice to generate

research that is more grounded in their daily experiences with collections. The research question is born out of practical issues and therefore maintains a direct relation with the goals of the intervention. This shift benefited from an institutional context that was also changing and that eventually resulted in TNA becoming an Independent Research Organization (IRO), allowing the CCD to pursue an integrated research agenda and set its own research priorities.

This context provided an opportunity to revisit the BT Collection and rethinking its value in relation to conservation research and practice. Once the conservation of the collection was decoupled from service delivery constraints, which were effectively paralyzing any progress, it offered itself to become a foundation for knowledge creation and experimentation. It is possible to extrapolate value based on strategic priorities, and this is what conservators did when they placed the collection at the center of a system that identifies these priorities as follows:

- People
- Possibilities
- Integrity
- Engagement
- Recognition
- Influence

So, for example, conservators can start from a research question and move from that to map it against TNA values and priorities so that they can assign a project's value at the onset. This is in contrast to undertaking conservation simply based on condition status. Current work that the CCD is undertaking includes the creation of practical tools that allow value to be identified and quantified at the project selection stage, using both business priorities and impact outcome measures as the foundations to establish the quality of the intervention and the appropriate resources to employ (fig. 5).

CONCLUSIONS

The work of the conservation team in the CCD has been instrumental in establishing and supporting the understanding of the professional conservator as researcher-practitioner—within TNA and sector-wide. This new concept recognizes the work of the conservation practitioner as research. Within TNA context, it describes the CCD's capacity to carry out research that substantially extends and enhances the national research base, and it demonstrates an independent capability to undertake and lead research programs. The Board of Trade Collection, with its inherent complexity and value, has been instrumental in providing a testing ground to establish new ways of working. Researching and treating the collection has allowed the embedding of impact assessment measures using a value assessment exercise that is now in the process of being finalized and applied to other collections.

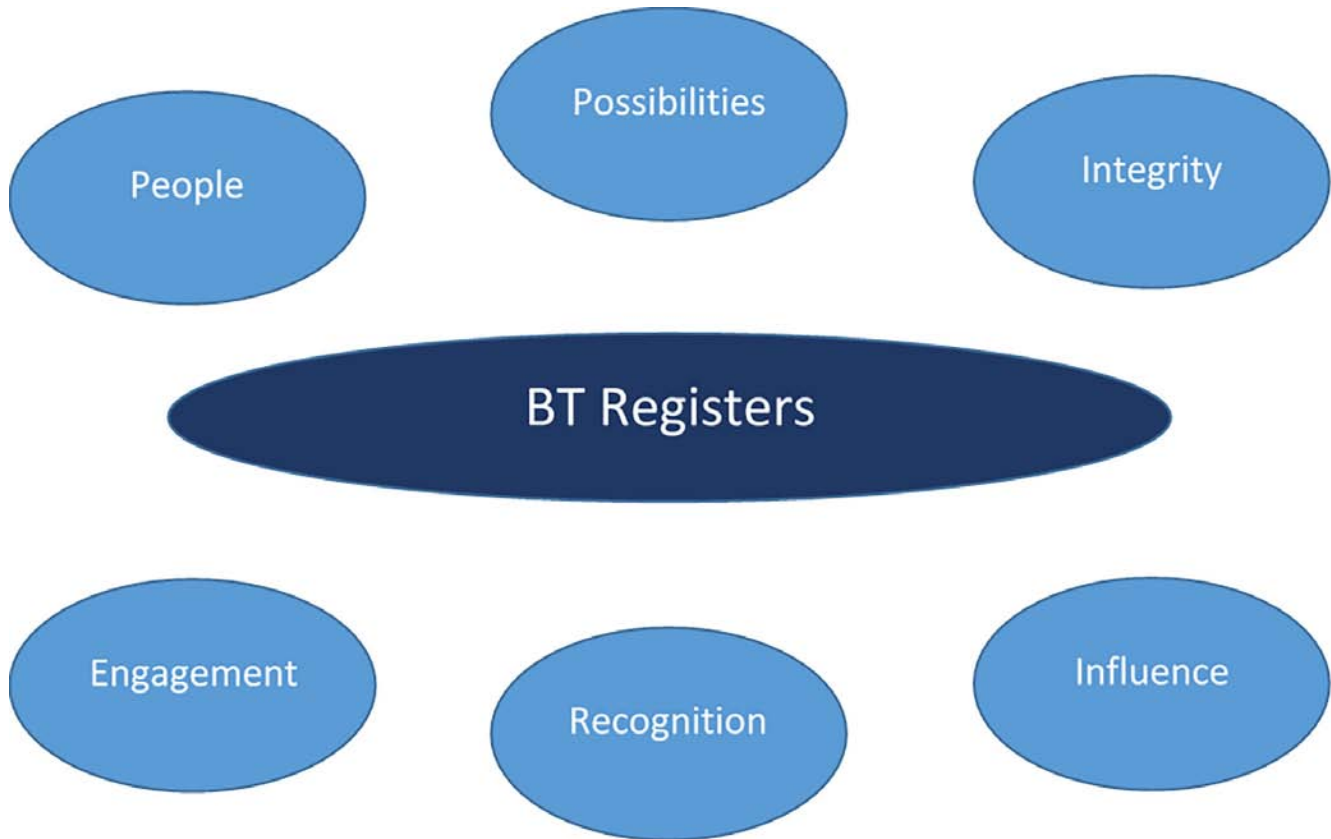


Fig. 5. Values chart showing the values and department priorities.

ACKNOWLEDGMENTS

The author would like to thank the conservation treatment team at TNA for sharing knowledge of the collection and providing valuable insights and references where no published literature was available.

NOTES

1. For historical background information on the Board of Trade Collection, see TNA's online catalog: <https://discovery.nationalarchives.gov.uk/details/r/C38>.
2. For guidance on how to access the designs, see TNA's online research guide: <http://www.nationalarchives.gov.uk/help-with-your-research/research-guides/registered-designs-1839-1991/>.
3. For an idea of resources employed for ad hoc conservation interventions to support one specific project, see <https://www.nationalarchives.gov.uk/designregisters/btconservation.htm>.

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Conserving the Australian Characeae Collection

INTRODUCTION

In 2007, Dr. Josephine Milne, co-author of this article and collections manager for the Royal Botanic Gardens Victoria, engaged conservators from Grimwade Conservation Services (GCS) to undertake a condition assessment of the Australian Characeae Collection. This is a significant collection of fire-damaged botanical specimens and their accompanying annotations on paper labels. The collection is held in the National Herbarium of Victoria (NHV), situated within the Royal Botanic Gardens in Melbourne. An initial assessment led to a treatment proposal, then a testing phase involving mock-ups, and finally the conservation treatment of around 70 items. The specimens and labels were found to be badly charred, making them virtually impossible to handle without causing loss. Stabilization of the collection was required to render the specimens and their labels accessible for cataloging and research.

BACKGROUND

The Australian Characeae Collection comprises charophyte specimens collected during the 19th century by the earliest collectors and explorers in Australia. Charophytes are aquatic green algae in the family Characeae, found in freshwater habitats (e.g., wetlands, lakes, and riverine habitats). When material was collected, it was first sent to Ferdinand von Mueller, who was the first government botanist at NHV from 1853 to 1896. Mueller then sent the material to experts in Europe for identification. Some of the specimens were retained in herbaria in Europe, notably Berlin and Kew, whereas others were incorporated into private herbaria, such as that of Otto Sonder. Sonder was a German pharmacist and botanist whose vast collection, including the Australian Characeae Collection, was purchased in 1883 by NHV and incorporated into the collection held within the Royal Botanic Gardens in Melbourne.

The Australian Characeae Collection is of great historic and scientific significance, as it contains many “type” specimens that are the definitive example of a species (Roberts 2009). Historic handwritten labels from the collecting botanists and annotations from later researchers accompany the specimens. The labels are an important primary source for researchers, as they contain valuable information about the specimens by several different botanists. Many of the labels have been annotated over subsequent decades, forming a highly significant and irreplaceable record. The annotations document the location and focus of many important botanists at particular times. Handwritten data by early Australian botanists including Ferdinand von Mueller are included in the labels. The significance of the collection was increased when early collections of Australian Characeae that had been incorporated into herbaria in Europe were destroyed during World War II bombings, including type specimens. Therefore, the collection of Australian Characeae at NHV is of great historic and scientific significance, as it contains many type specimens and, for some species, possibly the only existing example.

In 1958, the Australian Characeae Collection was damaged in a fire while on loan to the Botany Department within the University of New England in Armidale, New South Wales. Although many significant items were lost, 139 specimens of the collection miraculously survived and suffered relatively minor charring and water damage (Wood and Williams 1967). Now known as the Burnt Collection, these surviving specimens were too fragile to be accessed by researchers, with charred edges and fine particles of soot and loose charred fragments over the paper surface. Herbarium collections exist primarily as a scientific resource. Researchers, artists, and historians require access to the original material, as subtle details and nuances may be lost or omitted if facsimiles are relied upon. The fragility of the collection prevented it from being accessed both on-site and at other research locations in Australia and overseas, which has inhibited the cataloging work undertaken by Herbarium staff. Conservation intervention was required to stabilize the samples and reduce the risk of damage when handled for research purposes.

Papers presented during the Book and Paper Group Session, AIC's 49th Virtual Annual Meeting, May 10-June 25, 2021

DESCRIPTION AND CONDITION

Each item consists of the algae specimen mounted onto paper, plus up to five labels identifying the name of the specimen, the date and place of collection, and the name of the collector. Later labels and annotations were added by researchers. These sometimes included indications, with dates and initials, of original specimen material that was removed for testing. The labels are of various sizes, all smaller than foolscap. Some are printed, whereas others are handwritten, and many are annotated in ink, pencil, and crayon. Several labels have specimen plant material attached. Small paper envelopes containing loose fragments accompany some of the specimens (fig. 1).

A grant from the Royal Botanic Gardens supported the conservation treatment of an initial 20 specimens from the Australian Characeae Collection as a pilot project. Included in this group were the most significant type specimens, as

well as the most damaged and vulnerable material. The first batch of 20 prioritized items arrived at GCS in 2008, with a second batch of 50 items in 2012 when further funding was obtained. Each mounted specimen was supported on a piece of card, contained in a paper folder and then in a rigid card box. The mounted specimens and labels exhibited charring, embrittlement, and water damage sustained several decades previously in the fire. Some fragments were in cellophane bags, which had become brittle and discolored with heat from the fire. As individual labels were not identified, a tracking system was introduced to prevent the labels from becoming disassociated from their specimen, losing their relevance.

TREATMENT CONSIDERATIONS

Local repairs were considered as a treatment option, targeting each tear or fracture with an individual paper repair strip on the verso. It was believed, however, that local repairs would leave the edges of the specimens and labels susceptible to further damage and loss due to the fragility caused by the widespread charring sustained in the fire.

Encapsulation in polyester film was also considered as an alternative to more interventive treatment. Polyester film is a transparent, sturdy plastic and is chemically inert. It has many uses in conservation and is especially useful for providing a clear, protective enclosure that enables viewing and safe handling of an item. This option was not considered suitable, as it was feared that the static charge of the polyester film might dislodge the specimens and fragments of brittle paper. In addition, there would be the potential for damage to the fragile areas of the items if they needed to be removed from the enclosure. The polyester film might also impede proper examination of the specimens.

Lining of the specimens and labels was considered necessary to make them accessible once again and stable enough to withstand handling. A guiding factor was that the collection had to be given adequate physical stability to allow original material to be sent to researchers internationally. This dictated a level of intervention that would ensure a robust result. A more rigid than usual lining paper would be necessary and with a wider margin than is customary. This would prevent flexing of the brittle support and also provide some protection against handling and impact. The need for wide margins meant that the aesthetic value of the chosen lining paper rose in importance. The fragile nature of the charred paper and the inclusion of specimen plant material further complicated the lining process.

Lining can obscure details in the paper such as watermarks, chain lines, and laid lines, as well as any information that may be on the reverse. Lining can also cause an alteration to subtle characteristics of the paper, such as transparency and texture. Furthermore, the introduction of moisture and adhesive used during a lining procedure can result in a tendency for lined objects to curl. When choosing to line an object, conservators

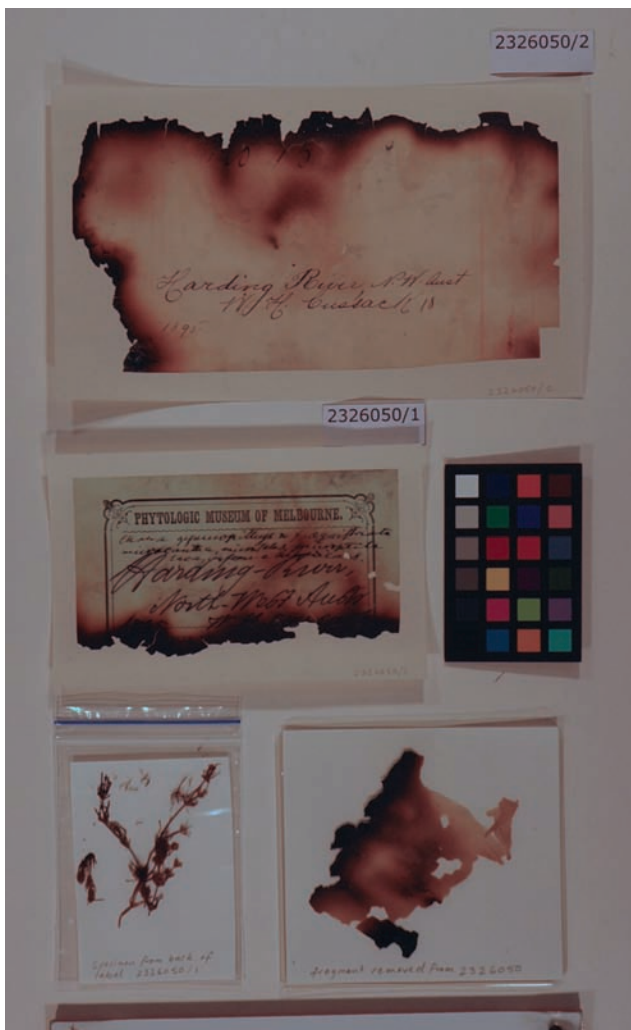


Fig. 1. Labels and fragments relating to MEL 2326050.

must carefully consider the risks and determine whether the benefits are justified. The method of lining and choice of adhesive and support paper are all based on several determining factors, such as the weight of the object, the solubility of the media, and the intended use of the lined object. In this case, the intervention required by lining and the subtle change this treatment would cause to the original paper characteristics were considered justified given the overarching need for accessibility and long-term preservation of the items (Owen et al. 1988; McAusland and Stevens 1979).

LINING METHOD

The choice of lining method needed to take into consideration the role of the specimens and their labels as both a scientific and historical resource. Algae specimens were often mounted without adhesive, and instead a bond was created simply by pressing the wet specimen onto the paper so that the internal mucilage of the specimen adheres it to the paper (Queensland Herbarium 2016). The treatment proposal therefore had to factor in the risk of specimens dislodging with the application of moisture. Another consideration was that no adhesive could be added to secure a specimen, as sometimes researchers remove parts of a specimen for microscopic examination and analysis. It was important not to contaminate the specimen in the event it would undergo scientific analysis in the future.

The following parameters were considered important when devising the lining method:

1. The lining process should not place the specimens or labels at risk.
2. The lining process should not obscure any inscriptions on the verso.
3. The lining paper must be sympathetic to the original material in terms of tone, texture, and fiber.
4. The lining paper must be both archival and robust, with wide borders to allow for handling.
5. The adhesive must not interfere with the integrity of the specimens as scientific samples.
6. The adhesive used for lining must be archival and reversible, in theory.

Professional conservators in Australia must adhere to the Code of Ethics of the Australian Institute for the Conservation of Cultural Materials (AICCM 2002). Under this code, any intervention must be governed by an informed respect for the unique character and significance of an object, as well as its physical, historic, esthetic, and cultural integrity. The principle of reversibility also guides modern conservation practice. Techniques that involve the use of materials whose future removal could endanger the physical safety of the object should be avoided. There are, however, “degrees of reversibility”

(Applebaum 1987). In theory, all the materials and techniques proposed in this treatment are reversible. In practice, removal of the lining papers and adhesive would be risky due to the fragility of the original material. Lining papers can usually be removed after extended humidification. This could potentially pose a risk to specimens held merely by their mucilage. Although linings and repairs should be easily removable, the ease of their undoing requires them to be less durable than some objects require. As important as the concept of reversibility is in conservation, in this case durability was a more important consideration. Conservators have an obligation to ensure to the best of their ability that the condition of an object remains unchanged long after treatment is completed. This includes an understanding of how these objects will respond and cope with their intended future use (Owen et al. 1988).

The most common method of lining currently practiced among paper conservators is the Japanese technique adopted from traditional scroll mounting. The object to be lined is humidified and placed face down on a flat surface. Paste is applied to a sheet of Japanese tissue that is then gently laid down onto the verso of the object, using a traditional Japanese Nabezake brush to smooth out wrinkles and encourage the bond. The lined object is then pressed under weight or adhered to a karibari board for drying. Although this method produces very good results, it was not appropriate for the Characeae Collection, as the items needed to be observed carefully during treatment. Many were too fragile to place face down, especially those containing specimens. Brushing the verso with a Nabezake brush could damage the charred edges of the paper and the specimen if present. Thus, early experiments focused on keeping the items face-up during lining and using the suction table to adhere the lining paper. An article by Sandra Grantham describing the latter was used as a starting point (Grantham 1994).

The problem often encountered when lining using a paper of heavier weight than the object is the tendency of the object to curl once dry. This is usually caused by internal tensions from the creation of a composite object (i.e., an adhesive plus two papers with different expansion and contraction characteristics). The tendency to curl can be minimized by using a dilute paste and a lightweight lining tissue, matching the papers as accurately as possible in terms of fiber type and grain direction and controlling the drying process (Nielsen and Priest 1997; McAusland and Stevens 1979; Donnithorne 1995). Matching the grain direction was not feasible, as the Characeae papers were so fragile that they could not be flexed to determine the grain direction. For reasons already discussed, a lightweight tissue was not appropriate in this situation. However, using a dilute paste was an easy strategy to adopt, and tweaking the drying process was certainly something that could be explored. Several lining and drying methods were trialled to ascertain the appropriate method. Experiments were carried out with different styles of tension drying, including a modified version of the Terylene lining as described in the *Paper Conservation Catalog* (Owen et al. 1988).

TESTING

A series of mock-ups was produced using charred paper to mimic the Characeae items. A selection of high-quality lining papers was acquired from Griffen Mill in Ireland, which were suitably rigid and tonally sympathetic to the labels. Several lining and drying methods were trialed to ascertain the appropriate method. The lined mock-ups were assessed with regard to satisfactory adhesion and degree of curling following lining and drying, as

described in figure 2. Curling occurred when the sample was lined using low suction and then removed and pressed beneath weight. This improved slightly when the sample was left to dry on the suction table. Taping the lining paper to glass and leaving the lined sample to dry under this tension saw improvements in the curling, but the adhesion was not satisfactory.

Following the testing and review, three proposed lining techniques were identified. The attachment and drying processes varied slightly, all using wheat starch paste as the adhesive.

No.	Lining Technique	Drying Technique	Result	Conclusion
1	Lining paper pasted out and placed on dry blotter on low suction. Mock-up placed on lining paper with Mylar over the top for first 2 minutes, suction a further 6 minutes.	Traditional pressing	Curling	Unsuitable
2	Lining paper pasted out and placed on dry blotter on low suction. Humidified mock-up placed on lining paper with Mylar on top.	Left on suction table for 1 hour until dry	Slight curling and poor adhesion	Unsuitable
3	Mock-up and lining humidified. Lining paper pasted out and placed on dry blotter on low suction. Mock-up placed on lining paper with polyethylene over the top 10 minutes.	Tension drying with tape	Good	Suitable for items with specimen attached
4	Lining paper pasted out and taped to glass with gummed paper tape. Mock-up placed on lining, smoothed with gentle bone folder.	Tension drying with tape	Adhesion failed	Unsuitable
5	Mock-up and lining paper humidified. Lining paper pasted out. Mock-up placed on lining, smoothed with gentle bone folder.	Pressed between felts; changed after 5 minutes, then 10 minutes	Good, slight curling	Suitable for labels
6	Mock-up and lining paper humidified. Bondina pasted to glass with starch; lining pasted to Bondina with MC; lining pasted with starch. Mock-up placed on lining and smoothed with gentle bone folder.	Tension drying with Bondina	Good	Preferred option for labels

Fig. 2. Lining tests on mock-up objects.

The first method, modified tension drying, was used for labels with no specimen. In this method, the label and lining paper were humidified through Gore-Tex. Bondina (non-woven polyester) was pasted with wheat starch paste and secured to a sheet of glass. The lining paper was attached to the Bondina with 2% A4C methyl cellulose. The lining paper was pasted out with wheat starch paste and the label placed on top and pressed firmly through Bondina with a flexible spatula or a bone folder. The lined label was left to dry on the glass for three days. The Bondina was then removed from the glass using a spatula (fig. 3). The lined label was inverted and the Bondina peeled from the back of the lining paper.

The second method added an extra step to modified tension drying and was employed when the lined label was curling after removal from the glass. The lined label was humidified and then secured again to a sheet of glass using gummed paper tape and left to dry for three days.

The third method, suction table lining, was used for items with a specimen attached. After humidification through Gore-Tex, the lining paper was brushed with dilute wheat starch paste. The mounted specimen was placed on the lining paper and gently pressed into place. The package was placed on the suction table and the suction started on low to initiate contact. A sheet of polyethylene was placed over the package and suction maintained for one minute. The lined specimen was then transferred to glass and edges secured with gummed paper tape (fig. 4). A piece of felt was placed on top for a few hours. After three days, the label was removed from the glass.

TREATMENT

All items were photographed before treatment and after treatment (figs. 5, 6) and assigned a number for tracking purposes that was inscribed in pencil on the verso lower edge of the lining paper. Each label or specimen was assessed individually,

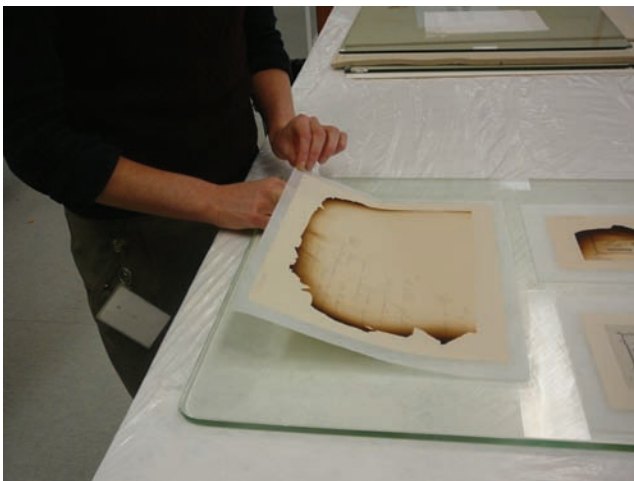


Fig. 3. Removal of a lined label from glass.



Fig. 4. Drying method following suction table lining for a specimen sample MEL 2326054.



Fig. 5. Before treatment, MEL 2355121.



Fig. 6. After treatment, MEL 2355121.

which involved recording the condition on a spreadsheet and testing the media for solubility. On the basis of this assessment, each item was assigned an appropriate lining technique. Linings were carried out as proposed or modified during treatment if required. The results of the lining process were recorded on a spreadsheet. All linings were trimmed to leave a wide border to protect the brittle damaged edges and allow for safer handling. One label with a numbered inscription on the verso had a small opening cut into the lining paper to reveal the inscription. Loose specimen or label fragments were collected in a polyethylene bag and retained with the labels.

CONCLUSION

The surviving specimens and labels of the Burnt Collection have immense historical and taxonomic significance. Michelle Casanova, a phycologist at the Royal Botanic Gardens, states, “Every specimen in this collection has a story to tell about the botanical exploration of Australia and the relationships between botanists at the time. Each specimen gives an indication, not only of where those people were, and what they were doing . . . but also what the environment and water resources were like” (Roberts 2009). This conservation

project has ensured that the Burnt Collection will continue to survive and be accessible to researchers, and more widely available as digitized images online via the Australasian Virtual Herbarium.

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Transforming Artworks from 3D to 2D Case Study: Treating Two Sets of Monumental Ink Rubbings in the Cleveland Museum of Art

INTRODUCTION

In the summer of 2019, Dr. Fletcher Coleman, an Eastern Asian art assistant professor at the University of Texas, contacted the Cleveland Museum of Art (CMA) regarding research he had been doing on the museum's ink rubbings of the Longmen cave reliefs. When these ink rubbings were requested for a review, they were found in poor condition due to the inadequate storage environment. The museum had not been aware of their condition until they were retrieved from storage last year. According to records, these two monumental rubbings were first shown at the opening of the CMA in 1916, and they had not been on display for almost a century since then (fig. 1).

The conservation projects at the CMA are usually coordinated with the rotation of special exhibitions. Therefore, a conservation project to treat these two monumental rubbings was proposed after the Chinese art curator Clarissa von Spee at the CMA initiated the exhibition *From Caves to Tombs: Chinese Pictorial Rubbings from Stone Reliefs* at the CMA (note 1). The exhibit explored the tradition of making and mounting ink rubbings from stone reliefs, practiced in China. Ink rubbing is the pioneer of typography. The earliest existing Chinese ink rubbing, *Wen-Quan Ming*, by the Tang emperor can be traced back to the Tang dynasty (627–649) (Liu 1986).

INK RUBBING PRACTICE

Ink rubbings in Western society may sometimes be underappreciated, as the rubbings, taken directly from the stone's carved surface, are considered a copy of the object rather than an original object (Catcher 2014). However, ink rubbings in East Asian art history play an essential role as primary sources and study materials by transferring images or inscriptions from an inorganic to an organic substrate. Before high-resolution color photography was available, life-size rubbings were taken from ancient sites and cultural relics in China. Transforming



Fig. 1. Photo of Binyang Central Cave Imperial Procession Rubbings Inaugural loan exhibition, Chinese art (Gallery XIII), The Cleveland Museum of Art, 1916, Cleveland Museum of Art Archives (Negative 1916-00268).

artworks such as stone or brick relief from a 3D sculptural relief to 2D paper creates an image of surface features for a more accessible study. Other 3D materials can also be rubbed on the paper surface, such as wooden, bamboo, ivory, porcelain, stele, and bronze. The 2D image records the incised patterns. After rubbing the paper over the hard surface of the relief and into incised areas, ink or pigment is deposited on the surface and edges of the objects, leaving incised areas uninked. This technique, along with seal carving, which produces mirror images of the object, has more than 1000 years of history.

There are three distinctive styles of rubbings: the Crow-Gold (*Wu-Jin Ta*), Cicada-Wing (*Chan-Yi Ta*), and Whole-Shape (*Quan-Xing ta*) (Lia, Zhang, and Belle 2020). The Crow-Gold style has darker inking, reminiscent of a crow's wings and glory, whereas the Cicada-Wing style has lighter inking like a cicada's delicate wings. The Whole-Shape style composites all elements of the objects in three dimensions. These three styles are usually applied to smaller objects and created on a smooth surface. However, surfaces can be rough and uneven due to the

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Fig. 2. Bletilla.

sculptures becoming weathered throughout the years. Most of the texture in ink rubbings would be among those three styles. A large rubbing is usually executed on outdoor metals or stone reliefs, and this transformation from three to two dimensions can be duplicated as needed. The purpose of “copying” rubbings is to promote showing, educating, and displaying of these objects to the public, especially for the huge sculptures in remote regions. However, the result of this “copying” function varies depending on the makers, time of making, techniques, materials, tools, the weather, and how much the paper has been moistened prior to making the copy. There are, therefore, no identical copies even when the rubbings have been taken from the same objects.

Understanding rubbing practice is essential and helpful for treating Chinese ink rubbings. Common rendering materials and tools are *xuan* paper, Bletilla (fig. 2), ink, dabbers (fig. 3), and brushes (fig. 4), among others.

Fig. 3. Dabbers, *ta bao*.

Fig. 4. Brushes include a smoothing brush and a temping brush.

Xuan paper is made of a mixture of sandalwood and straw fiber; it is the substrate on which the ink rubbings will be made. It can be used in two ways to retrieve the images. One technique starts with dry paper that is adhered to the stone relief. The paper is then tamped into the engravings on the stone relief. Another technique requires the paper to be moistened and tamped into the engravings without any adhesive. When the paper is peeled off from the stone relief (fig. 5), the engraved areas come out white after the ink rubbing, whereas everything else is black or pigmented.

Bletilla or *baiji* is a traditional Chinese medicine herb used as an adhesive for making rubbings. The dry root of Bletilla is soaked in water for a day to extract this adhesive before using. The clear and yellowish extract is brushed evenly to the surface of stone relief before the *xuan* paper is spread over. Bletilla extract temporarily adheres the *xuan* paper to the surface of stone relief when making larger rubbings. It can be substituted for water in smaller rubbings. For modern



Fig. 5. The paper is peeled off from the stone relief.



Fig. 6. Big dabbers.

practice, the author has been using a mixture of water and methyl cellulose as an alternative adhesive, as Bletilla can discolor the surface of the stone relief.

Ink sticks are made of a mixture of soot and animal glue. Ink is ground and dissolved into water on the surface of a flat stone, called *Ink Stone*, *yantai*. Dabbers, *ta bao*, made of cotton or silk



Fig. 7. Smoothing brush.



Fig. 8. Tamping brush.

cloth stuffed with cotton, are then dipped into the inky liquid. Dabbers are usually shaped like *baozi*, Chinese buns, or garlic. The sizes of dabbers vary according to the size and material of the surface relief. The shaped dabber must be stuffed evenly to create the flat and solid bottom/base necessary for a successful rubbing (fig. 6).

Brushes include the smoothing brush (fig. 7) and tamping brush (fig. 8). The former is applied after xuan paper is aligned and leveled out onto the stone relief. Various sizes of the tamping brushes are used to gently tamp the xuan paper onto the stone relief to ensure the paper has adhered well to the surface of the stone relief.

DESCRIPTION AND EXAMINATION OF TWO MONUMENTAL RUBBINGS

The two rubbings, titled *Rubbing of Imperial Procession with Emperor and Empress* (figs. 9, 10), were acquired by the CMA in 1916. Their dimensions are as big as 203 × 386 cm overall. There are about 20 figures in each rubbing. The stone reliefs had been found in Central Binyang Cave, Longmen,



Fig. 9. Rubbing of Imperial Procession with Emperor, taken from Northern Wei dynasty (386–534) Central Binyang Cave, Longmen, Henan province.



Fig. 10. Rubbing of Imperial Procession with Empress, taken from Northern Wei dynasty (386–534) Central Binyang Cave, Longmen, Henan province.

Henan province, China, dating to the Northern Wei dynasty (386–534). The stone relief *Procession with Emperor* is currently at New York's Metropolitan Museum of Art (fig. 11), and the stone relief *Procession with Empress* is at Kansas City's Nelson-Atkins Museum of Art (fig. 12). Many fragments of the relief were pieced together in several restoration projects at the Nelson-Atkins Museum of Art (Coleman 2020b). As the two rubbings at the CMA were executed approximately between 1900 and 1915 according to Coleman (note 2), they were made before the actual stone reliefs were transported to the United States and are essential to the history of the stone reliefs.

Based on the ink texture, tone, and shapes of strokemarks on the CMA's *Rubbing of Imperial Procession with Emperor and Empress*, it is suggested that the xuan paper was dabbed with ink while the aligned xuan paper was still wet. The relief surface is textured, so the inked areas appear uneven, with dry and wet strokes (fig. 13). These should be considered part of history and an accurate record of the state of the reliefs when the ink rubbings had been done, as long as the rubbings are in good condition themselves.



Fig. 11. Stone relief of *Emperor Xiaowen and His Court*, Northern Wei dynasty (386–534). Limestone with traces of pigment, 208.3 × 393.7 cm. From the east wall of the Binyang Central Cave, Longmen Grottoes, Henan Province, China. The Metropolitan Museum of Art, New York, Fletcher Fund, 1935 (35.146).



Fig. 12. Stone relief of *Offering Procession of the Empress as Donor with Her Court* as seen on display in 2018 at the Nelson-Atkins Museum of Art, Kansas City, Gallery 204.

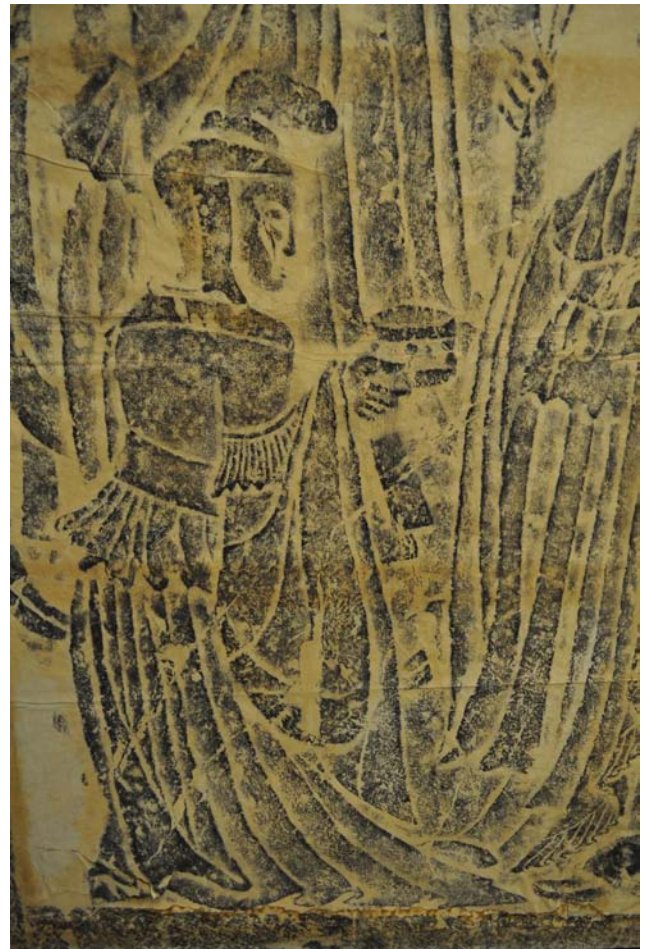


Fig. 13. Ink on rubbings appeared uneven with dry and wet strokes.



Fig. 14. Western stretched canvas for a display purpose.

Like the traditional Chinese format of paintings and calligraphies, the rubbings are usually mounted as hanging scrolls, album leaves, handscrolls, horizontal hanging scrolls, and flat mounts. Some other formats, such as rolled or folded for larger rubbings, are also commonly seen. When the rubbing tradition reached Western society, they were usually mounted onto stretched canvas for display purposes (fig. 14). Although there is nothing wrong with this method, the rubbings should have been released from the stretcher for storage.

The CMA rubbings were in poor condition, as they had remained on canvas stretchers since the opening exhibition from more than 100 years ago. Although the xuan paper of the rubbings had been lined with sheets of stronger long-fiber paper, the short-fiber xuan paper still lost flexibility after being stretched out for such a long term, becoming brittle with tears, losses, creasing, and yellowing (figs. 15–17). It was also a challenge to move around stretched rubbings of such a large size. The tears, losses,

splits, and dust might have accrued during handling in a limited storing space (fig. 18). Dark moldy stains at the



Fig. 15. Tear.



Fig. 16. Loss.

bottom section of the two rubbings indicate that the storage area may have been flooded or had leaking water on the floor in the past (fig. 19). Yellowing lines caused by the acidic wooden stretchers were also visible on the rubbings (see fig. 17), despite the protective barrier of the lining paper between the rubbings and the stretchers (note 3). All of these issues showed that treatment was in need for the rubbings.

The rubbings were photographed with normal, transmitted, and raking light. Transmitted light was used to determine if there were any weak points or thinner areas in the rubbings. The recommendation is to reinforce thinner areas with strips or sheets of paper, depending on the size of the thin area. Raking light is often used to determine if the lining process is causing creasing in Chinese paintings, but not all creases that raking light reveals on ink rubbings should be flattened.

TREATMENT STEPS

Because of the rubbings' dimensions, three people carried out this project in a larger studio at the CMA. The treatment steps are presented next.



Fig. 17. Yellowing.

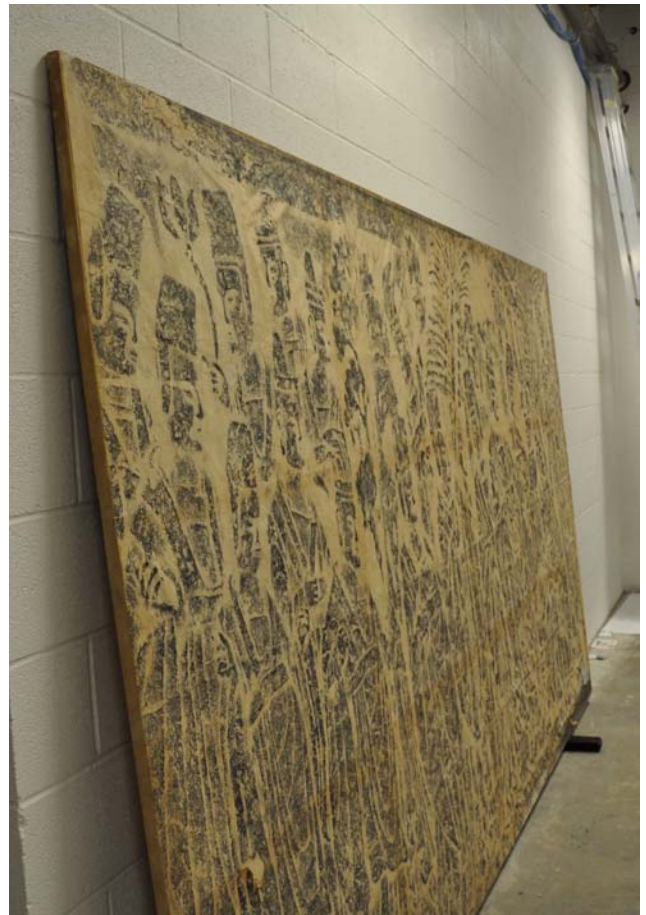


Fig. 18. Poor storing environment.

Separating and Disassembling the Painting from the Stretcher
The lined rubbings were adhered along the perimeter of their backs to canvas on the wooden stretchers. It was decided to separate the rubbings along with the canvas from the wooden stretchers by trimming the canvas with scissors



Fig. 19. Mold.



Fig. 20. Separating and disassemble the painting from the stretcher.

along the four glued edges (fig. 20). Except for the edges of the canvas, which were still adhered to the back of the rubbings, the canvas was then removed from the rubbings. The wooden stretcher was well documented before being discarded.

Dry-Clean with Flour Dough

The methods of vacuuming and “flour dough” cleaning were conducted. After vacuuming the surface of the rubbings, a mixture of water and flour was kneaded and left to rest. The proportion of water with flour was determined by Zhihong Zhang’s experience. Before she retired from the Palace Museum in Beijing, she participated in a big conservation project of *Juanqin zhai* in Qianlong Garden. After resting, the kneaded dough was shaped to a strip and rolled on the surface of the rubbings to remove surface dirt. A spot test was carried out to test the stability of ink before this process, making sure the ink would not be picked up (figs. 21, 22).

Wash

The rubbings were washed with water after protective rayon paper was placed on the surface. A brush carrying water was introduced onto the surface. The process was repeated until



Fig. 21. Clean kneaded dough.

the rubbings were all damp. The dirty water was then removed with a clean rolled towel. This step was repeated until the water wrung out from the towel appeared clean (fig. 23).

Remove the Old Lining on the Back

After the two large rubbings were washed, they were flipped over with a wide paper roller facing down. The strips of canvas on the edges and old lining sheets were carefully removed while the rubbings were still wet. Each sheet of old lining was measured as small as 15×11 in. An assumption is that lining a huge rubbing with smaller sheets would have been easier to handle (fig. 24).

Reline and Flatten the Rubbings on a Drying Board

The first lining is the most important step among all mounting steps. After removing the old lining sheets, the splitting and the misaligned areas were realigned (fig. 25). The rubbings were then lined with sheets of toned xuan paper. The toned paper was first dampened with water and gently folded



Fig. 22. Dusty kneaded dough.



Fig. 23. The rubbings were washed.



Fig. 24. Remove the old lining on the back.



Fig. 25. Re-aligned.

in preparation for use. A thin layer of paste was applied two to three times onto the back of a rubbing until it was evenly pasted out (fig. 26). The premoistened toned xuan paper was then smoothed out onto the pasted back of the rubbing. The rubbing was air-dried facing down.

Reinforce Thinness and Creases to Compensate for the Thickness of the Rubbings

The thin areas were reinforced with a layer of xuan paper to compensate for the thickness. The creases were also reinforced with paper strips to avoid the risk of splitting in the future (fig. 27).

Prepare and Trim the Border Silk to Join to the Edges of the Rubbings

Plain silk was chosen instead of patterned silk for the border of the rubbings, as it created a well-balanced composition with the textured strokes of the rubbings. Plain silk was lined with xuan paper and paste and then air-dried. The lined silk was then colored with a brush and a mixture of traditional Chinese pigment and ink. Seven centimeters of silk strips were trimmed and joined to the edges of the rubbings. The ends of the silk strips were trimmed to a 45° angle at the corners.

Final Backing and Drying Process

Because the dimensions of the rubbings were so large, sheets of muslin were lined with paper as a final layer to create better support for the rubbings. Four sheets of lined muslin were



Fig. 26. Reline and flatten the rubbings.



Fig. 27. Reinforce thinness and creases to compensate for the thickness of the rubbings.



Fig. 28. Final backing and drying process.



Fig. 29. Display in the gallery at the CMA. Courtesy of David A. Brichford, The Cleveland Museum of Art.

applied onto the back of the rubbings with paste and a brush. The lined rubbings were air-dried. The next day, the rubbings were lightly sprayed with water. The four edges were pasted, and a clean lab floor was used as a drying board for the rubbings (fig. 28).

Display

For temporary display of such large rubbings, a wooden stretcher filled with sheets of Verolite board was used to reduce weight (fig. 29). In addition, see the after treatments in figures 30 and 31.

CONCLUSIONS

The rubbing technique comes from China, so some Chinese painting conservators tend to try and make them flat during the mounting process like with traditional Chinese paintings. It is important to know the rubbing process and understand that it is unavoidable to have



Fig. 30. After treatment, *Rubbing of Imperial Procession with Emperor*. Courtesy of David A. Brichford, The Cleveland Museum of Art.



Fig. 31. After treatment, *Rubbing of Imperial Procession with Empress*. Courtesy of A. Brichford, The Cleveland Museum of Art.

creases in the rubbings after remounting as the xuan paper expands and shrinks after being peeled off from the relief stone during the rubbing process. As mentioned earlier, these creases were created during the rubbing procedure. To flatten the creases will cause distortion of the image or inscription, resulting in loss of authenticity of the rubbings. The conservation project was completed successfully in eight months. The yellowing stains were much reduced, and the torn areas were reinforced and lined. The rubbings can be on display safely and should be taken off the wooden stretchers after a six-month display. Each rubbing executed from the same stone relief might record the same images or inscriptions; however, the ink is absorbed into the xuan paper differently. Similar to the concept of a print, ink rubbings are a copy of a 3D object, so there can be many rubbings from the same object. Despite being copies, each rubbing is unique and executed differently, so they should be treasured for their aesthetic value and their connection to their original objects.

ACKNOWLEDGMENTS

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NOTES

1. The exhibition was proposed for display in June 2021 for six months in the Chinese Gallery at the CMA.
2. Interview with Dr. Fletcher Coleman, 2021.

3. The wooden stretcher was probably poplar. Further identification of wood has not yet been made.

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- Lia, W., Q. Zhang, and R. Belle. 2020. *Lithic Impressions. III, From Stone to Ink on Paper*. Bruges, Belgium: Van de Wiele Publishing.

Liu, Wing-Fong. 1986. *Traditional Chinese Rubbing Techniques*. Hong Kong: Urban Council.

SOURCES OF MATERIALS

Rubbing Tools

Guo Fang Brush
223 Chang'an West Rd.
Datong District
Taipei, Taiwan 10349
+886-2-2558-0437

IKA YI-HSIA HSIAO

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A Digital Imaging Tool for Identifying Photoactive Zinc Oxide Watercolor Pigments

INTRODUCTION

Chinese white is a zinc oxide watercolor pigment made popular in the last half of the 19th century. Zinc oxide's photocatalytic properties and the resultant degradation on paper have only recently appeared in conservation literature (Hey 1987; Daniels 1990), and while zinc oxide-induced degradation in works of art on paper has been documented in various case studies (e.g., Kemp, Wise, and Hamilton 2004; Singer and Liddie 2005), some works of art on paper containing this photoactive pigment remain pristine more than a century after their creation. Variation in zinc oxide's photoactivity is tied to the variation in its UV-induced fluorescence, a well-established relationship in the literature (e.g., Winter and Whittem 1950; Klingshirn 2007; Clementi et al. 2012; Artesani et al. 2017, 2018) but one that is presently underutilized by paper conservators. Guides to pigment identification using UV-induced fluorescence typically only mention one fluorescent color for zinc oxide, and there is great disagreement between sources, with some describing fluorescence as yellow (Carden 1991; Cosentino 2014), blue (Isacco and Darrah 1993), and ranging from "orange-buff" to "bright apple green" (Nagle 1928, 307). This study aims to characterize the UV-induced visible fluorescence of zinc oxide watercolor pigments via fluorimetry and digital image analysis and tie these results to photoactivity in both mock-up and historic case study zinc oxide watercolor paints on paper. Digital image analysis of artworks illuminated by various wavelengths of light is a common practice among conservators and a low-cost method of identifying artists' materials, and while other methods are needed to verify the results of this preliminary identification, the method is promising for characterizing the photoactivity of zinc oxide pigments in artworks where its presence has been verified.

Zinc oxide watercolor paints were first introduced commercially by Winsor & Newton in 1834. Marketed as "Chinese white," the newly available white pigment led to a shift away from transparent watercolor painting in England in the latter half of the 19th century. Artists utilized Chinese white for highlights or mixed it with tints to create opaque body colors, which approximated the diffusely reflecting surfaces of oil paints (Avery 2002). This new style was promoted in many artists' manuals, which were publications meant to instruct the amateur artist in painting techniques. John Ruskin was an especially popular publisher of these manuals, and his writing influenced artists both in the UK and the United States to use the new zinc oxide pigment in their watercolors (Ruskin 1858).

ZINC OXIDE PRODUCTION METHODS

Chinese white was widely regarded as a chemically stable alternative to lead white in watercolors for more than a century; however, many watercolor paintings and pastels that contain these zinc oxide pigments have become visibly degraded in both the paint film and adjacent paper support. This degradation stems from zinc oxide's semiconducting properties, which are in turn dictated by the production method used.

Zinc oxide pigments have primarily been produced by one of two production methods: the *indirect* or French method and the *direct* or American method. The methods yield pigments with different crystallite sizes and morphologies, crystallinities, and electrical surface activity leading to reactions with surrounding materials. The *indirect* method was developed in France by Stanislas Sorel and E.C. Leclair in 1840 and was the first method patented for mass-producing zinc oxide pigments (Remington and Francis 1954; Downs 1976). The method involves boiling zinc-containing ore, then igniting the zinc vapor in an oxygen-rich atmosphere and collecting the resultant pigment in a series of hoppers, which gather pigments of similar density and quality. These pigment crystallites range from 30 to 2000 nm in size, are nodular in

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shape, and have good crystallinity. The abundance of oxygen in the ignition chamber ensures a near-perfect 1:1 ratio of zinc-to-oxygen ions in the resultant pigment (Fleury 1912; Moezzi, McDonagh, and Cortie 2012). Although the pigments produced by this method in the 19th century could be made in abundance and with very high purity and bright white color, they remained too expensive for the American market.

The *direct* method of pigment production was developed in 1850 by the New Jersey Zinc Company to bypass the need to import zinc oxide pigments from France at great expense. They developed their production method by roasting zinc ores in a coal bed, resulting in zinc vapor and carbon monoxide. These were oxidized in an ignition chamber to produce zinc oxide and carbon dioxide. These pigments particles were needle-like and larger than *indirect* method particles, as well as lower in purity and less white but cheaper to produce. These pigments also had more surface defects, favoring an abundance of zinc ions as oxygen was only introduced at the end of the production process (Auer, Griebler, and Jahn 2005).

Both *indirect* method pigments and *direct* method pigments were sometimes annealed to remove impurities and improve their working properties. This annealing was often done in an anoxic chamber, which removed oxygen ions and volatile impurities from the polar surfaces (Auer, Griebler, and Jahn 2005). The literature suggests that the best pigments were annealed, with Arthur Hebert Church suggesting in his book *The Chemistry of Paints and Paintings* (1890) that the whitest, densest pigments were subjected to “powerful mechanical compression when red-hot” (135), whereas Winsor & Newton claims on their website that their 19th-century pigment was heated “to a very high temperature” that “produced the first real alternative white with good opacity” (Winsor & Newton 2011). The reason for annealing was primarily to improve working properties and opacity, although the process also ensured that pigments were not electrically active on their surfaces, a property of zinc oxide only understood in the 20th century after physicists began studying zinc oxide as a semiconductor.

PHOTOCATALYTIC PROPERTIES OF ZINC OXIDE

Zinc oxide is an *n-type* semiconductor, meaning it tends to maintain an abundance of electrons on its surface. These electrons are provided by the occupied valence orbitals of oxygen ions and comprise the valence band. When illuminated by a sufficiently energetic wavelength of light, these valence band electrons cross an energy gap into the unoccupied valence orbitals of the zinc ions where they become conductive, moving freely across the surface and filling what is known as the conductance band. After losing enough energy, they fall back to lower energy states.

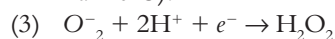
When electrons are excited into the conductance band, they leave behind a “hole” (h^+) or positively charged space in the crystal lattice. Both excited electrons and holes are free to react with adsorbed oxygen and water. Initially, two reactions occur. An oxidation reaction occurs when holes prompt adsorbed water to dissociate (Dodd et al. 2006; Jacobs et al. 2017):



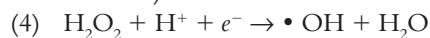
A reduction reaction involves the chemisorption of oxygen onto the particle surface via an excited electron (e^-), resulting in the creation of a superoxide (Dodd et al. 2006; Jacobs et al. 2017):



Both reactions (1) and (2) create highly reactive products in hydroxyl radicals and superoxides, which can additionally combine with another surface electron to form hydrogen peroxide (Singh, Saha, and Pal 2015):



Finally, another hydroxyl radical can form when hydrogen peroxide reacts with a proton formed in reaction (1) and another surface electron (Singh, Saha, and Pal 2015):



Surface electrons and the holes they leave behind are the primary driver of reactions (1) through (4). Annealing zinc oxide pigments removes oxygen ions from the surface, decreasing overall electrical activity and increasing both oxygen defects and defects caused by shifting of surface zinc ions into the crystal lattice or out of the crystal entirely (Wang et al. 2005; Srinivasan et al. 2008) (note 1). These defects also create energetic traps for excited electrons to fall into. These trap states are within the band gap, meaning electrons spend less time on pigment particle surfaces before relaxing into these shallow trap states. In the absence of defects, Zhu et al. found that excited electrons could participate “in possible photocatalytic reactions rather than to recombine at the shallow energy levels of planar defects” (2014, 1).

DEGRADATION IN WATERCOLORS

Reactions (1) through (4) manifest in four distinct types of degradation in zinc oxide watercolors on paper: sulfate salt formation, screening of the paper support from UV damage, browning and embrittlement of the paper support, and cracking of the paint layer.

Sulfate Salt Formation

Sulfate salt formation occurs in the presence of sulfur dioxide or sulfuric acid, common industrial pollutants that, along with water, convert zinc oxide to zinc sulfide. The hydrogen

peroxide formed in reaction (4) oxidizes zinc sulfide to form zinc sulfate mono or heptahydrate salts (Singer and Liddie 2005; Ebert, Singer, and Grimaldi 2012). These salts are deposited on the image surface in a process called *efflorescence* and can form pale halos if they are dissolved in high-humidity environments and migrate outward into the surrounding paper (Colbourne 2006) (fig. 1).

Paper Screening

Zinc oxide also screens paper from UV-induced photolysis by strongly absorbing wavelengths of light below ~ 390 nm (Stutz 1925; Bacci et al. 2007). This is the energy required for electrons to jump into the conductance band, meaning the more UV absorbent the pigment, the more reactive. UV screening manifests as distinct changes in paper tone from dark exposed paper to lighter paper where the pigment has been applied. At the pigment boundary, the paper can become brittle and strained due to varying rates of expansion and contraction due to moisture.

Paper Browning

Paper beneath and adjacent to zinc oxide pigments can become discolored via oxidation of cellulose hydroxide side groups (Daruwalla and Narsian 1966; Conte et al. 2012). First, as in the left side of reaction (4), hydrogen peroxide and an electron

from zinc oxide's conductance band remove hydrogen from a hydroxide side group, leaving a carbonyl and creating a hydroxyl radical. These carbonyls increase the conjugated double bonds in cellulose, leading to greater absorption of visible light.

Cracking of the Paint Layer

Cracking and loss of paint layers containing zinc oxide are common and likely caused by a combination of two processes: (1) expansion and contraction of the paint layer with changes in humidity leading to a loss of film elasticity and (2) changes to intermolecular interactions between polysaccharides resulting from hydrolysis of glycosidic bonds in the gum medium. A combination of acids in the aged papers, UV light, repeated exposure to moisture and drying, and oxidative products described in reactions (1) through (4) likely work together to reduce elasticity in the paint layer. Monosaccharides themselves appear to be very stable and do not change composition or structure with age (Bonaduce et al. 2007; Riedo, Scaroni, and Chiantore 2013).

FLUORESCENT PROPERTIES OF ZINC OXIDE

The same process of excitation and relaxation of electrons that catalyze reactions (1) through (4) can also cause the emission of a photon in a process known as fluorescence.

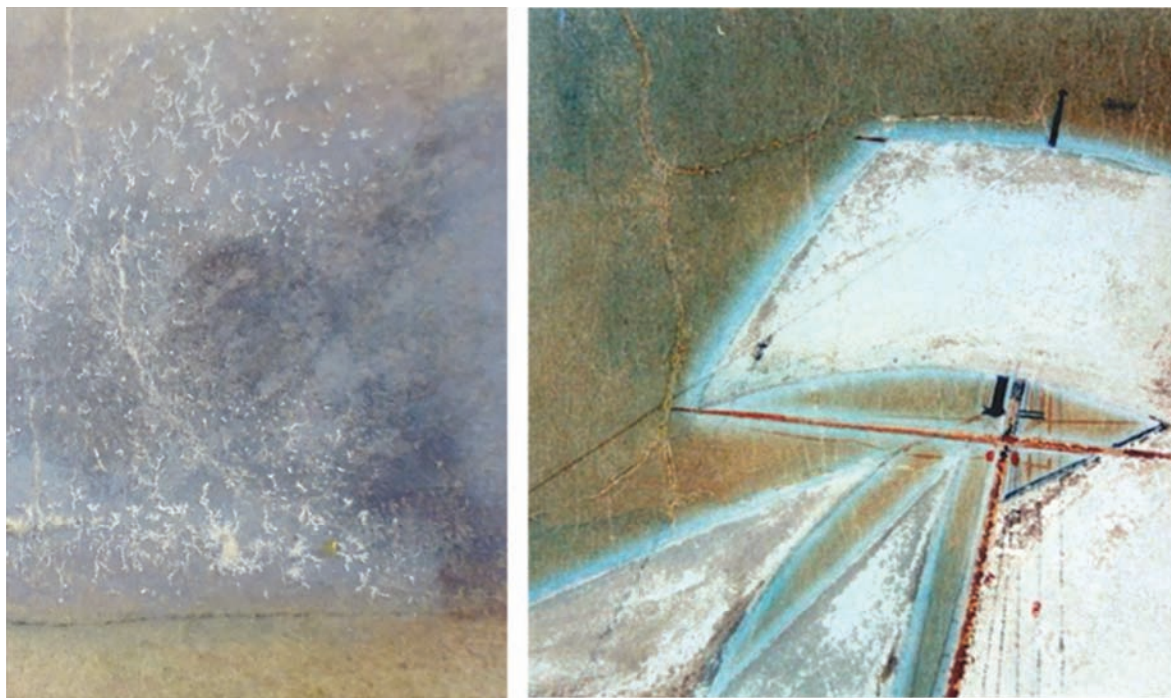


Fig. 1. *Left*: Detail of *General View of St. Mary's Cathedral, Iona* with sulfate salt efflorescence visible as needle-like blooms on the painting's surface. *Right*: Zinc sulfate salts have formed and dissolved into the paper, slowing the rate of paper discoloration and creating a pale halo. From Singer and Liddie (2005).

The wavelength of the emitted photon is proportional to the energy gap crossed upon relaxation. This energy is either the energy of the gap between the conductance and valence bands, known simply as the band gap, or the energy of the gap between the conductance band and a trap state, which in zinc oxide tends to be a lower energy than the bandgap energy. Both types of relaxation are associated with a color of fluorescence, whereas the perceived overall fluorescence is a combination of these two fluorescent colors.

Near-band-edge (blue) fluorescence. Electrons relaxing across the bandgap emit a blue-colored light centered at between ~370 and 390 nm (Chen et al. 2011; Bandopadhyay and Mitra 2015; Artesani et al. 2018). Called the near-band-edge emission, this blue fluorescence is associated with pigments containing fewer defects, as it results from transitions between zinc and oxygen ions. Additionally, this fluorescence emits primarily from one polar surface, indicating that it is more prominent in pigments with shorter crystallite lengths (Fabbri et al. 2014). Both pigment crystals with fewer defects and smaller, shorter crystallite lengths are typical traits of pigments produced by the *indirect* method of production.

Green fluorescence. Additional “trap” states formed by crystal defects and impurities (Van Dijken et al. 2000) cause electrons to relax to energy levels closer to the conductance band, resulting in a longer emitted wavelength. These longer wavelengths are broad bands in zinc oxide that appear green in color. Oxygen vacancies and zinc interstitials, or zinc ions in positions they do not normally occupy, have been linked with this green fluorescence (Kröger and Vink 1954; Janotti and Van de Walle 2009) and with shorter excitation times (Zhu et al. 2014; Penfold et al. 2018). These defects are common in pigments produced by the *direct* method and occur along the long *c* axis of the crystallite, meaning the longer particles typical of this process increase the contribution of green fluorescence (Fabbri et al. 2014). Additionally, annealing both *direct* and *indirect* pigments tends to reduce the blue fluorescence by increasing defects, causing a greater green contribution to overall fluorescence.

DIGITAL IMAGING IN CONSERVATION

Establishing the relationship between fluorescence and photoactivity prompts the question of utility for conservators who wish to use this information to prevent photocatalysis in watercolors containing zinc oxide. A fluorimeter could allow a conservator to compare the intensity of the blue and green peaks quantitatively but is not readily available to those conservators working privately or in smaller institutions. Digital imaging methods present a promising alternative, as they are already widely used to characterize fluorescing materials in artworks illuminated by UV light. Zinc oxide watercolors present good candidates for fluorescence analysis, as they

do not generally contain varnish layers and the minor fluorescence of polysaccharide binding media is typically far less intense than the pigment fluorescence.

Several factors complicate digital imaging methods of characterizing UV fluorescence. Variations in digital image capture standards can lead to miscommunication about a pigment’s fluorescence, whereas different camera sensitivities can lead to variations in perceived color. Paper fluorescence can also interfere with characterization of pigment fluorescence, as watercolor paints are by their nature always semitransparent, even when heavily applied. Regardless, the error introduced by these complications may not be so great as to invalidate the utility of the method.

METHODOLOGY

The following methodology was carried out to assess the viability of a digital imaging method for determining whether a zinc oxide pigment is relatively inert or highly photocatalytic. It first aimed to link rates of photocatalysis with fluorescence, then determine how reliably fluorescence could be linked with photocatalysis, thus gauging the utility in this case of digital imaging as a predictive tool.

Creation of Mock-Ups

Mock-up samples were created using three types of paper substrates and eight pigments in gum arabic binding medium. Whatman #1 filter paper was chosen because it is free from fillers and additives and contains only cotton fibers. A naturally aged (~40 years) highly sized Fabriano NOT (cold-pressed) cotton rag watercolor paper was also selected because it contained a fluorescent calcium carbonate filler as well as cotton and linen fibers that would not themselves contribute additionally to fluorescence. Finally, a mid-19th-century wove, mixed-fibered handmade paper from a folio was used because it did not contain fluorescent fillers but rather wood pulp and discolored, acidic degradation products.

All pigments were added to a 1:4 w/v mixture of Cornelissen-supplied gum arabic in distilled water, a ratio suggested by Seymour (2007). In addition, 0.2 g of pigment were added for every 1.5 mL of gum water. This produced a pigment-rich paint that resisted cracking and flaking upon drying. This was applied to a 1 × 2 cm square area.

The eight pigments studied are listed in figure 2 and represent three analytical grade *indirect* method pigments, three analytical grade *direct* method pigments, and two commercially sourced artists’ pigments. A contemporary Winsor & Newton Chinese white was initially included in this study but was abandoned because it contained titanium dioxide, making it difficult to compare with other pigments and historic case studies. A control sample was painted onto all papers consisting of the gum arabic water.

Production Method	Sample Number	Pigment
<i>Indirect</i>	1	Zinc oxide red seal from Norkem Limited
	3	Zinc oxide high purity from Norkem Limited
	4	Zinc oxide white seal, code 28170000 from Bruggemann Chemical, Ludwig, Germany
<i>Direct</i>	6	Zinc oxide American Process from Norkem Limited
	7	
	9	Zinc oxide 2011 from Grillo-Werke AG Zinc oxide spezial, code 28170000 from Bruggemann Chemical, Ludwig, Germany
Unknown	15	Kremer Pigments Zinc White 46300
	16	Cornelissen Zinc White

Fig. 2. Mock-up pigments and production methods.

Case Studies

Five watercolor paintings from the mid-19th to early 20th century were studied and compared with mock-ups. Three pieces were visibly degraded due to zinc oxide pigments, whereas two did not appear to be affected by the presence of the pigment. These case studies are listed in figure 3. All case studies were confirmed to contain zinc oxide via energy-dispersive x-ray analysis of zinc and sulfur ions. A high zinc-to-sulfur ratio verified that the pigments were oxides and not sulfides or sulfate salts.

Particle Size and Morphological Analysis for Determining the Production Method

Crystallites, or individual crystals making up zinc oxide pigment particles, were measured for all mock-up samples and for three case studies: *S.S. Buda*, the ruin drawing, and the watercolor by Thomas Harper. This was to provide a point of comparison between unknown case study and mock-up pigments and mock-up pigments produced by known methods. Given the extremely small size of zinc oxide crystallites, a TESCAN MIRA3 scanning electron microscope was utilized to collect images of powders and in situ pigments using the secondary electron detector. Crystal morphologies were also characterized using four characteristics: pyramidal ends, rod-like shape, nodular or round crystallites, and acicular or needle-like crystallites.

Crystallites were measured in ImageJ using its scale and measure functions. Lengths and diameters were measured for 100 crystallites from each pigment and calculations carried out

assuming cylindrical geometry. Size values were obtained by calculating the cube root of volume. A similar method was carried out by Li and Haneda (2003), who measured 200 crystallites in the same way to obtain size ranges for zinc oxide pigments.

Inducing Photocatalysis in Mock-Ups

Samples were exposed to light in a Q-SUN Xenon Test Chamber Xe-1 light aging machine with a xenon arc lamp tungsten bulb (1800 W). The temperature inside the machine was moderated at 25°C. Two UV filters were used, a Daylight Q and Window Q filter, which approximate indoor conditions and restrict the UV light present. The machine was calibrated to 1.1 W/m² at 420 nm. Mock-ups were placed on top of a layer of Gore-Tex, which allowed gradual humidification from a triple layer of dampened Whatman #1 filter paper. All test samples were exposed to a total of 50 hours of light (note 2) in 5-hour increments, with rewetting of Whatman paper occurring between each exposure. Samples were dried overnight between increments. This was partly out of necessity because the light aging machine could not be run overnight but would also induce deterioration to the paint layer by expanding and contracting the paint layer and paper substrate.

Characterizing Degradation Visually and with Russell-Grams

After light exposure, any visible degradation in mock-ups was documented and compared with case studies. Additionally, peroxides were detected on samples after light exposure using Russell-grams, a technique first described by Russell (1908).

Date	Title	Artist	Type of Visible Degradation	Collection
Early 20th century (dates unknown)	<i>Bouquet of Flowers</i>	Irene Kendal (dates unknown)	Paint cracking and cupping, areas of paint loss	National Trust, UK
Dates unknown (late 19th century)	<i>General View of St. Mary's Cathedral, Iona</i>	Unknown	Sulfate salt conversion, paper browning	Historic Environment Scotland
1899	<i>S.S. Buda</i>	George Thompson (dates unknown)	Sulfate salt conversion, paint loss, paper masking, halos	Private
Mid-19th century	<i>View of the River Coquet</i>	Thomas Harper (1820–1889)	None	Laing Gallery, Newcastle Upon Tyne
Late 19th century	Ruin drawing (title unknown)	Unknown	None	Study collection at Burt Hall, Northumbria University

Fig. 3. List of case studies and visible degradation.

This technique involved sensitizing lithographic film with a 1.5% ammonium hydroxide solution, then placing the dry film emulsion-side down over the mock-ups in a Russell-box (fig. 4). Any peroxides formed on the zinc oxide surfaces reduced the silver nitrate in the film, resulting in a dark, exposed area corresponding to areas of degradation (Russell 1908; Daniels 1986). The film was exposed for 36 hours, then developed with a 1:1 mixture of Kodak Xtol with water, agitated for 6 minutes, then fixed in a 1:4 solution of Structurix fixative with water and finally rinsed for 15 minutes. The resulting image was high contrast and clearly mapped areas of peroxide formation.

Fluorimetry

Emission spectra were collected for mock-up samples on Whatman and folio paper using a Horiba FluoroMax 4 spectrofluorometer with excitation wavelength of 325 nm, slit

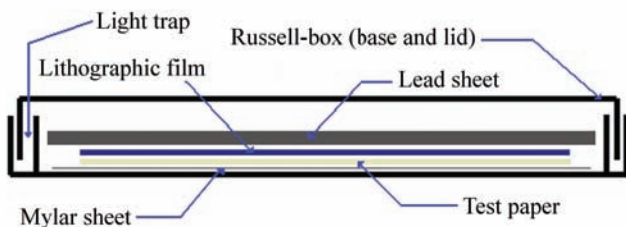


Fig. 4. Schematic for Russell-gram, following established method by William J. Russell (1908).

opening of 2 nm, an output range of 335 to 640 nm, and a 60° angle of detection. Spectra were corrected for dark count by dividing the counts per second by microamps as measured by the reference detector. An average spectrum was created from the three spectra collected with highest return, as this represented the thickest painted regions. Minimum values were subtracted to correct the baseline, and area was normalized to 1 to facilitate peak area comparisons. The range of wavelengths was limited from 370 to 640 nm for *indirect* and commercial pigments and from 380 to 640 nm for *direct* method pigments, as this eliminated noise to either side of the main two peaks.

The processed spectra were analyzed using an Interactive Peak Fitter developed by Professor Tom O'Haver at the University of Maryland for use in MATLAB. Two Gaussian peak shapes were input and the peak fitter returned component peaks, as well as peak locations, heights, areas, R² values, and error percentages. These were compared among mock-ups to identify trends.

Digital Imaging

Mock-up samples. Mock-up samples were imaged in a blacked-out room using a Canon EOS 6D digital camera with a CMOS imaging chip with a built-in IR filter and fitted with a Kodak Wratten 2e UV-cut-off filter over the lens that cut out wavelengths below 400 nm. Two Narva LT 36W/073 black-light blue UV lamps supplied light at 365 nm and were set up at 45° angles to the sample at about a meter distance while

Case Study	Cropped Size (pixels)	Exposure (seconds)	f/stop	Camera Distance (m)	Camera	Light Source
Irene Kendal	67 x 104	1	8	2	Canon 6D	Narva UV
Thomas Harper	731 x 434	0.5	5	1	Canon 6D	Narva UV
S.S. Buda	17 x 18	15	8	2	Canon 6D	Narva UV
St. Mary's	JC4 – 435 x 477 JC7 – 238 x 230	NA	NA	0.1	Huawei cell phone camera	365-nm UV torch, fluorescent room light
Ruin drawing	57 x 72	8	8	2	Canon 6D	Narva UV

Fig. 5. Case study image acquisition parameters.

the camera was placed 23 cm from the sample. Exposure time was maintained at 0.5 seconds, white balance at 8000K, and ISO at 200. F-stop was adjusted for each paper type to avoid overexposure and was set to the following: 5.0 for Whatman paper, 6.3 for Fabriano paper, and 4.5 for Folio paper.

Images were cropped to 869×674 pixels and nonpigmented areas subtracted in ImageJ using a background subtraction methodology outlined in the appendix. RGB pixel intensity values were extracted, and both mean and median values for each channel were obtained in MATLAB. Normal distribution was assured by comparing the two values. Mean green intensity values were divided by mean blue intensity values from the same sample to characterize fluorescence from digital image data and determine if changes to these ratios occurred with light exposure or correlated to degradation.

Case studies. Imaging parameters for case studies varied, as they could not always be imaged in the photographic studio used for mock-up image acquisition. ISO was maintained at 200, but other parameters changed. These are shown in figure 5. Images were processed like mock-ups, although fluorescing areas were cropped to exclude paper, and therefore background subtraction was unnecessary.

RESULTS

Determination of the Production Method

Mean size values yielded a clear trend with all unknown pigments appearing most like analytical *indirect* method zinc oxides (fig. 6). This included both commercial artists' pigments and pigments from three of the five case studies. Two

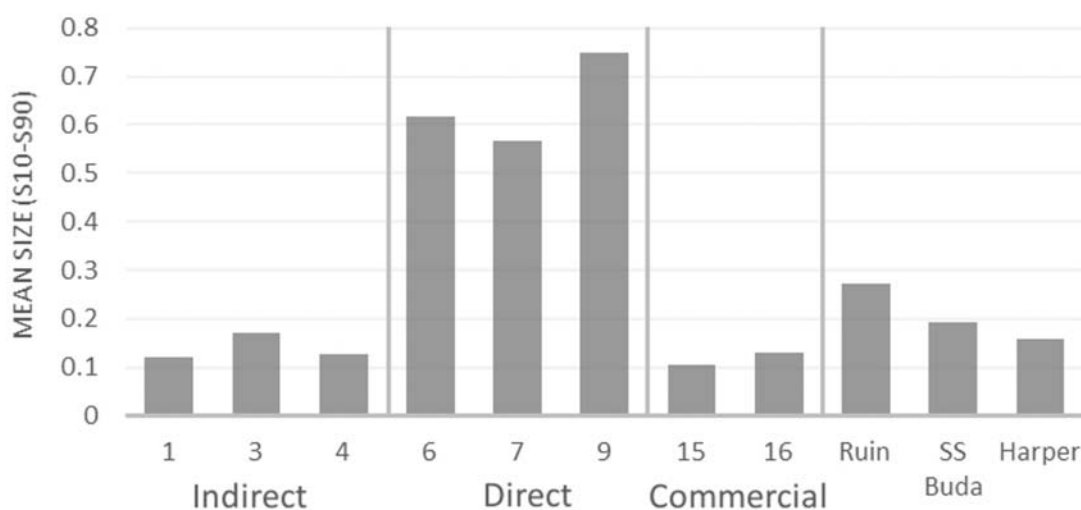


Fig. 6. Mean crystallite sizes for mock-up pigments and three case study pigments. Means exclude lowest and highest 10% of particles to eliminate skewing by outliers.

Sample	Pyramids	Rod-Like	Nodular	Acicular
1		•	•	
3		•	•	
4		•	•	
6	•	•		•
7	•	•		•
9	•	•		•
15		•	•	
16		•	•	
Ruin drawing		•	•	
Thomas Harper			•	
S.S. Buda			•	

Fig. 7. Morphologies of mock-up and case study crystallites.

case studies could not be analyzed, as the pigments were too embedded in the binding medium for clear analysis.

All unknown pigments were also morphologically like *indirect* method zinc oxides, shown in figure 7 as samples 1, 3, and 4. Nodular pigments are typical of *indirect* method paint pigments (Morley-Smith 1950, 1958) and were not found in any *direct* method samples, shown as 6, 7, and 9.

Russell-Grams

Only zinc oxides on Whatman paper imaged well using the Russell-gram technique, whereas other papers tended to image as black as the pigments. Two of each *indirect* and

direct method analytical samples were imaged as well as both commercial artists' pigments. Developed images of these samples after 50 hours of light exposure showed very little to no peroxide formation on *direct* method pigments, whereas *indirect* method and commercial pigments both imaged darkly, indicating high levels of peroxide formation (fig. 8).

Visual Signs of Degradation

Two visible signs of degradation were observed in mock-ups after light exposure: paper browning and paint cracking. Browning was observed only on Whatman paper mock-ups, which all browned except *indirect* pigment 1. Browning on the verso was most severe for *indirect* samples 3 and 4. Paint cracking occurred in all samples on Fabriano and Folio papers except for commercial pigment 15 on Fabriano paper. Gum arabic control areas did not visibly change after light exposure.

Fluorimetry

Peak area ratios were calculated by dividing the areas of the green peaks by the blue peak areas. Doing so divided samples into two types: type 1 ratios were at or below 5 and included all but one *indirect* sample, including commercial pigments. Type 2 had ratios above 6, typically greater than 10, and included all *direct* method samples and *indirect* sample 1 (fig. 9). These ratios typically decreased in type 1 pigments and increased for type 2 pigments, except for *indirect* sample 3 on Whatman in the former case and *indirect* sample 1 on Whatman in the latter. *Direct* method sample 9 had a ratio in the hundreds due to the nearly complete absence of any blue peak.

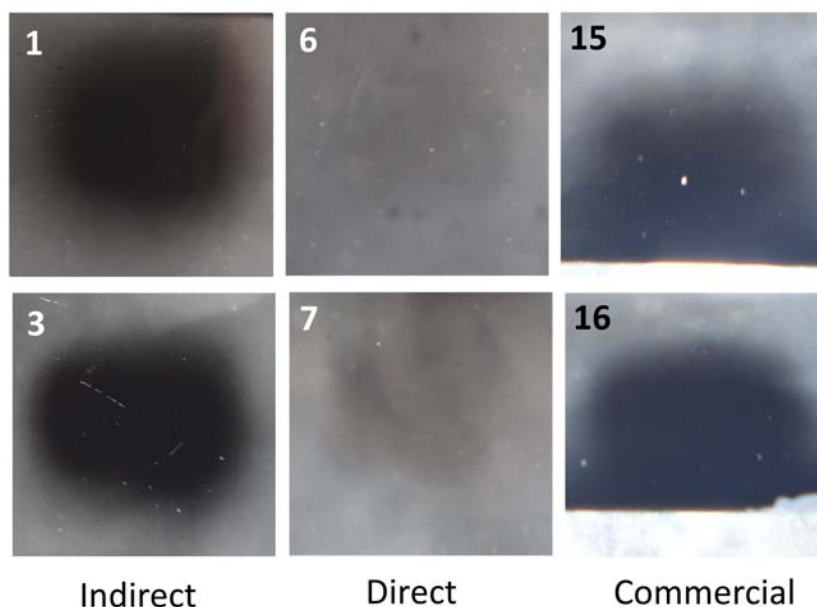


Fig. 8. Russell-grams of mock-up samples. Areas of peroxide formation image black.

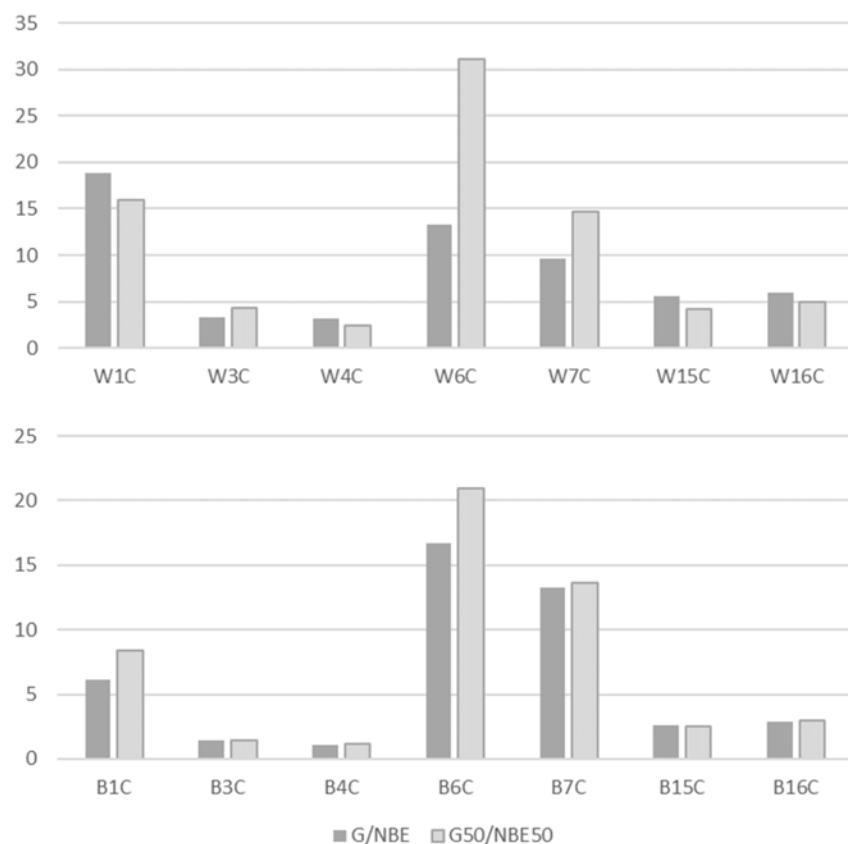


Fig. 9. Ratios of green-to-blue (near-band-edge or NBE) peak areas calculated using Tom O'Haver's Interactive Peak Fitter. W = Whatman #1 paper, B = Folio paper. Dark gray bars = unexposed samples, and light gray bars = after 50 hours of light and moisture exposure.

The two types were also distinguishable by peak shape. Type 1 contained a distinct blue peak of much higher intensity than the green peak, whereas type 2 contained a small blue peak and a strong green peak. Only *indirect* method pigments are represented by type 1, whereas type 2 contains all *direct* method pigments and one *indirect* method pigment (fig. 10).

Digital Image Analysis

Whatman paper mock-ups. Green/blue color channel ratios increased after light exposure for all pigments on Whatman paper except the control gum on paper, which decreased. This indicates that the increase was due to changes to the pigment and not the paper substrate. The green/blue ratios also grouped the pigments into the same two fluorescent types, as were observed using fluorimetry, apart from sample 9, which was grouped with type 1. This first type had a ratio below 1.7, whereas type 2 pigments had ratios over 1.7 (fig. 11).

Fabriano paper mock-ups. Changes in fluorescence on Fabriano paper after light exposure varied, and visible changes to

pigment fluorescence were less obvious than the paints on Whatman paper. The two fluorescent types were still discernible, with type 1 maintaining ratios below 1.6 and type 2 above 1.6 (fig. 11)

Folio paper mock-ups. Green/blue ratios consistently decreased after light exposure for all pigments on Folio paper except *indirect* method sample 1. This trend was also seen in the control gum arabic painted onto Folio paper. This indicates that the decrease is likely due to the paper and not the pigments themselves in most cases. Green/blue ratios fell at or below 1.6 for type 1 pigments including sample 9, whereas Type 2 were above 1.6 (fig. 11).

Case studies. All green/blue ratios calculated from case studies were less than 1.6. The lowest ratios were from *General View of St. Mary's Cathedral, Iona*, followed by the Irene Kendal watercolor, then *S.S. Buda*, the ruin drawing, and finally the Thomas Harper piece with the highest ratio (fig. 12).

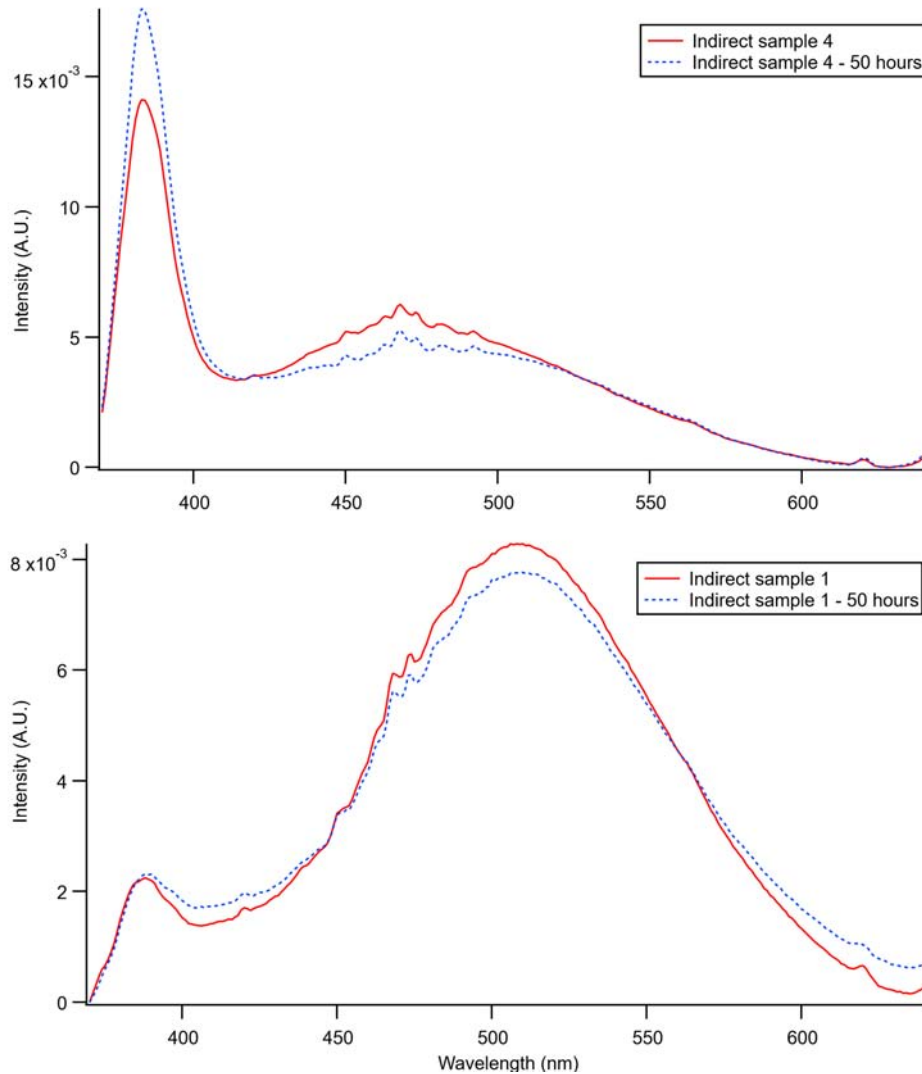


Fig. 10. Typical emission spectra for type 1 (top) and type 2 (bottom) pigments.

DISCUSSION

Relationship Between Fluorescent and Degradation Types

A strong negative correlation of -0.805 was found between the green/blue sRGB color channel ratios from Whatman paper and peroxide formation. Although the data set is small, this indicates that digital imaging may be a reliable indicator of photoactivity. Browning did not correlate well with green/blue sRGB color channel ratios, a trait that may be explained by the role of paper size in degradation type observed. Irradiated mock-ups on Whatman paper exhibited paper browning, whereas paints on Fabriano and Folio cracked after irradiation. This pattern of degradation is observable in those case studies in which the pigments have sunk into the page or appear to sit within the fibers. These pigments have, over time, caused browning of the paper,

as in the case of *General View of St. Mary's Cathedral, Iona*. Irene Kendal's *Bouquet of Flowers* instead has severe paint cracking and loss. The type of degradation observed in photoactive pigments appears to be related to the degree of sizing in the paper sheet on which it has been painted. Where pigment sinks into paper fibers, these fibers interact more readily with peroxides forming on pigment surfaces and oxidize, eventually becoming brown. Sized papers are somewhat protected by the paint layer itself that sits primarily on top of the paper sheet and forms peroxides on the exposed surface of the paint film. These reactions, along with wet-dry cycles, cause cracking, cupping, and pigment loss.

Standardizing Acquisition Parameters and Processing Methods

Further development of an image processing tool requires standardization of image acquisition parameters. Dyer, Verri,

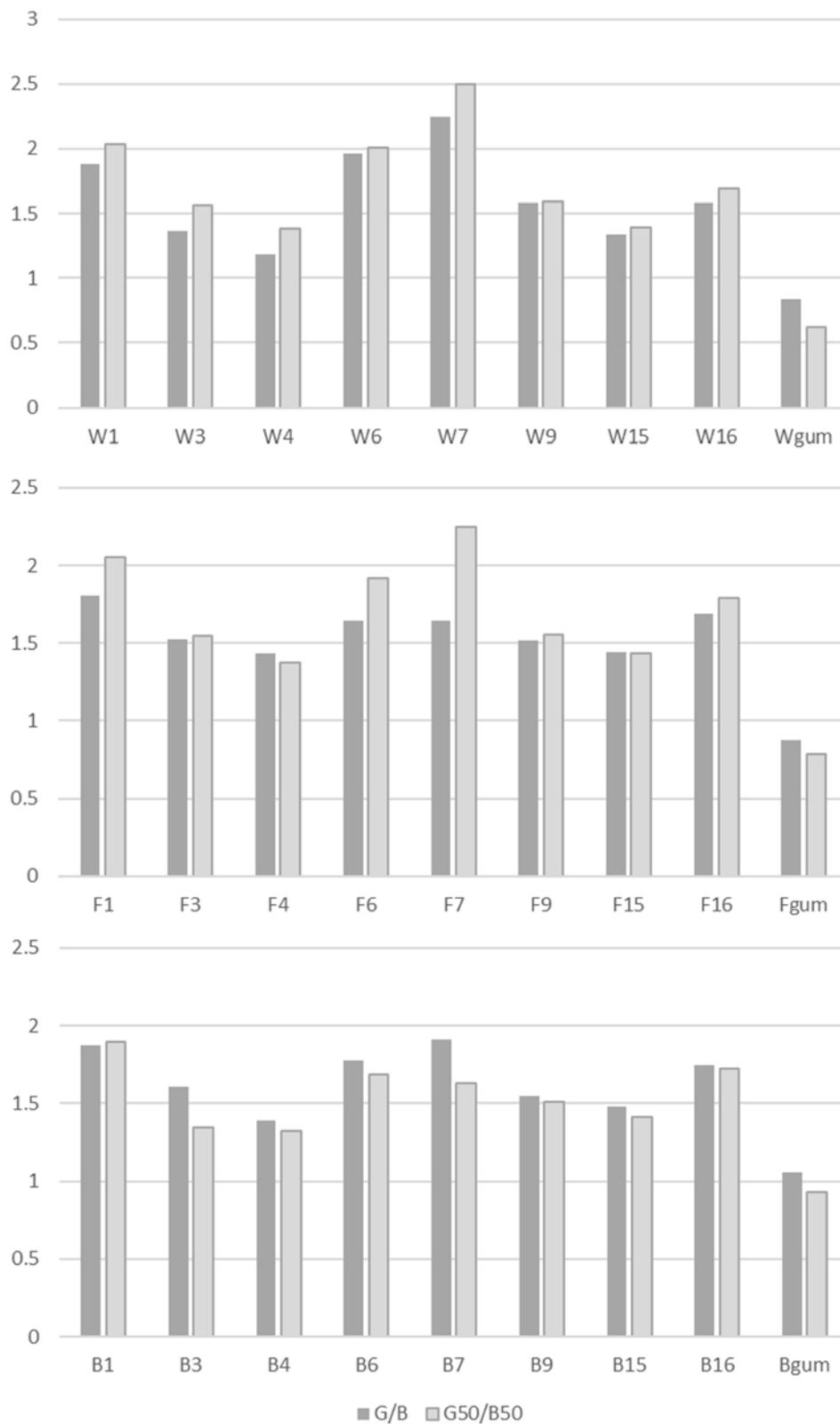


Fig. 11. Ratios of green-to-blue sRGB color channel ratios from digital images of mock-up samples. W = Whatman #1 paper, F = Fabriano paper, B = Folio paper. Dark gray bars = unexposed samples and light gray bars = after 50 hours of light and moisture exposure.

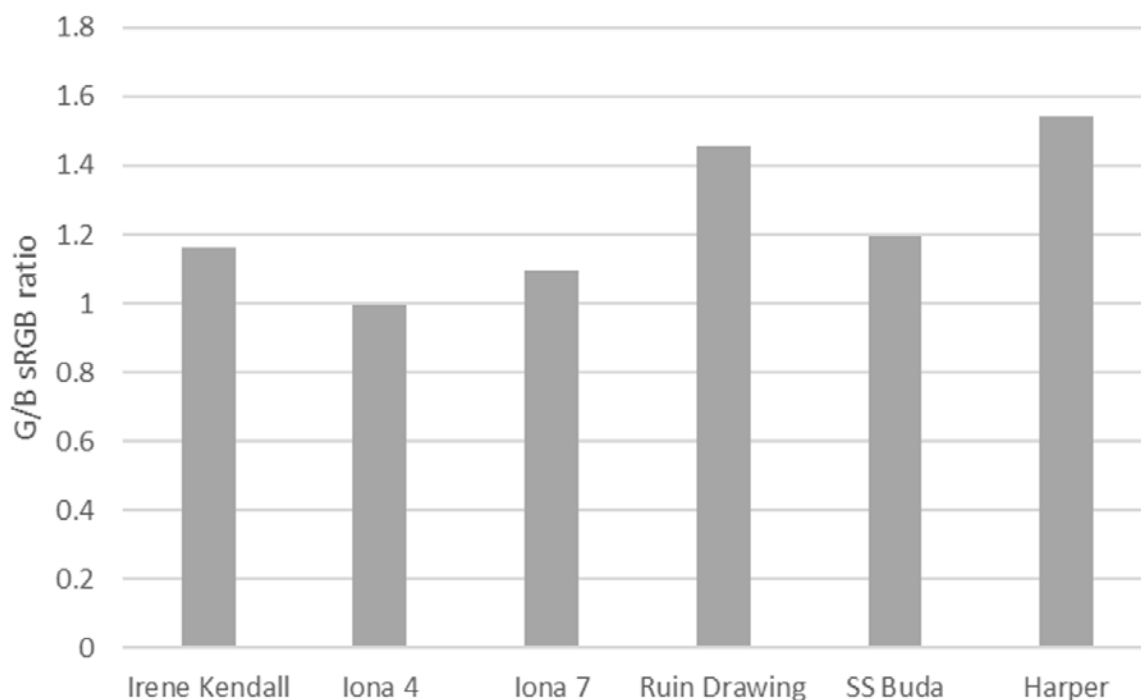


Fig. 12. Ratios of green-to-blue sRGB color channel ratios from digital images of case studies. Iona 4 and Iona 7 were both collected from *General View of St. Mary's Cathedral, Iona*.

and Cupitt (2013) outlined an ideal workflow for acquiring and processing UV-induced visible fluorescence digital images:

1. Image capture
2. Correction for uneven surface illumination
3. Correction for camera response using a Macbeth color chart in visible light
4. Correction for ambient light
5. Correction for changes to fluorescence due to pigment-binder interactions

Standardizing UV lighting and UV-cut-off filters is a simple first step, as is eliminating other light sources from the image acquisition area. Following procedures for steps 2 through 4 will eliminate most contributions to differences between imaging setups. Step 5 accounts for interfering fluorescence from binders and substrates. Inputs from UV reflectance grayscale references were input by Dyer, Verri, and Cupitt (2013) into a modified Kubelka-Munk equation to correct images pixel by pixel. This method was utilized effectively to obtain qualitative data for opaque paint layers but presents issues when applied to watercolors. In theory, the absorption coefficient in the Kubelka-Munk equation allows for image correction of semiopaque paint layers,

but this coefficient cannot be determined for watercolors, as it requires a thickness value. Watercolor paints permeate the paper substrate and do not form cohesive layers that can be measured for thickness. A correction for fluorescing underlying paper may not be possible utilizing the Kubelka-Munk equation given this complication. Rather, an image processing method may require that paper substrates not be overly fluorescent in comparison to applied paints. Given that paper fluorescence appeared to reduce significantly with light exposure, and that historic case study papers were not very fluorescent, historic artworks may not in fact suffer from the complication presented by a highly fluorescent substrate. Even if a zinc oxide watercolor wash were semi-transparent, the intensity of its fluorescence compared with the substrate may in fact allow for image processing using green/blue sRGB color ratios.

Current Pigment Manufacturing Trends

All commercial artists' pigments in this study and analyzed case study pigments proved to be produced by the *indirect* method of production. Although it has been established that these pigments tend to be photoactive and that annealing can in fact reduce the photoactivity of zinc oxide, the commercial pigments studied do not appear to be annealed. Additionally, the permanence rating for watercolors is still based on the

tendency to fade, a metric that cannot be applied to a white pigment. Winsor & Newton give zinc oxide a permanence rating of AA, or Extremely Permanent. No mention is made of its photoactivity, which is somewhat understandable, although as mentioned earlier, the site does reveal the company's practice of heating zinc oxide pigments "to a very high temperature" in the 19th century (Winsor & Newton 2011). Golden similarly strives for quality in their paints, assigning permanence ratings to their watercolors based on the ASTM light-fastness scale, but again this scale only accounts for fading (Golden Artist Colors 2016). The idea of permanence in watercolors may need to be re-evaluated for photoactive white pigments such as zinc oxide.

Although tempting, replacing *indirect* pigments with *direct* method pigments in watercolors is not entirely preferable due to the latter's greenish hue. Instead, an annealed *indirect* method pigment may present the best option for watercolor paint manufacturers. *Indirect* method sample 1 was the only pigment that did not cause browning on Whatman paper, although it did show signs of peroxide formation. It is a lower-purity grade *indirect* method pigment with a similar fluorescence to *direct* method pigments, being the only pigment in the type 2 fluorescence grouping. Importantly, it had excellent whiteness and dispersed well in gum arabic. Such a pigment could present a model for paint manufacturers wishing to produce less photoactive pigment. Although this pigment did crack on highly sized papers, this may be due to the absence of a humectant in the mock-up paints. Watercolors often include glycerine or honey, which can mitigate the issue of paint cracking, although these were excluded from test paints to simplify paint mixtures and reduce interference from fluorescing or UV-absorbing media.

Implications for Storage and Display

Dark storage is standard for paper artworks, as is maintaining relative humidity levels around 50%. Unfortunately for conservators, reoxygenation of zinc oxide surfaces has been documented in the dark, occurring as atmospheric oxygen takes up the position of surface oxygen vacancies. This replenishes valence band electrons and reduces trap states, increasing conductivity (Bao et al. 2011; Gurwitz, Cohen, and Shalish 2014). The extent of this effect is not known, although it has not been reported that the crystal is completely reoxygenated, nor that it converts pigments with an excess of defects into highly photoactive pigments with strong blue fluorescence. As such and given light's role as the main energy for degradation reactions (1) through (4), dark storage is mostly advantageous for watercolors with zinc oxide pigments.

It is tempting to recommend anoxic storage and display to mitigate this reoxygenation, although studies indicate that by removing adsorbed water and oxygen from pigment surfaces, anoxia increases surface electron accumulation (Brown 1957; Gurwitz, Cohen, and Shalish 2014). Townsend et al. (2008)

reported an increased rate of yellowing and embrittlement of paper in the presence of conductive pigments, whereas pigments such as Prussian blue, vermilion, purple madder, and sepia have been reported to fade in anoxia (Townsend et al. 2008; Thomas 2012; Ford 2014; Lerwill et al. 2015). The risk of reoxygenation in dark storage is not so great as the risk to paper and other pigments in anoxia, and therefore the latter is not recommended for zinc oxide regardless of its level of photoactivity.

Display conditions must primarily reduce exposure to intense levels of light, as intense lighting may result in prolonged peroxide formation. The process of obtaining materials for Russell-grams meant that six months elapsed between light exposure and collection of data, and yet peroxide formation was still easily detected on the more photoactive *indirect* method pigments. Low or intermittent moderate lighting is therefore recommended for the display of zinc oxide-containing watercolors.

Although UV light is the primary catalyst for zinc oxide's photoactivity, conductivity is still measurable on the pigment surfaces when illuminated by visible wavelengths of light as demonstrated by Gurwitz, Cohen, and Shalish (2014) (fig. 13). Overall reduction of light intensity and exposure is vital to reduce this conductivity and the persistent peroxide formation associated with it.

Additional complications are presented by museum lighting recommendations that utilize the lux or foot-candle unit, one which only accounts for the intensity of visible wavelengths of light. The shift to LED lighting simplifies lighting concerns, as they do not contain the UV and IR components present in incandescent or fluorescent lighting. They are also tunable, allowing for the reduction of blue wavelengths if desired. Implementation guidelines

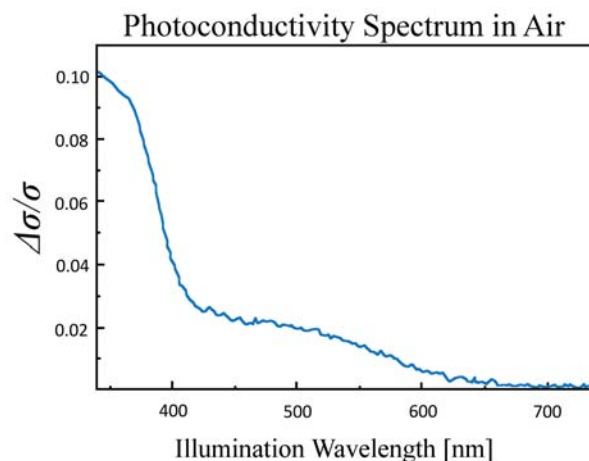


Fig. 13. Measured conductance on zinc oxide surfaces when illuminated by various wavelengths of light. Conductivity is reduced but maintained when illuminated by visible wavelengths. Figure credit: Gurwitz, Cohen and Shalish 2014.

for LED lighting are readily available (e.g., Weintraub 2010; Druzik and Michalski 2012; Perrin, Druzik, and Miller 2014), as are methods for replicating original illumination conditions if a museum wishes to display a piece in similar lighting to the time period in which it was produced (Cuttle 2000; Schanda, Csuti, and Szabó 2015). Historic lighting has the added benefit of tending to have a lower blue contribution. As demonstrated by Gurwitz, Cohen, and Shalish (2014), lower intensity lighting tending toward yellow and red wavelengths will reduce surface conductivity and photocatalytic reactions on zinc oxide pigment surfaces.

CONCLUSIONS

This study has connected the varied fluorescence of zinc oxide pigments in watercolors with their variable photoactivity and resulting degradation of paint films and paper substrates. The relationship between production method and photoactivity was explained, with *indirect* method pigments dominating in historic examples but suffering from higher rates of photoactivity due to their low defect concentration. Evidence in the literature suggested that pigment manufacturer Winsor & Newton likely annealed their pigments to improve working properties, unknowingly increasing defect concentrations in the process and reducing photoactivity.

Distinct size differences between production methods allowed for the production method of unknown study pigments to be identified via crystallite size analysis. Modern commercial pigments compared well with *indirect* method analytical zinc oxides (commercial pigments at 0.105–0.131 μm and *indirect* analytical pigments at 0.121–0.170 μm). Sizes measured from three case studies also indicated an *indirect* production method (Harper at 0.159 μm , S.S. Buda at 0.193 μm , and the ruin drawing at 0.271 μm). Contemporary and case study pigments were also morphologically similar to analytical *indirect* zinc oxides, being short and nodular in shape rather than needle-like as is typical of *direct* method zinc oxides.

Visible signs of degradation took two forms in mock-up samples after exposure to light and moisture for 50 hours. Browning of the paper substrate behind and adjacent to pigments was observed for all samples on Whatman #1 filter paper, whereas all samples except commercial pigment 15 cracked on sized Fabriano and Folio papers. Zinc oxide pigments generally caused browning of the paper when the paint had sunk into the paper fibers, as seen in unsized Whatman #1 filter paper samples and *General View of St. Mary's Cathedral, Iona*. Paints on highly sized papers such as Fabriano and Folio mock-up papers experienced cracking and loss of media, also observed in Irene Kendall's *Bouquet of Flowers*. Although all mock-up pigments experienced browning on Whatman paper and cracking on sized Fabriano and Folio papers, these

effects were most severe for *indirect* samples 3 and 4, both high-purity analytical-grade zinc oxides.

Both fluorimetry and digital image analysis grouped pigments into two types. Type 1 pigments included *indirect* pigments 3 and 4 and the commercial artists' pigments. They were characterized by low green/blue ratios and a green peak centered at 460 to 485 nm (Zhu et al. 2014), a peak location associated with low defect concentrations and high photoactivity (Zhu et al. 2014). Type 2 pigments included *indirect* pigment 1 and all *direct* method pigments except in digital image analysis when sample 9 was grouped with type 1 pigments. Type 2 contained a green peak at 500 to 515 nm, a location associated with high defect concentrations and low photoactivity. Type 1 pigments tended to be those that degraded most severely in mock-ups, whereas type 2 did not. Additionally, Russell-grams for type 1 pigments imaged darkly while type 2 did not, apart from *indirect* sample 1, which still produced surface peroxides but did not cause paper browning. Case studies followed the trend established by mock-ups. Paintings without visible signs of degradation had high green/blue sRGB color ratios, whereas those with degradation due to zinc oxide pigments had lower ratios.

Green/blue sRGB color ratios were relative within data sets and not consistent across paper types. Some consistency can be achieved with further refinement and standardization of image acquisition and processing methods, although methods for correcting for substrate fluorescence suffer from limitations presented by the nature of watercolor paints to permeate the paper substrate. Given that paper fluorescence appears to diminish with degradation, historic samples may not suffer from too much interference by the substrate when characterizing fluorescence. Additionally, green/blue sRGB color channels were consistently higher for type 2 pigments than type 1, indicating that these color channel ratios may provide a valuable tool for characterizing photoactivity if interfering fluorescence and quenching can be accounted for.

Low green/blue sRGB color channel ratios for case studies indicate that these have not obtained a defect concentration high enough to be in the type 2 class, indicating that even after 100 years they are still photoactive. Along with theories that zinc oxides may reoxygenate in dark storage, this finding indicates both that surface defect concentration increases very slowly and that a reaction endpoint may not be reached by photoactive type 1 pigments.

Storage for all paintings containing zinc oxide should follow general recommendations for paper. Of greatest concern are display conditions given the persistence of peroxide formation in dark storage. The literature suggests that conductance on zinc oxide surfaces is maintained even when UV and infrared wavelengths are removed from lighting. LED lighting naturally eliminates these harmful wavelengths and is tuneable, meaning the blue contribution can be reduced,

which will in turn reduce photoactivity. Reduction in lighting intensity and duration is similarly possible using contemporary museum lighting and is best practice for zinc oxides.

Although anoxic display and storage removes oxygen and moisture that would eliminate peroxide formation, anoxia should be avoided for zinc oxide-containing watercolors, as surface conductivity is increased in vacuum.

Pigment manufacturers presently do not account for photoactivity when classifying pigments for permanence, relying only on fading that does not account for white pigments. Additionally, commercial pigments in this study were *indirect* method pigments of the first, reactive fluorescent type. Perhaps future pigment suppliers could produce watercolor paints with annealed *indirect* pigments, reducing photoactivity while maintaining the brilliant whiteness valued in Chinese white. Permanence scales could be expanded or modified for photoactive pigments to account for variation in surface conductivity.

APPENDIX: BACKGROUND SUBTRACTION METHOD IN IMAGEJ

Background subtraction was carried out in ImageJ of UV fluorescence images taken with the Canon EOS 6D digital camera. A duplicate image was created, then the Subtract Background process was opened. With “create background” selected, the rolling ball radius was set to 20. This smoothed the intensity curve of the image and removed shadows and surface texture. The image was then converted to luminance and an auto threshold applied. Selecting a dark background when thresholding blackened the fluorescent area. Remaining holes in the dark area were filled with Process → Binary → Fill holes. Finally, the luminance image was subtracted from the original color image using Process → Image Calculator. The remaining image consisted of only fluorescing areas on a black background.

NOTES

1. Although the absence of oxygen ions has been detected in zinc oxides in a gradient along the c axis (Fabbri et al. 2014; Johnson 2020) and is likely the cause of the conversion of blue fluorescence to green with age, the formation of oxygen vacancies is energetically unfavorable in zinc oxide lattices produced by the *indirect* and *direct* methods. Rather, replacement by hydrogen is a more likely mechanism for the removal of oxygen ions. For clarity, this study will refer to the defect as an oxygen vacancy even though it is more likely a hydrogen substitution. This is not yet verified, however, although a stoichiometry favoring zinc ions is well documented (Janotti and Van De Walle 2007; Oba, Togo, and Tanaka 2008; Ellmer and Bikowski 2016).
2. Based on experiments by Singh, Saha, and Pal (2015). By replicating the author’s exposure levels in the presence of moisture, peroxide formation was assured in the time allotted.

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Conservation Treatment of Atlases, Foldouts, and Guarded Structures

INTRODUCTION

This article discusses the varieties of folds, guards, attachment methods, and compensation that conservators encounter in books, how they affect the function of the book, and how conservators can best treat books with these elements. It draws on the author's experience as a book conservator at the Library of Congress and other institutions, and particularly from her experience repairing atlases. Although foldouts and guarded structures and their problems appear in many book genres, the author tends to focus on atlases, which have been a longtime interest of hers.

SCOPE AND SOURCE MATERIAL

The author's interest in this topic started in 2006 during her internship year working with Pamela Spitzmueller at Harvard University. Spitzmueller shared her notes and models from workshops she had given to various groups in the 1990s and early 2000s. Since then, the author has delved more into the topic, particularly because of treatments done while working at the Library of Congress.

The Library, of course, has huge collections, with a particular strength in atlases. As the book conservation liaison for the Geography and Map Division, the author has had the opportunity to do survey work, develop preservation plans, and perform treatment on a fair number of atlases, perhaps more than a conservator whose attentions are spread more broadly. She also has had the great privilege of working with many Advanced Rare Book Conservation interns as they worked on conserving atlases.

The Library's collections are high-use, which allows the author to see the effects of handling. Somewhat related to this, however, are the effects of heavy-handed ownership by the Library and former owners of its materials. Many of the atlases encountered were previously taken apart, each map lined with thick cloth, and then rebound. This was frequently

done in the early 20th century by the Government Printing Office. Their methods were robust, but they used the materials available at the time—acidic paper, poor quality adhesives, and leather prone to red rot.

Starting in the 1970s, the Library of Congress adopted more sound conservation principles: moving away from a “one-style-fits-all” approach to rebinding, using better quality materials, and beginning to document condition and treatment actions. A review of treatment documentation dating back to the 1980s provided a sense of the changing practices in conservation and how earlier treatments have held up over time.

This article seeks to present helpful tips on understanding, conserving, and preserving atlases, foldouts, and guarded structures, drawing on the author's experience, published treatment reports, and historical binding manuals. Discussion is limited to traditional, fairly simple codex forms made of flexible paper. Although some of the terminology and discussion is borrowed from the Book and Paper Group (BPG) and Photographic Materials Group (PMG) publication, *Conservation of Scrapbooks and Albums* (Brown 2000; Horton 2000; Wootton, Boone, and Robb 2000), this article will not cover topics such as albums, stiff-leaf structures, pop-up books, lift-the-flap books, and artist's books. For those who are interested in the creative potential of folded structures, Hedi Kyle's article “The Fold: Evolution, Function, and Inspiration” (2017) focuses on variations on the accordion fold and also describes many other historical and modern folded structures.

STRUCTURES AND PRESERVATION CHALLENGES

The treatment of bound structures that include foldouts and guards presents several structural and preservation challenges. Most of these relate to fitting oversize pages into a more moderately sized book. When a page is too large for its codex, the common solution is to fold it up and allow the reader to unfold it when the need arises. This can lead to weakened areas along the fold and stress from repeated unfolding action. Once folded, the foldout has a disproportionate bulk

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within the codex. This affects the book both at rest and in action; compensation is needed to avoid a difficult-to-store wedge-shaped book, and bulky foldouts disrupt the flow of the pages being turned. Finally, foldouts frequently require guards to position and attach them to the binding. This creates a second flex point past the gutter that must work within the constraints of the binding.

Atlases, especially, are frequently oversized. The information they convey cannot be broken out onto multiple pages without losing its function, and large areas or density of detail can only be shrunk so far. This leads to other preservation challenges, as large books are more difficult to store, use, and repair.

Folds and Fold Position

Conservators usually do not get to choose how a page is folded or where a fold is positioned within a book. However, they may do so when adding a facsimile of a missing foldout, refolding a hopelessly confused foldout, or reattaching a loose page whose original position was unclear. Conservators may also strategically reposition a foldout during treatment to allow it to be used without causing damage. This article will consider the advantages and disadvantages of some of these choices (note 1).

A simple bifolio map whose fold runs parallel to the spine of the book can be attached at the center fold or on one end. Center attachment allows the vulnerable fold to be protected within the binding. However, it must be placed far enough away from the gutter to allow the map to open flat. Center attachment is very intuitive, as a reader turning pages naturally comes to the page. Side attachment is less intuitive, and a careless reader may tear the fold in an attempt to open the page. Folds located at the book edges are also subject to environmental damage as the fold is exposed to air, moisture, and pollutants (Spitzmueller 1996). Once unfolded, side-attached maps can face the text of the book. Attachment at the left side allows the book to be opened in a left-to-right reading pattern. Attachment at the right allows the map to face title pages. This is reversed, of course, for right-to-left reading patterns, as in Arabic and Hebrew texts.

For a two-panel map whose fold runs perpendicular to the spine of the book, it is easier to fold a panel up and away from the reader, particularly with very large books. This top-up configuration is also easier to display in a traditional book cradle. However, the bottom-down method appears to have been favored by binders, as it left a clean edge at the head that could be trimmed and decorated.

A 1903 bookbinding manual instructs the binder to align the edge of the map with the head of the book and fold up from the bottom, repeating as necessary until the foldout is reduced to the height of the book. Only then should the binder make vertical folds, and those in a zig-zag pattern. The author notes that when there are several maps in sequence,

older manuals suggested alternating between flush to the head or tail, but that he recommends that they all be flush to the head to allow the book to be smoothly trimmed, as this prevents the penetration of dust and insects (Adam 1903).

For maps with multiple folds running parallel to the spine of the book, there are a few folding patterns to avoid. The “squashed scroll” is time consuming to refold and has many nested folds that can confuse the reader. Irregular folding patterns can also confuse the reader, leading to misfolded maps. An accordion fold, however, is regular and intuitive. Having the text face upward and the free end positioned near the fore edge also provides a visual cue to the reader about how to unfold the map.

Folds are slightly thicker than a double thickness of paper would be, and if many folds are stacked on top of one another or around each other, they add bulk. This bulk can be reduced by staggering the folds.

Cross folds occur when vertical and horizontal folds intersect. As they cross, one of the folds remains in one orientation—mountain or valley—and the other switches. When the map flexes, the mountain and valley folds are in conflict. This leads to tears that begin at the center point and propagate outward.

Cross folds can also lead to compression creases because the outer section must stretch around the inner, despite them being the same size (fig. 1). Paper can be squeezed and stretched up to a point. This allows cross folds to happen but results in weakened outer folds and crimped inner folds.

Consider an oblong map whose head is folded in once and then has multiple folds parallel to the book spine. If these are done in a repeated valley pattern, the folded-in head is always being forced into the smaller space. If the folding lines alternate between valley and mountain, as in an accordion, the compression alternates, and there is less stress overall. These observations about stress and compression have implications for mending strategies, and they are discussed in more detail in the following.

Guards

There are three main types of guards used for attachment of pages. The first is a reversed v-guard or meeting guard, where gatherings are sewn through their center folds onto guards (Conroy 1987; Minter 2015). The other two types of guards are adhesive. Figure 2 shows guards of uniform thickness. A moderately stiff paper extends from the plate to the gutter where it is folded over and sewn along with the rest of the book. Figure 3 is a laminate guard construction. Multiple layers provide stiffness in the gutter, and a single layer flexes across a small gap. The flexible gap allows plates to open flat without requiring the plate to flex.

Attachment

Plates or foldouts can be nonadhesively attached by sewing them along with the rest of the book through an extended

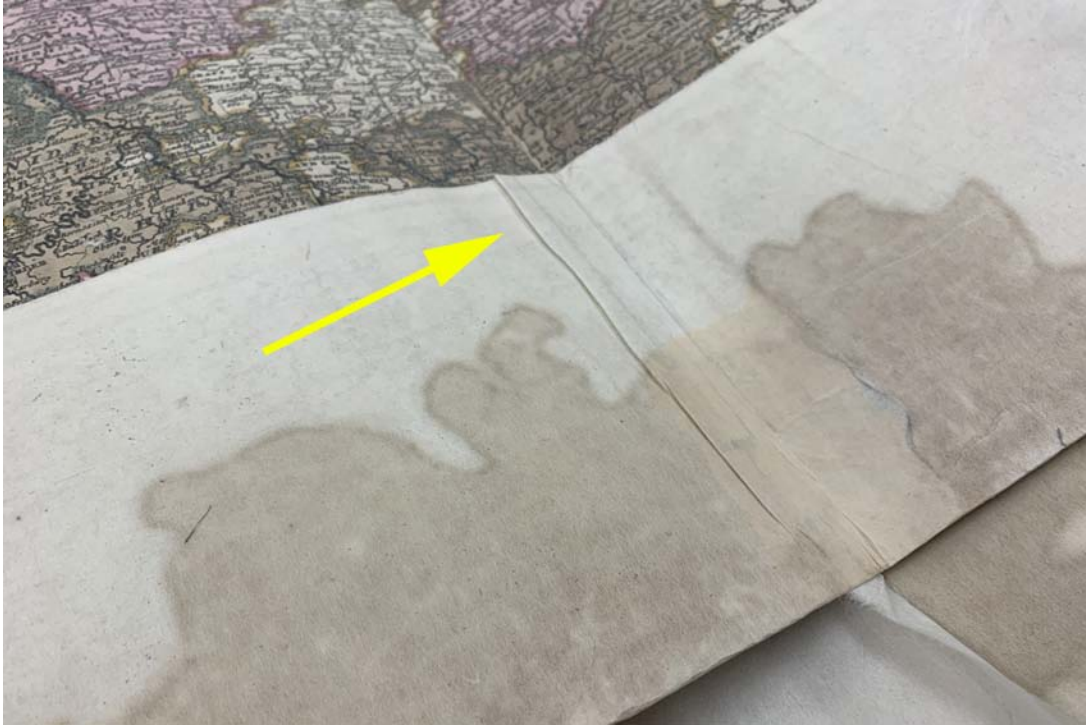


Fig. 1. Compression crease. Braakman, *Atlas Minor*, 1706, Library of Congress, Geography and Map Division.



Fig. 2. Guards of uniform thickness, original binding. Blaeu, *Atlas Maior*, vol. 11, 1667, Library of Congress, Geography and Map Division.



Fig. 3. Laminate guards, after 2018 rebinding. Carey, *American Atlas*, 1795, Library of Congress, Geography and Map Division.

edge. This is referred to as “guarded in” or “sewn in.” More commonly, the plate or foldout is tipped to a guard or a leaf with a line of adhesive. That strip of map-adhesive-guard forms a thick sandwich. This can be unusually weak, if poor quality adhesive has caused chemical damage to the paper, or it can be excessively stiff and strong, leading to a breaking edge just to the side of the sandwich.

If a foldout taller than the book is sewn in or adhered near the gutter, it must be lipped, meaning that a part is cut away to allow it to fold into the book without catching in the gutter. This cutting away is discussed in a 1915 bookbinding manual (Pleger, 41–43) and in the appendix. This internal corner is vulnerable to damage and frequently tears as the map is handled.

Compensation

When a thick foldout is attached into a binding, it can make the book too thick at the fore edge. *Compensation* is the general term for material added in the gutter of a bound volume to compensate for the thickness of bulky material positioned toward the fore edge. Many bookbinding manuals discuss compensation, and a wide variety of materials and methods are suggested. Paper is most common, but cloth and board have also been used.

Figure 4 shows an even stack of paper used as compensation. These strips were probably folded at the spine and oversewn along with the rest of the book. Joseph Zaehnsdorf’s 1880 *Art*

of Bookbinding suggests that compensation should be formed of paper strips, folded to be $\frac{1}{4}$ to 1 in. wide and sewn through the fold along with the rest of the text block (Zaehnsdorf 1880, 10). John Pleger’s 1915 *Bookbinding and Its Auxiliary Branches* describes using strips of paper glued together and then whip stitched as the common method, then recommends using perforated sheets as a newer method (Pleger 1915, 41–43):

A common method on side-stitched pamphlets containing a number of large maps is to trim the text after gathering, and to supply the thickness of the maps with stubs one-half to three-fourths of an inch wide on the binding end. The maps and stubs are put in place and the book stitched. This besides being very slow, is hardly in keeping with the progress of the times. There are obsolete signatures in all binderies which can be utilized to good advantage as fillers by perforating them one-half to three-fourths of an inch from the fold and gathering in sufficient number to take up the thickness of the folded map. The books can be sewn on a sewing machine or stitched, and the necessity for fillers to trim and forward is obviously eliminated. After the books are bound, the places provided for the maps are cleared at the perforation, leaving the regulation stub to take up the thickness. The maps are tipped on the stubs at the left end.

Both of these techniques can leave a thick shelf of compensation against which neighboring pages can break. Figure 5 shows compensation stubs that are staggered or offset from



Fig. 4. Stiff block of compensation, 20th-century rebinding. *Carey's American Pocket Atlas*, 1801, Library of Congress, Geography and Map Division.



Fig. 5. Staggered compensation, 20th-century rebinding. Tanner, *A New American Atlas*, 1823, Library of Congress, Geography and Map Division.

each other. They do not offer the same even appearance but are more gentle on neighboring pages.

The Action of the Book Spine

All of the guarding, attachment, and compensation methods discussed previously have an effect on the action of the book spine. In his 1987 article “The Movement of the Book Spine,” Tom Conroy analyzes the codex as a moving system and talks about how the spine structure directly affects the function of the book. Conroy discusses reverse v-guards or meeting guards, where gatherings are sewn through their center folds onto guards that position them out from the gutter. The length of the guards and the pliability of the spine must be balanced—a pliable spine allows the guards to fan out and raises the opening above the level of the neighboring pages. Sufficiently long guards allow the pages to open flat but still be supported by their neighbors. In Conroy’s example, the drape of the paper is not very important because the gathering hinges at the point where it is sewn to the guard. The goal is to allow the book to open flat, even if the pages are very stiff (Conroy 1987).

Guarded structures can be designed for a variety of purposes. When the goal is a foldout that opens flat, Conroy’s analysis works: the ideal configuration places the map far enough out from the gutter to escape the curve of the spine. In these cases,

the book is said to have sufficient throw-up. Heavily rounded books, books with inflexible spines, and thicker books all need longer guards. This is particularly important when the map has a fold perpendicular to the spine of the book, as a flat plane of opening is necessary to avoid damage.

Conroy does not discuss structures where the plate is attached to the guard with adhesive. In these situations, the hinging does not happen along a line of action but is rather flexing across an area. This can either be a guard that curves up out of the gutter and is attached to a plate or it can be a stiff laminate guard, followed by a flexible hinge that is then adhered to the plate. The adhesive attachment of plate to guard usually causes a change in flexibility, from that of the guard, to the glued sandwich, to the plate alone. This affects the drape of individual pages and the flow of the book spine as the pages are turned (Albro et al. 2012).

Figure 6 shows a book that does not open well—the spine has no pliability, and the guards are too short. This forces the map to flex, which has caused the stiff paper to break as it attempts to curve out from the gutter.

Guarded structures are frequently irregular in construction, and this often causes problems with the movement of the spine. Text pages can break against the edge of a stiff stub. Unevenly thick gatherings and stiff blocks of compensation can lead to preferential openings.

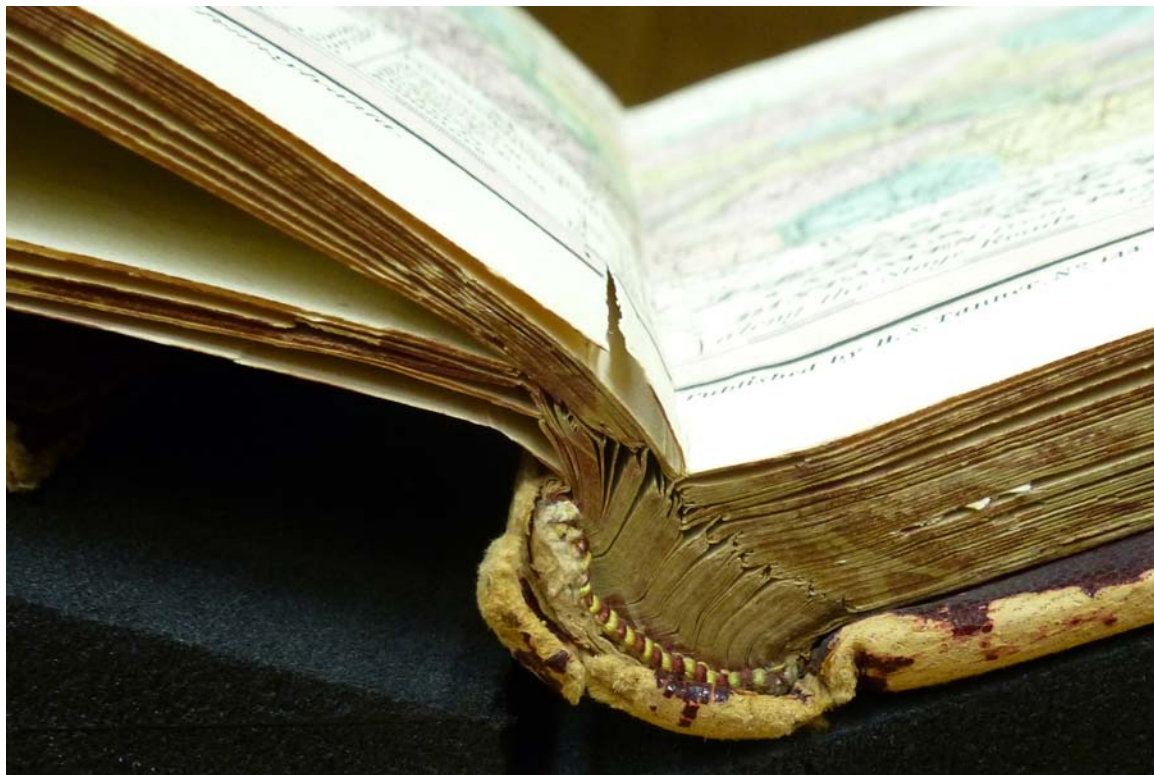


Fig. 6. Restricted opening, early 20th-century rebinding. Tanner, *Atlas of the United States*, 1835, Library of Congress, Geography and Map Division.

Other Preservation Challenges: Printing Methods, Annotations, and Color

Although the various media used in books, their aging characteristics, and their interaction with specific conservation treatments is a topic beyond the scope of this article, some cautionary thoughts relate specifically to atlases. Perhaps most obviously, the first complication is that the media and application technique used on map pages can be completely different from those used on text pages. Differences can occur because of relief printing versus intaglio printing, different mechanical press equipment, different paper, and sometimes even a different printing shop. Annotations are also commonly added to printed maps and can be difficult to see. And many printed maps from the 15th to the 19th century were hand colored. Although maps with printed color appear as early as 1511, hand coloring predominated until lithography became common in the mid-19th century (Woodward 2007). For more about the use of color in maps, a good source is the University of Michigan online exhibit *The Geography of Colorants* (Helm, Platte, and Rother 2018) based on Melissa Zagorski's 2007 thesis.

Hand coloring may have been done shortly after printing, or added later to enhance appearance and value. These colorants may cause deterioration, with verdigris degradation of copper-based green colorants being a particular challenge. The time period of hand coloring can be difficult to determine, but in addition to the usual techniques of observation and analysis, it can be useful to closely examine the media where it passes over a fold. A clean, uninterrupted field of color can be evidence that the hand coloring was applied before folding (Albro et al. 2012), whereas painting over a worn, well-used fold can lead to feathering or pooling of the media.

HISTORICAL TREATMENT METHODS

Conservators frequently find themselves undoing or working around the edges of previous treatments, and it is helpful to understand how those treatments were performed. A variety of historical techniques for treating and rebinding maps and guarded structures is summarized in the following.

Rearrangement, Rebinding, and Substitution

Atlases, more than many other genres of printed works, were freely and frequently rearranged and updated. For many early atlases, this process began before the work even left the printer's workshop. Atlas production methods in 17th-century Amsterdam have been described as a "bibliographer's nightmare": updated letterpress text was printed on the back of copperplate maps of many different states and dates, and "almost every atlas that left the printer's and binder's workshop is different from the next one in the same edition" (Van der Krogt 1996, 154).

A 19th-century publisher of atlases in Philadelphia advertised that his updated maps would be colored in a similar style

so that substitutions could be made by the owner (Ristow 1985, 197–198). Substitutions can occur at many stages in the life of an atlas—an analysis of a 1513 Ptolemy revealed that one of the maps had been replaced with one from a newer edition shortly after printing, whereas another had been swapped out by a book restorer in the early 20th century (Albro et al. 2012).

Map dealers, collectors, and librarians frequently considered atlases to be mere collections of maps, to be broken up or rearranged to suit financial or organizational goals (Akerman 1991, 3–10). In addition to the map arrangement, the underlying structures of guards and prosaic bindings were rarely valued, and rebinding was common. Commercial rebinding in the 20th century frequently meant cutting off folds and oversewing, a particularly poor choice for books that need to open well. As a general statement, one should not assume that a printed atlas is a consistent, well-understood bibliographic entity. Binding, structure, and pages should be carefully examined for inconsistencies, and a conservator should use particular caution when spot-testing in preparation for humidification, mending, or washing.

Sectioning, Lining, and Lamination

Cloth lining of maps dates back at least to the 1660s (Bagrow 1975, 16). By the 19th century, maps were frequently lined with cloth (or "mounted") as part of their initial binding, and this was a standard restoration technique in the 19th and 20th centuries. Larger maps with multiple folds were commonly sectioned by cutting them along fold lines, followed by cloth lining. A gap was left between the sections to allow the map to fold. Zaehnsdorf, in his 1880 manual, calls for the linen gap to be the exact thickness of the paper. In his second edition, that is corrected to be "more than equal to the thickness of the paper" (Zaehnsdorf 1890).

A frequently cited 1950 guide to map preservation states, "Ideally, every map worth preserving should be mounted." The guide provides instructions for mounting and notes that linen is preferred for very valuable maps, but cotton percale is thinner and preferred when the map will be folded into a book. Crepe silk or silk was used for fragile maps, either by itself or in combination with cloth. The linings were usually adhered with wheat flour paste, sometimes with additives like formaldehyde or alum to deter pests, or glycerin to improve flexibility (LeGear 1950).

From the 1930s to the 1970s, cellulose acetate lamination, sometimes accompanied by deacidification, was a common technique for preserving maps, especially in large institutions. Maps that would be folded into bound volumes were sectioned before lamination and the folds reinforced with cloth (Minogue 1943, 36–37). Other lining and lamination techniques included pressure-sensitive cellulose acetate linings or commercially prepared dry mount linings (LeGear 1950).

Media Stabilization

Media degradation is not a problem unique to atlases or foldouts, but it is frequently discussed in the published literature. In some cases, degradation results from the heavy handling and page manipulation that maps and foldouts undergo. In other cases, it is due to the pigments used to hand color printed maps.

Flat maps were sometimes protected with surface coatings like varnish, shellac, Krylon spray, or liquid cellulose acetate (LeGear 1950), and these might also have been used to protect or consolidate folded maps. Cellulose acetate dissolved in acetone was also used to stabilize water-soluble media prior to washing (Minogue 1943, 22–23).

Hand-colored maps commonly suffer verdigris damage. Large areas colored with copper-based green pigment become brittle, discolored, and extremely fragile. Damage sinks through the page and penetrates onto adjacent pages. A number of conservation publications describe the challenges and treatment options, but more research is needed. See Tsai 1992, Carlson 1997, Brostoff et al. 2011, and Albro et al. 2012.

Historical treatment for verdigris damage has included the application of alum-containing sizing solutions (Brostoff et al. 2011; Albro et al. 2012), bleaching to restore color, and consolidation with a variety of adhesives, including poly vinyl alcohol (Blank, Dobrusina, and Lebedeva 1984) and cellulose ethers (Dobrusina et al. 2019).

PREVENTIVE CARE AND SAFE HANDLING

Preventive care is the most effective means of preservation, and most of the recommendations for environmental control, pest management, and disaster preparedness apply equally across all library and archival materials. But a few safe handling precautions apply especially to atlases and foldouts.

Adequate space is essential. Reading room tables must accommodate large foldouts without having them extend past the edge of the table. Soft weights and book supports should be available, and staff should instruct patrons in their use. A limited angle of opening can prevent damage to bookbindings. Some books with foldouts, however, must be laid flat to allow cross folds to open clear of the gutter, so staff should not rigidly insist on the use of book supports. If possible, staff should be available to assist with difficult folding and unfolding. Books with foldouts are particularly vulnerable to damage if they are carelessly closed—the foldouts should be supported as the book is closed, especially if the book is very heavy.

DIGITIZATION PREPARATION

Digitization drives the workflow of many conservation labs, and foldouts are a recurring challenge both for conservators and scanning staff. Careful project planning and education

are essential. Collections with large numbers of foldouts may require significant preparation, as tears and disfiguring creases are common.

For certain digitization projects at the Library of Congress, books with foldouts are scanned in stages. Digitization scans the bound volume, skipping any large foldouts. The book is then brought to conservation, where the foldouts are unfolded, mended, and opened out onto a support board. The books are returned to digitization, the foldouts scanned, and then conservators refold the maps into the bindings. Although this process is time consuming, it produces the best possible image while minimizing handling. For other projects, scanning staff are specially trained in safe folding and unfolding.

CONSERVATION TREATMENT

Mending

Foldouts are more frequently damaged than text pages because of how they must be handled—unfolded, stretched out over a surface, and then refolded. Folds are weaker than the surrounding paper and tear more easily. Foldouts are also sometimes printed on thinner paper or adhered with stiff glue. Mending techniques must accommodate these challenges.

There are many factors to consider when mending paper, and the following discussion is largely based on mending moderate-weight Western paper using wheat starch paste and kozo paper or heat-set tissue. The conservator must weigh these recommendations with the normal considerations of paper weight, sensitive media, readability of underlying text, productivity, and skill level.

The first tip is to mend with as little adhesive and the thinnest tissue as possible. Mends should be strong enough to withstand handling but weak enough to allow the paper to flex overall and to fold along the desired line. If a heavy mend is made on a paper that needs to be handled a lot, it may cause a tear to appear elsewhere.

That said, mends over folds sometimes do need to be stronger than mends on flat paper. For example, wheat starch paste or Lascaux is sometimes preferable to heat-set Aquazol 200 or 500, to prevent the mend from detaching from the fold as it is flexed (Kelly et al., 2022).

The second tip is to not rush to fix problems that relieve stress. Figure 7 shows a compression crease that occurred inside a cross fold. It is not obscuring text, and if flattened, it may just reappear or relocate once the map is refolded.

Figure 8 shows a small hole that has formed at the intersection of two folds. It may be better to mend up to, but not over, the hole. Hedi Kyle described a small medieval magical charm folded into 25 panels, as discovered by Pamela Spitzmueller. The person who made the charm snipped off the corners, relieving the tension and allowing the booklet to be compactly folded (Kyle 2017). This principle can be

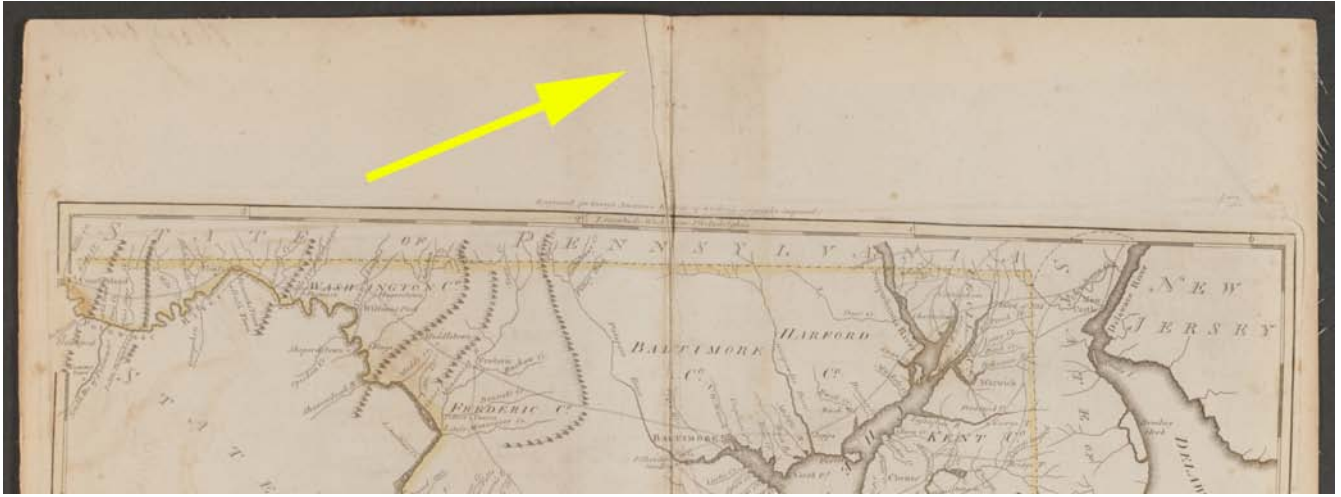


Fig. 7. Compression crease, during treatment. Carey, *American Atlas*, 1795, Library of Congress, Geography and Map Division.

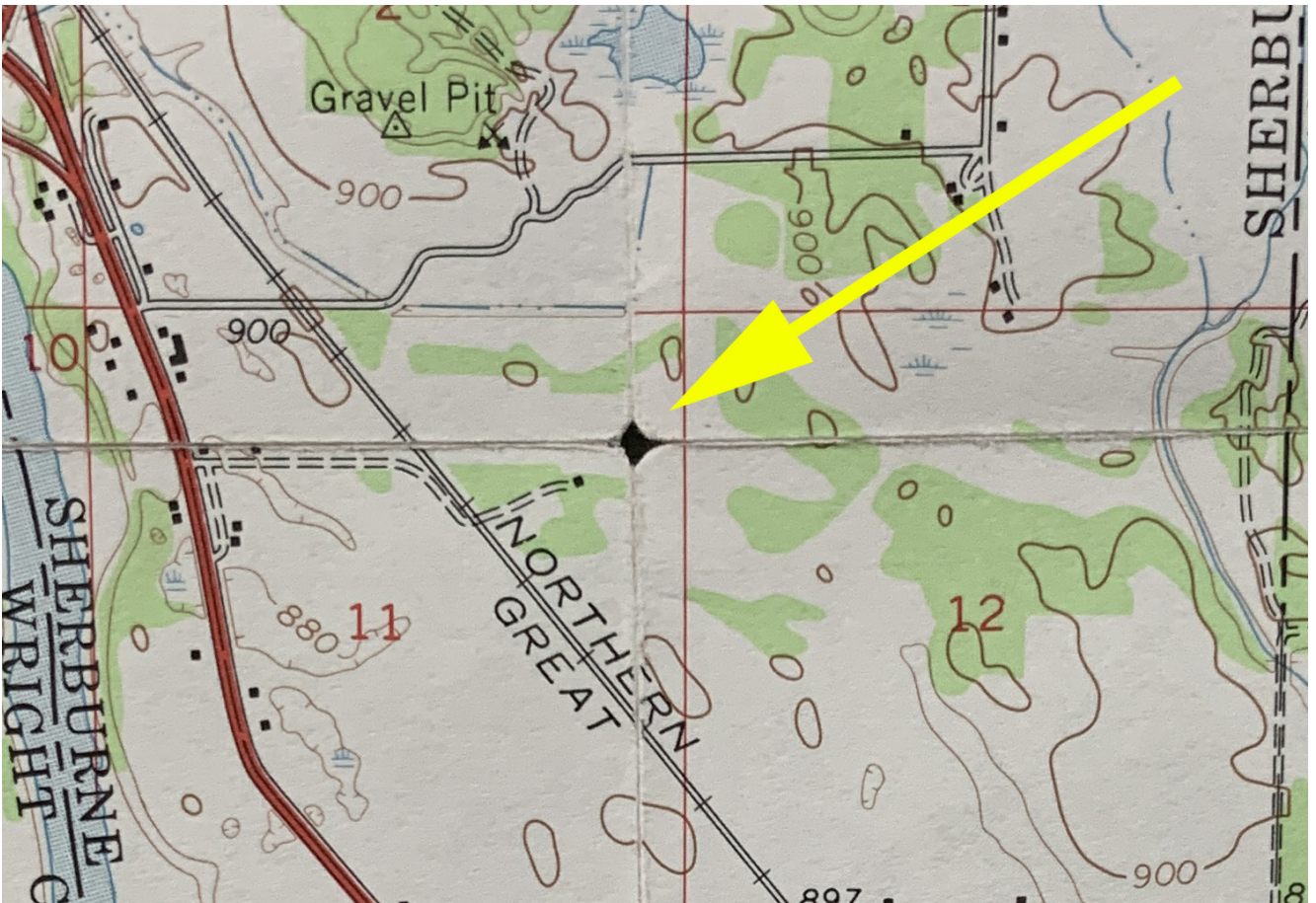


Fig. 8. Small hole at fold intersection. Model made by author.

applied during mending—by leaving intersections unmended, one may prevent the recurrence of the stress that led to the tear. If mending over the hole, make certain that the new material is flexible and compressible.

Figure 9 is a book from 1820 in its original binding. The binder added slits in the paper to allow the foldout map to more easily escape the gutter. Although this has led to small tears at the end of the slit, the tears did not propagate into the map. If those cuts were mended, the point of stress would move up to the internal corner, and the new tear could be worse.

Double-sided mending can be a useful technique. A thicker kozo tissue can be used on the verso and a very light-weight tissue on the recto. The author's favorite pairings are 5 and 12 gsm kozo papers, or 5 and 8 gsm kozo papers. These mends should not create an even sandwich, but instead one should be narrower and the other wider to avoid creating a hard breaking edge. A thin remoistenable tissue applied over the recto of a tear can smooth down rucked up edges, whereas a thicker and stronger tissue can be used on the verso of the map.

The order of mending can make a difference. With double-sided mending, and with nested folds, the author always tries

to work from the inside out. When book conservators mend nested folds in gatherings, they frequently work from the inside out, mending the innermost bifolio before the outermost, and allowing the mends to dry with the bifolios closed. This allows the mends to accommodate the added bulk of the mending paper and conform to the final configuration of the gathering. Similar principles can be applied to foldouts, with a few refinements to allow the final page to both lay flat and sit closed with equal ease.

To do this, the valley side of the fold is mended first, allowed to dry flat, and then the mountain side of the fold is mended and left to dry folded. This is particularly important with water-based mending techniques where the adhesive and the mending tissue expand when wet and contract while drying. Other conservators have recommended allowing the mends to dry at a 90° angle (Spitzmueller 1996; Vidler 2013).

Because of the stresses on folded maps, it is not uncommon for gapping tears to significantly affect the map's function. These tears can frequently be realigned with repeated cycles of humidification and drying under weight. Realignment of text can be facilitated with temporary bridge mends using non-water-soluble adhesives, like a pre-coated tissue that can be applied with heat or solvent (but not water). These mends stay in place during humidification and can be removed before final mending.

As discussed earlier, foldouts are particularly vulnerable when there is an internal corner, which occurs when the plate folds out from the head or tail. That vulnerability is the result of stress being directed at a single point. This can be mitigated by creating a rounded internal corner to distribute that stress. Figure 10 shows a model that has been deliberately cut this way. If fixing tears in that area, consider trimming the mending tissue, not to a right angle but extended beyond the paper to make a rounded corner.

Pamela Spitzmueller taught this mending technique when the author was a book conservation intern, but the author had never seen a historical example until recently. A 1903 bookbinding manual, in English but translated from German, shows the rounded internal corner in an illustration, but the text does not discuss it (Adam 1903, 26–27). A real-world example then turned up in a set of books published in Berlin (Agrippa von Nettesheim 1916), as discussed by William Kiesel in his article on foldouts in esoteric and magical literature (Kiesel 2015). Since these examples are both German in origin, it is possible that there is more mention of this technique in German language bookbinding manuals or sources.

One other interesting thing about these examples is that in addition to being rounded, the internal corners are offset from a fold. If a tear starts, it will run diagonally but not immediately hit a weak fold. This makes them just a bit more resistant to damage.

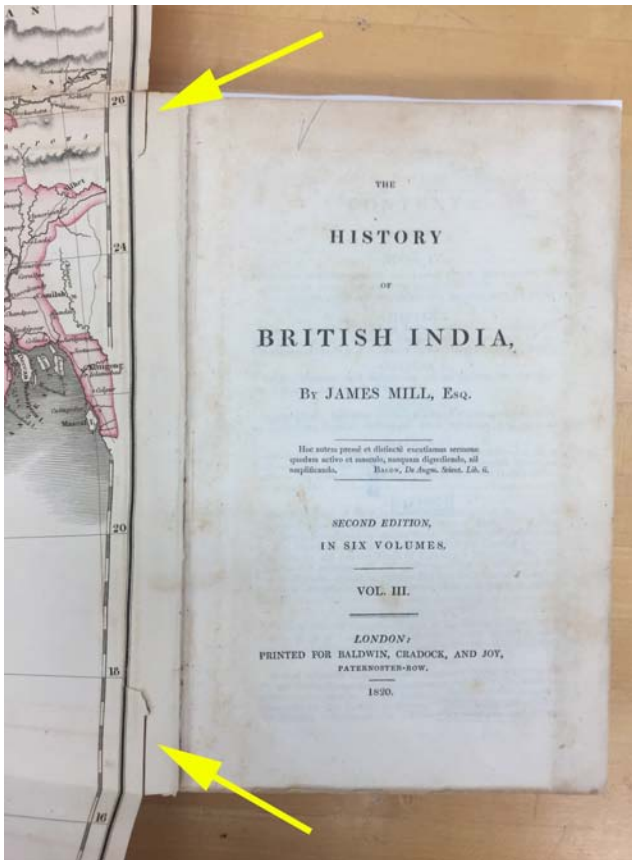


Fig. 9. Foldout frontispiece with slits to facilitate opening. Mill, *The History of British India*, 1820, study collection.



Fig. 10. Rounded internal corner. Model made by author.

Repositioning of Maps

Once a conservator has mended the foldouts, what is next? Limited interventions that allow foldouts to be used safely may be more appropriate than complete disbinding. These options should be weighed carefully against the artifactual value of the book in its current arrangement, and they are more applicable to mass-produced modern books than for rare or significant earlier works in original bindings.

If a foldout cannot be used safely because of how it fits into a binding, it can be removed and either rehoused or put back into the binding with improved methods. This can include making a longer guard, trimming compensation guards that interfere with the map, or changing the attachment position of the map.

Figure 11 shows an 1881 atlas with a four-panel foldout attached at a center fold. The tight binding did not allow the map to open flat in this configuration, so the thin map paper tore, starting at the fold intersection. There was not space to move the map out from the gutter, so the conservator removed the map and reattached it on an edge. This allowed the map to open flat off to the side. Other conservators have described their decision to reposition foldouts, as in Karen Vidler's 2013 series of blog posts on the "Proeschel Atlas Conservation Project" and Hannie van Herk's blog posts

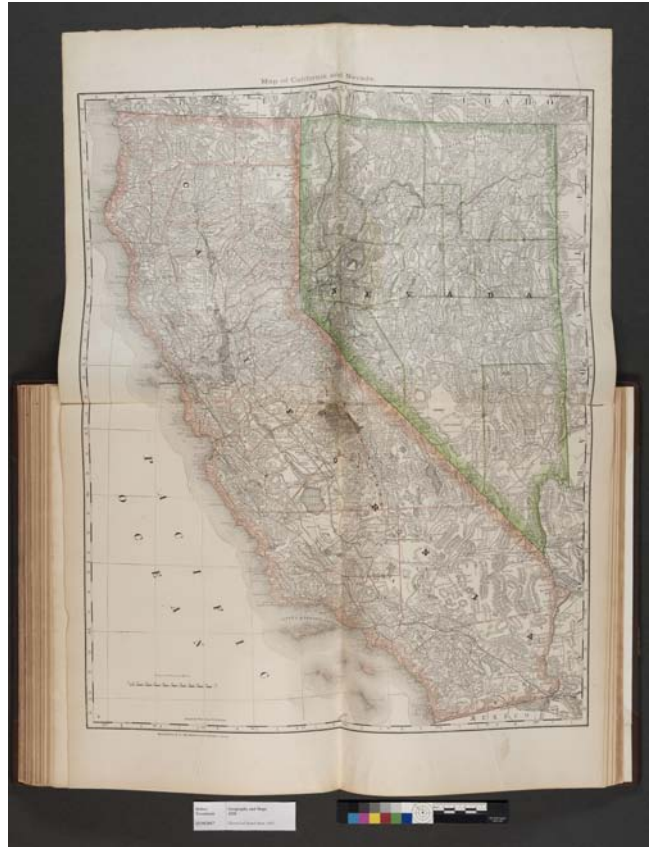


Fig. 11. Center attached four panel map, before treatment. *Historical Hand-Atlas*, 1881, Library of Congress Geography and Map Division.

on the treatment of the University of Amsterdam's *Atlas der Neederlanden* (2010–2014).

Guarding

Once plates are being moved around, the conservator needs to think about guards. In book conservation, *guarding* refers to mending the center fold of a section, as well as to adding additional material to the binding edge of plates or foldouts to move them away from the gutter. The second definition is what this article is addressing.

Earlier in the article, three types of guards were identified. The first is a reversed v-guard or meeting guard, where gatherings are sewn through their center folds onto guards. This is a good structure to use when center folded bifolios must open all the way to the gutter, or when the attachment method must be nonadhesive. It also offers the advantage that none of the original surface is covered by a guard.

For adhesively applied guards of uniform thickness, the guard must be stiff enough to support the plate out from the gutter. This usually means a text-weight Western paper or a very substantial kozo paper. This kind of guard was the

standard choice for books with foldouts tipped to guards, starting in the 1500s. Therefore, if a primary goal when rebinding a book is to match a historical original, this is a good choice. The challenge is that the paper in the gutter is the same paper that is getting glued to the plate, which can be hard on fragile originals and can add a lot of thickness. Some bookbinding manuals discuss thinning the plate at the point of overlap to reduce swell (Cockerell 1901, 56–62), although this would be a questionable choice for a conservator because of the loss of original material.

For guards with a flexible gap, the laminate can combine various kozo papers, or kozo paper(s) with Western paper(s). The paper weights should be appropriate to the size of the book and the thickness and quality of the plates. In general, a thicker paper is laminated to a thinner paper. The thick paper provides the necessary stiffness to lift the plates out of the gutter and to provide compensation for the thickness of the plates. A thin, strong paper provides flexibility across the gap and does not add too much bulk where it is adhered to the plate (Parks and Muratore 2021). Stiff laminate guards are particularly important for heavy foldouts or plates—a floppy guard will collapse into the gutter under the weight of a bulky foldout. Some combinations that the author has used include laminates of 15 gsm handmade kozo, laminates of 32 gsm machine-made kozo, or that same 32 gsm kozo laminated to 85 gsm, machine-made, 75% cotton paper. The guard material must adhere well to the foldout, and strong adhesives like wheat starch paste are necessary.

Variations of this laminate structure have been used in early photograph albums and late 19th century bindings. In those cases, cloth was generally used as the flexible element that crossed the gap. The author has not observed laminate guards in original atlas bindings before the mid-19th century, and so their use on older books seems to always indicate a rebinding. Despite the anachronistic appearance, the author has used laminated guards with kozo hinges to rebind 18th- and 19th-century atlases.

Cloth-Lined Maps

Before thin and strong kozo papers began to be used widely in Western book conservation, cloth was the best choice for linings and flexible hinges (Matthews 1929, 30–34). It may still have a place when conservators treat cloth-lined maps. As mentioned earlier, the Library of Congress has many atlases in which each map was lined with cloth and then bound. For obvious reasons, the treatment of these books frequently leaves these linings in place.

Although paper sticks very well to paper, sticking paper to cloth can provide poor results. Instead, cloth laminate guards can be better for hinging cloth-lined maps. To prepare the guards, first size thin aerocotton by brushing thick A4M methylcellulose (3%–4% w/v in water) onto both sides of the cloth, then let the cloth air-dry, smoothed out on polyester

sheets or Plexiglas. This makes the dried cloth a little stiffer, as well as much easier to handle and cut to size. Laminate the cloth with Western paper, leaving a flange of cloth off to one side. This flange is then adhered to the map, with a small gap between the plate and the laminate to allow flexing. A space-filling adhesive like PVAC or PVAC-methylcellulose mix works well for adhering cloth guards to (nonoriginal) cloth linings. The cloth is flexible and strong, and the stiff laminate positions the plate away from the gutter.

When guarding with paper, the usual method of applying guards to plates is to fully adhere the overlapping parts. *Partial tipping*, however, is when the guarding material is left unadhered along the free edge to provide a softer transition between the three layers of guard-adhesive-plate and the single layer of the plate (fig. 12). This is similar to the feathered edges of kozo paper used in paper mending. When using a thin kozo guard, a feathered edge may be best. When using a thicker kozo or Western paper guard, partial tipping can be useful and is much more efficient than trying to pare the edges of each paper hinge. Note that partial tipping should not be done at the binding edge of the plate. If failure occurs there, it is preferable that it happen in the guard rather than in the plate. Some partial tipping has been observed in original bindings dating back to the 17th century. This may sometimes have been done intentionally, and sometimes it was an accidental by-product of how binders glued things.

Partial tipping can also be useful as the guarding material approaches a cross fold. These are very vulnerable areas on a map because conflicting mountain and valley folds must pop away from each other. This is especially true near the gutter of a book where the opening is restricted. Partial tipping at this point allows the map to reshape itself more gently, over a larger area.

The map in figure 13 may have originally been glued right up to the fold but has popped up off the guard through use. This is another example of how a map has relieved itself at a stress point. Dabbing a little glue in there to “fix the problem” would be a mistake.

Partial tipping does create a potential point of delamination, but with good quality adhesive and paper, this is not a significant concern. Cloth-to-cloth connections, however, tend to delaminate easily, and so partial tipping should not be used. Cloth-to-cloth connections are also most likely to arise when guarding cloth-lined maps, which tend to be very robust and unlikely to crack along a breaking edge.

Resewing and Rebinding

The choice to take a book apart and rebuild it is not one to take lightly. First, this choice inevitably destroys a portion of the material history of the object. Even when the structure is not original, there may be interesting provenance, use, or cultural information represented in the existing binding. Second, rebinding and the associated removal of thread,



Fig. 12. Partial tipping. Winterbotham, *The American Atlas*, 1796, Library of Congress Geography and Map Division.

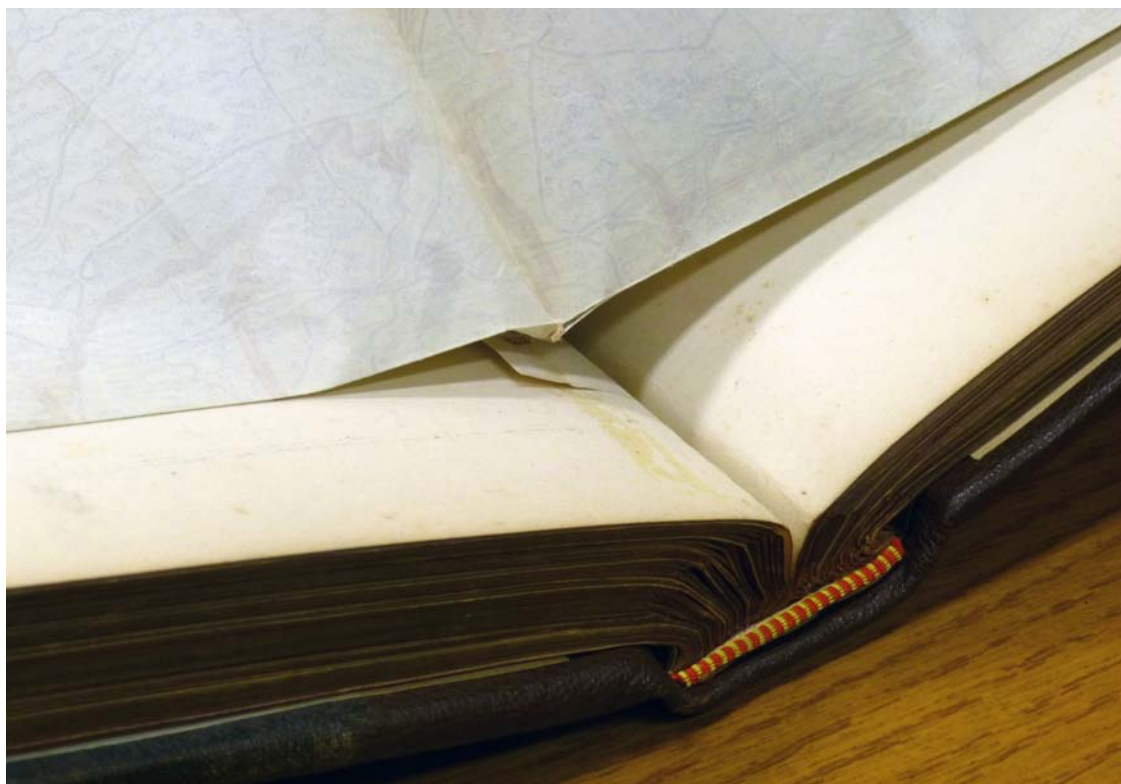


Fig. 13. Partial tipping at fold intersection. *Historical Hand-Atlas*, 1881, Library of Congress Geography and Map Division.

adhesive, linings, guards, and so forth always poses some risk to the object. Skill and experience mitigate but cannot eliminate those risks. In addition, rebinding is very time consuming, especially when guards, hinges, and compensation strips are added in. Despite this, rebinding a guarded structure is sometimes the best way to resolve structural problems and can allow a volume to be handled and used safely.

To help make the work of guarding multiple pages more efficient and consistent, jigs are essential. A variety of straightedge widths can make quick the work of precutting and folding guards. Brass spacers can ensure even and consistent distancing of plates from their compensation. A template or tray of binder's board can help to position each plate on its guard so that the heads and fore edges are well aligned (Bainbridge 2012).

One of the author's favorite jigs is designed to facilitate the partial tipping recommended earlier. Since the name "Guard-O-Matic" was already claimed for a different labor-saving device (Brooks 1984), this will be dubbed the "Atlas Guard-O-Matic" (fig. 14). To make the Atlas Guard-O-Matic, weld together three pieces of Mylar, forming a lower base layer and two upper flaps, with a quarter-inch gap between them. Place the guard into the sleeve so that the area to be glued is exposed and the free edge of the guard is masked by Mylar.



Fig. 14. Atlas Guard-O-Matic.

Apply adhesive, remove the guard from the sleeve, and place the foldout on the guard, leaving just the edge of the guard unadhered.

When a book is rebound, many choices affecting how it opens need to be considered. There needs to be a careful balance between the flexibility of the materials, the width of guards, and the pliability of the spine. The width of the guards should be proportional to the size of the book, and larger and thicker books need wider guards.

To give a sense of the variation, the largest atlas the author has rebound was 24½ in. tall and 2½ in. thick with cloth-lined, center-attached maps that unfolded out from the head and tail. Cloth-laminate guards that extended 1½ in. from the gutter and had a ¼-in. cloth gap were constructed and then hinged to the maps with a ½-in. overlap. For an atlas with similarly sized pages, but 1 in. thick and with center-attached bifolios, laminate kozo paper guards that extended 1 in. from the gutter and had a ¼-in. single-layer kozo paper gap were made and hinged to the maps with a ½-in. overlap. Smaller books have received ½- to ¾-in.-wide guards and ⅛- to ¼-in.-wide gaps.

Each book is different, and some may need to open more than others because of their paper qualities or how the plates unfold. The sewing method and spine linings of course have an effect on the opening. In general, it is best to avoid oversewing or excessive spine linings, because the guards should fan out at the spine and assist with the opening of the plates.

Once materials have been selected and cut to size, the order of assembly needs to be considered. This can be done several different ways. Oversize guards can be made first and folded along the spine edge; the excess width is trimmed, gatherings formed and pressed, and the plates adhered so that everything is aligned to the head. Excess guard lengths at the tail are then trimmed, and the book is sewn. However, for a book that needs gold-edged guards to match the plates, plates can be attached after sewing and edge gilding.

There can be some challenges during the sewing stage. For large books and books with foldouts, it can be difficult to support heavy pages while opening the text block to the fold. In addition, the heavy pages can collapse at that second hinge and make positioning difficult. Conservators have come up with all sorts of clever ways of supporting oversize pages using magnets, wire, binder's clips, or stiff boards (e.g., Peachey 2019; Avery and Lindsey 2019). If the structure of the book permits, the easiest solution to this problem is to position the short compensation guards consistently to one side of the sewing. When sewing from the correct side, only the guards need to be lifted, rather than the entire sheet. Of course, some books have plates adhered to both sides of the guard, and a way to suspend the pages during sewing needs to be devised.

When resewing a very large volume of cloth-lined maps, each bifolio can cling to its neighbor through cloth-to-cloth friction, making it difficult to jog pages to the head or even

shift a gathering into position for sewing. This problem can be resolved by placing a sheet of glassine between the pages that need to be shifted, then removing the glassine to lock the pages into position.

It may also be possible to attach large plates to the guards after rounding and backing, as is sometimes done in production bindery work (Van Herk 2010–2014). Especially for very large books, this is an attractive option because it is very difficult to get large books in and out of a job backer.

As a final caution, most of the preceding tips were designed for text blocks with guards of matching widths and fairly consistent structures. Guards are designed to push pages out past the gutter of the book and must be stiff enough to hold the page there without collapsing. The placement of that stiff material can cause problems when neighboring, unguarded pages or endpapers must flex against it. Treatment decisions need to consider not only how the book functions as individual guarded leaves and gatherings but also as a moving system.

For books with many bifolio pages on guards, there is a tendency to end up with a wedge-shaped book, as the overlapping guards and plates exceed the thickness of the pages at the fore edge. Cockerell (1901) and Banks (1972) both discuss pressing after the plates are attached to guards to reduce the thickness of the overlap, and older books may have been beaten.

Encapsulation and Post-Binding

A final and entirely different option for rebinding is polyester encapsulation. Deteriorated plates can be encapsulated and then re sewn with an otherwise strong text block, or the entire book can be encapsulated and put into a post-binding. These bindings can even include foldouts, with the foldouts sectioned or intact (Ruzicka 1983). Encapsulation can be a good choice for high-use brittle books. However, encapsulated books triple in thickness and oversize atlases can become incredibly heavy.

CONCLUSIONS

The conservation of atlases, foldouts, and guarded structures cannot be formalized to a list of standard steps, but hopefully the preceding discussion can help guide conservators through some of their choices. In the author's experience, these treatments are rarely standard and always require creative problem solving.

A better understanding of these structures can also help conservators understand how the books were produced, marketed, used, and valued. In many published works on cartography and atlases, the physical structure is ignored or misunderstood. A conservator's experience is a valuable tool in correcting those errors and can provide insight into the significance of an object. As an example, the University of Michigan based its exhibit *Mr. Vignaud's Maps: Unraveling a*

Cartographic Mystery from the Golden Age of Dutch Cartography on their efforts to understand the successive bindings and arrangement of composite atlases based on physical evidence (Utter and Platte 2018).

This article is an initial attempt to gather together information about these structures. Research will be continued, with a particular focus on the history of foldouts in books, traditional binding methods, and older conservation techniques. Input from others and suggestions for continued exploration of this topic are welcomed.

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APPENDIX. GLOSSARY

There is a wide variety of terms used to describe foldouts, guarded structures, and atlases. This glossary gives preference to Roberts and Etherington's *Bookbinding and the Conservation of Books: A Dictionary of Descriptive Terminology* (1982) and the *Ligatus Language of Bindings Thesaurus*. Other terms were adopted from sources listed in the Terminology section of the Bibliography.

Apron: "The extra amount of unprinted paper left to serve as the binding edge of a leaf which folds out" (Roberts and Etherington). A **full apron** is an apron of extended length that allows a foldout map to be fully visible when a book is closed. Note: The terms throw out, full apron, and foldout have overlapping meanings in various glossaries.

Atlas: A collection of tables, charts, plates, or maps.

Compensation: Material added in the gutter of a bound volume to compensate for the thickness of bulky material positioned toward the fore edge. Also called **compensation guards** (Roberts and Etherington) or **compensating guards** (Ligatus). Simple strips of board or paper are sometimes called **compensation stubs** (Wootton, Boone, and Robb 2000; Brown 2000).

Composite atlas: A collection of previously issued maps from various sources, gathered together into a binding. Also called **atlas factice**, **Lafreri atlas**, or **Italian assembled-to-order**

(IATO) atlases. The last term was “coined by George H. Beans to describe the sixteenth-century Italian atlases assembled for clients by map publishers from a stock of separately published maps” (Woodward 1982). **Composite atlas** is the Library of Congress Genre/Form term. When differently sized maps are gathered into a binding, strips of paper adhered to the map edges, or **marginal strips**, are sometimes added to create an even book block (Woodward 1987).

Cross fold: Two folds that intersect, generally at right angles (Angsüsser 2013). Also called a **right angle fold** in the paper industry. A **French fold** refers to a single sheet of paper folded into fourths using a cross fold.

Foldouts: “Inserts that are larger than the trim size of the book or other publication and which must be folded before insertion” (Roberts and Etherington). Also called a **throw out** (Glaister 1996, 476).

Guard: “A strip of cloth or paper on which an illustration, map, etc., may be attached and sewn through with the section, thus allowing free flexing” (Roberts and Etherington). Ligatus distinguishes between **leaf guards** for single leaves or bifolios, and **extension guards** for foldouts. Also called a **conjugate guard** (Woodward 1982).

Guarded in: “Plates which are inserted into a book without being tipped to one of the leaves of the book. The paper area of the plate is wider than the leaves of the book, the projecting part being wrapped around the fold of the section. A narrow strip of paper appears elsewhere in the book as a consequence” (Roberts and Etherington). Could also be called **sewn in**.

Guarded in pairs: “A method of securing two plates to one guard. While the positioning of the guard within the section may or may not allow for either or both sides to be located near the accompanying text material, guarding in this manner may help alleviate some of the swelling caused by the thickness of the material used for the guards” (Roberts and Etherington).

Hooked: The formation of a fold at the spine edge of a leaf to allow the leaf to be sewn into the binding (Glaister 1996, 233). This is called a **returning guard** in Brown (2000).

Lipped: “A method of accommodating a [foldout] that is longer than the trimmed height of the book. A portion of a leaf to be folded adjacent to the gutter margin is cut away, i.e., lipped, so that the remaining portion may be folded without buckling and creasing the binding margin” (Roberts and Etherington). Glaister calls this **nibbed** (1996, 343). This cutting away is discussed in bookbinding manuals (Pleger 1915, 41–43).

Reversed v-guard: “A folded guard . . . to which a section is sewn, the folds of the guard meeting in reverse. The guard consists of several strips of paper folded with the two open ends being folded back on the guard, either together or in opposite directions . . . Also called ‘meeting guard’” (Roberts and Etherington); see also **continuous guard** (Roberts and Etherington) and **meeting guard** (Horton 2000, 24).

Simple fold: A fold consisting of a single crease. The orientation can be either **mountain fold** or **valley fold**.

Stub: “[A] strip of paper or cloth tipped to the gutter edge of a leaf to match the thickness of a flat object, such as a photo or map, mounted to the leaf. Several strips of stubbing may be needed if the mounted object is thick” (Horton 2000, 26). “1. That part of an original leaf which is left after most of it has been cut away from its conjugate leaf. See also: Cancel. 2. A narrow strip of paper or linen sewn between sections of a book for the purpose of attaching plates, maps, etc.” (Roberts and Etherington).

Throw-up: The curving of the book spine when it is opened. Throw-up helps the leaves lie flat (Greenfield 1998).

NOTE

1. Folding patterns are difficult to describe in words, and even then, terminology varies significantly from one author to another. Stephan Angsüsser (2013) states, “Folds with vertical folding lines are called horizontal folds, while those with horizontal folding lines are called vertical folds.” But many authors use “horizontal fold” and “horizontal folding lines” interchangeably. To reduce confusion, this article will try to specify whether folds are perpendicular or parallel to the spine of the book.

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Playing with Time: Budgeting Light-Induced Damage to Manage Light Risk Associated with the M+ Opening Exhibition

INTRODUCTION

Overall Context: M+

Based in Hong Kong, M+ is a new museum dedicated to collecting, exhibiting, and interpreting visual culture of the 20th and 21st centuries. Designed by Herzog & de Meuron, it aims at becoming one of the largest museums of modern and contemporary visual culture, with a broad ambition to be one of the world's leading cultural institutions. The museum has a total of 17,000 square meters of exhibition space.

Currently, the M+ collection consists of roughly 7700 objects and 47,000 items from archives and the library's special collection and covers a wide geographic range with a large emphasis on Hong Kong artists. Since the inception of the project, the collection has been acquired at a fast pace. With newly constructed facilities and a fast-growing museum team, the organization is coping with constant rejigging of teams' roles and responsibilities while constantly evolving and developing into a functional museum toward business as usual.

In line with organizational objectives, it is imperative for M+ to form a general strategy on preventive conservation. In particular, an emphasis has been placed on light exposure limits and rotation of collection items on exhibition, as these issues factor into budgeting and have an impact on exhibition narrative. In addition, institutional commitment for rotation has been managed from early on to ensure the program is sustainable in consideration of the growing but yet still relatively small team and of budget allocation, as well as future commitment to rotation.

Basic Information on Light-Induced Deterioration

When UVs are excluded, color change is the main light-induced deterioration: it is irreversible, cumulative, and follows the "reciprocity principle": for instance, 6 months under 50 lux induces the same change as 3 months under 100 lux.

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Light sensitivity is assessed and described using Blue Wool Standard (BWS) cards: any material changing color as quickly as BWS1, 2 or 3 is considered highly sensitive to light. Materials at BWS7 or above have low to no light sensitivity.

The light dose that induces a Just Noticeable Difference (JND) in color has been studied using accelerated light aging tests under mild conditions. Results obtained for BWS below 3 are indicated in figure 1.

It is usually and internationally accepted as best practice to exhibit highly sensitive items only for 3 months at maximum 50 lux, every 2 years, with no UV or daylight used.

M+ Opening Exhibitions and Rotation Needs

Around 1500 collection items, representing approximately 20% of the M+ collection, were selected for the opening exhibitions. Roughly 9% of the total exhibition includes

	Light Dose to a JND* (in lux-hours—no UV)
BWE 1	~100,000
BWE 2	~600,000
BWE 3	~2,400,000
*JND in color for flat, opaque, mid-size materials compared side by side under daylight at minimum 500 lux.	

Fig. 1. Light dose to reach a JND (in lux-hours) by BWS for highly light sensitive materials.

surrogates of the collection and will not be included in the present study.

M+ has planned seven opening exhibitions (with durations varying between 12 and 16 months) to showcase the collection and to foster audienceship within the community, as well as across Asia and the world. More than 60% of the items selected for exhibit are likely highly sensitive to light. These are mostly works on paper, including photography and different contemporary printing techniques, often pristine and with unknown behavior to light. It comprises prestigious art works such as Marcel Duchamp's *Rrose Sélavy (Box in a Valise)* (1935–1941/1963–1966), *Press Conference*, oversized gouache on paper by Zou Tiehai, as well as a large collection of photographs including silver prints, artist-designed posters, architectural drawings, and various kinds of mass-produced items. It should be noted that other 3D and installation art items can also be highly sensitive to light depending on the materials used.

Considering the item selection and the exhibition durations, and without taking into account any other mitigation means, more than 1800 rotations were required to comply with the already-mentioned international exhibition recommendations associated with best practice. Implementation of such a massive rotation program was not achievable, especially at an early stage of the institution's existence. In addition, the budget restrictions induced by the COVID-19 pandemic were forcing the institution to consider reducing costs related to its operations, including the one associated with the rotation program.

This presentation describes an alternative approach to mitigate the light risk associated with the M+ opening exhibition series that draws on differentiating an unwanted change from the resulting damage, which is the loss of the item's value.

USING A VALUE-BASED APPROACH FOR THE LIGHT RISK MITIGATION DECISION

Damage resulting from light exposure depends on various parameters:

- The item's light sensitivity plays a key role, as it determines the induced color change.
- The extent of damage is also related to the item's museum value, which depends on its cultural significance, its importance within the collection, and expected use by the institution. More damage would result from fading Duchamp's *Box in a Valise* than one of the mass-produced posters from the collection.
- Finally, the role color plays in the museum value is the last parameter to consider. A similar color change would have a greater impact on *Press Conference* with all depicted flags than on a black-and-white print.

Value at Risk to Light of a Collection Item

Value at risk to light of an item is the portion of its museum value that is negatively affected by its light-induced color change. It depends on the role the color information is playing in conveying the item's museum value, and as a general rule, *the higher the value at risk to light, the tighter the control*.

Figure 2 unfolds the overall approach on how to assess value at risk to light of a collection item to help mitigate its light risk and manage its change adequately. To assess the value at risk to light of a collection item, one needs to understand the relation between the exposure to light of an item and the resulting loss of its museum value. This is done by first estimating the induced color change and then the consequent loss of value.

To quantify the light risk, the total loss of value at risk to light is evaluated by estimating the color change below which all color information would be lost. This threshold is expressed in JNDs and depends on the role of the color information in the museum value. For illustration purposes, this article will use an example with a threshold of 10 JNDs.

The next step is to set an expected lifetime for the item in the collection. This depends on the item's museum value, and as a general rule, *the higher the value, the longer the lifetime*. Suppose that the example in this exercise has an expected lifetime of 500 years.

The maximum acceptable color change (in JNDs) over the item's lifetime (in centuries) can be budgeted resulting in deducing a Preservation Target (PT), the period of managed use during which 1 JND is allowed. It corresponds in this example to 10 JNDs for the next 500 years and is equivalent to 1 JND for every 50 years.

The light dose allocated to the PT is quantified by assessing the item's material light sensitivity. In the example provided, for an item with light sensitivity equivalent to BWS1, the allocated light dose to PT corresponds to 100,000 lux-hours for the next 50 years.

The final step is to manage light risk associated with the use of the item by applying the reciprocity principle. This allows one to safely optimize the visibility of the item while maximizing the duration of its physical exhibition. Exhibit recommendations express the resulting balance.

Setting Levels of Light Control According to Value at Risk to Light

By applying this light control approach to the subset of the collection identified as highly sensitive to light, M+ is able to build broad categories of relative value at risk to light and to set levels of light control accordingly, following the general rule that the higher the value at risk, the tighter the control.

As indicated in figure 3, three levels were used to assess an item's museum value: High, Medium, and Lower. Each value level is associated with a lifetime for the item in the collection—the higher the value, the longer the lifetime. The role

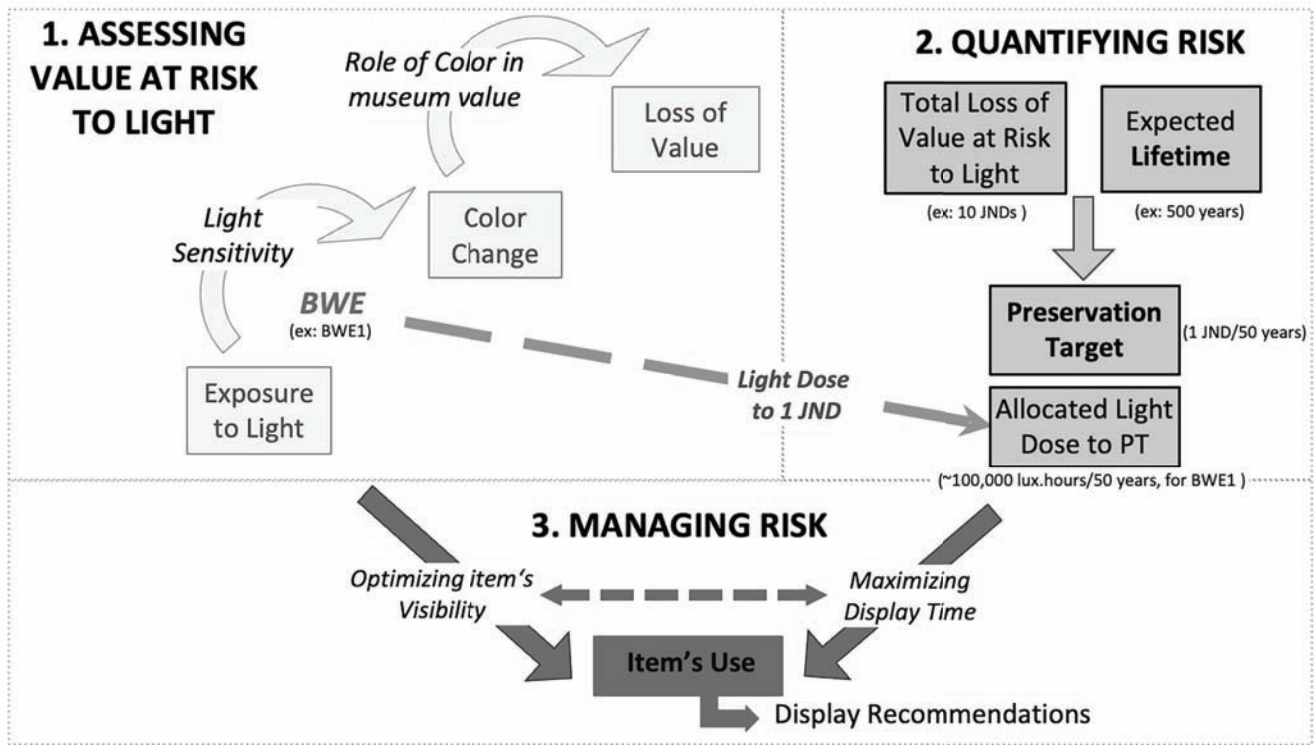


Fig. 2. Schematic showing use of value at risk to light of a collection item to help in managing its light risk.

		Museum Value		
		High	Medium	Lower
Role of Color Information	Important	A	B	C
	Average	B	C	D
	Smaller	C	D	D

Fig. 3. Category of relative value at risk to light by museum value and role of color information.

of color information is estimated by evaluating the impact of color change on the item’s museum value. Three levels were used: Important, Average, and Smaller. Each level is associated with a threshold of maximum color change (in JNDs). Four categories of relative value at risk to light are obtained: A, B, C, and D. Category A includes items with the highest value at risk and D with the lowest.

Each category of relative value at risk is associated with a PT: the higher the value at risk, the longer the PT. PTs reflect the commitment of the institution regarding the care and the use of

its collection: setting them is one of the most sensitive decisions regarding collection care. It is institution specific and should involve the entire institution and be endorsed at its highest level.

Figure 4 presents the PTs as currently set at M+ at its early stage of existence to fit its collection of contemporary visual culture.

Press Conference, with its high museum value and the important role of the color information, is a good representation of category A. An artist-designed poster would well represent items from category B, whereas an example for

Category of Relative Value at Risk to Light	Time to Reach 1 JND
A	20 years
B	10 years
C	5 years
D	2.5 years

Fig. 4. Value-based M+ PTs (in years) by category of relative value at risk to light.

M+ Preservation Target	Category of Relative Value at Risk to Light	BWE 1 (100,000 lux-hours)	BWE 2 (600,000 lux-hours)	BWE 3 (2,400,000 lux-hours)
20 years	A	Individually Assessed ~3.5% at 50 lux max (or 10 days/year) Loan highly restricted	Individually Assessed ~20% at 50 lux max (or 10 weeks/year) Loan restricted	Short Exposure ~80% at 50 lux max (or 9 months/year)
10 years	B	Individually Assessed ~7% at 50 lux max (or 3.5 weeks/year) Loan restricted	Short Exposure ~40% at 50 lux max (or 4.5 months/year)	Mid-Exposure No time restriction at 75 lux max
5 years	C	Individually Assessed ~14% at 50 lux max (or 7 weeks/year) Loan restricted	Short Exposure ~80% at 50 lux max (or 9 months/year)	Mid-Exposure No time restriction at 150 lux max
2.5 years	D	Short Exposure ~28% at 50 lux max (or 5 months/year)	Mid-Exposure No time restriction at 75 lux max	Mid-Exposure No time restriction at 200 lux max

Note: Max % of its PT, an item can be on display assuming ~ 150,000 lux-hours annual light dose; no UV / no daylight.

Fig. 5. M+ Exhibition recommendations for highly sensitive materials.

category C would be an installation containing black-and-white photographs as essential elements.

Furthermore, the M+ exhibition recommendations are formulated by cross-referencing the PT table—as just seen—with figure 1 that indicates the light dose to reach a JND for each BWS. They are presented in figure 5. To allow for easier viewing, note that this figure only includes the recommendations for highly sensitive collection items.

Overall Value-Based Decision Framework

Figure 6 summarizes the decision framework used at M+ to prioritize the mitigation of the light risk for items highly sensitive to light and to formulate its exhibition recommendations.

First, the category of relative value at risk to light of an item needs to be assessed using the table presented in figure 3. Once this is done, it is possible to quantify the light risk, and to deduce the item’s PT according to values shown

1. ASSESSING VALUE AT RISK TO LIGHT

Table 2: Category of relative value at risk to light

		Museum Value		
		High	Medium	Lower
Impact of Color Change	Important	A	B	C
	Average	B	C	D
	Smaller	C	D	D

2. BUDGETING CHANGE & QUANTIFYING RISK

Table 3: M+ Value-Based Preservation Targets

Category of relative value at risk to light	Time to Reach 1 JND
A	20 years
B	10 years
C	5 years
D	2.5 years

3. MANAGING LIGHT RISK

Table 4: M+ Display Recommendations
(Max % of its PT, an item can be on display assuming ~ 150,000 lux-hours annual light dose; No UV / No daylight)

M+ Preservation Target	Category of relative value at risk to light	BWE1 (~100,000 lux-hours)	BWE2 (~600,000 lux-hours)	BWE3 (~2,400,000 lux-hours)
20 years	A	Individually Assessed ~3.5% at 50 lux max (or 10 days/year) Loan highly restricted	Individually Assessed ~20% at 50 lux max (or 10 weeks/year) Loan restricted	Short Exposure ~80% at 50 lux max (or 9 months/year)
10 years	B	Individually Assessed ~7% at 50 lux max (or 3.5 weeks/year) Loan restricted	Short Exposure ~40% at 50 lux max (or 4.5 months/year)	Mid exposure No time restriction at 75 lux max
5 years	C	Individually Assessed ~14% at 50 lux max (or 7 weeks/year) Loan restricted	Short Exposure ~80% at 50 lux max (or 9 months/year)	Mid exposure No time restriction at 150 lux max
2.5 years	D	Short Exposure ~28% at 50 lux max (or 5 months/year)	Mid exposure No time restriction at 75 lux max	Mid exposure No time restriction at 200 lux max

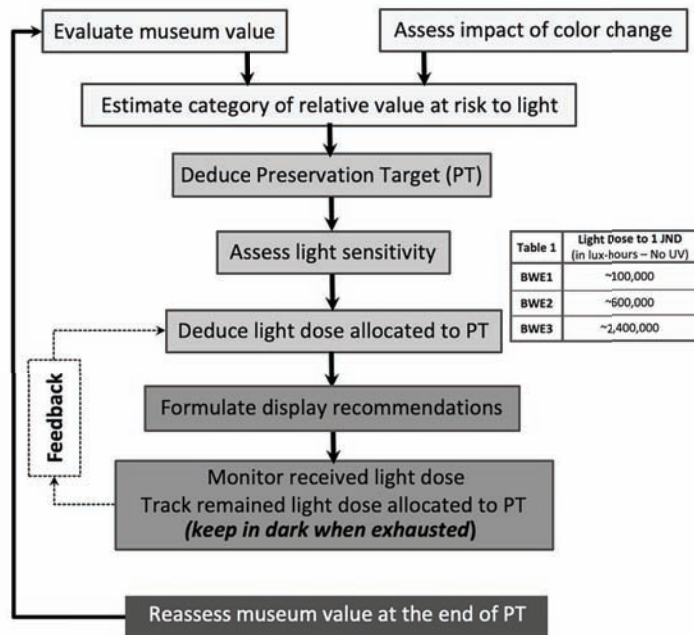


Fig. 6. Value-based decision framework to mitigate light risk as used at M+. Adapted from Beltran et al. 2021.

in figure 4, which have been approved by M+ executives. Light sensitivity can then be assessed. Once the item's BWS Equivalence (BWE) is estimated, the light dose allocated to the PT is deduced using the data already presented in figure 1. Light risk can then be managed over the item's PT according to the various contexts involving its exposure to light.

The reciprocity principle is applied on the light dose allocated to the PT, and the exhibition recommendations can be formulated as already mentioned (see figure 5).

Monitoring the light dose received is required, and the remaining light dose allocated to the PT is tracked and updated after each exposure to light. Once the light dose allocated to PT is exhausted, the item should be kept in the dark until the end of the set duration. At that end of it, the item's museum value is reevaluated along with its associated category of relative value at risk, and a new PT is then set.

Adjustments to Circumstances Associated with the M+ Opening

Some adjustments needed to be made to the overall decision framework to deal with the uncertainties and time pressure associated with the specific circumstances of the M+ opening.

They are highlighted in green in figure 7.

As museum value is still a working concept, making assumptions to approximate it was necessary: it was

estimated by assessing the importance of the item in the exhibition curatorial narrative. Three levels were considered. The role of color information was estimated in a systematic manner and using two levels only: Important, for all colored items and/or with low contrast, or Average, for black-and-white items with high contrast. The category of relative value at risk to light was then defined following table 2bis of figure 7, and the corresponding PT, deduced using data from figure 4 as already explained. Note that category D of relative value at risk to light as defined in figure 3 was not used for the opening exhibition to stay on the safe side.

Finally, to estimate the light dose allocated to PT, the light sensitivity of the selected items considered likely sensitive to light needed to be roughly estimated: as the conservation team was not in a capacity to assess item-by-item due to the limited access to the collection, it was decided that light sensitivity of any colored item likely would be equivalent to BWS1.5 and to BWS3 for black-and-white items on robust support. Corresponding data are shown in table 1bis of figure 7, and the resulting exhibition recommendations used for the M+ opening exhibition are presented in table 4bis of figure 7.

The implementation of a few actions, highlighted in purple in figure 7, are already anticipated to take place after the opening exhibition:

1. ASSESSING VALUE AT RISK TO LIGHT

Table 2bis: Categories of relative Value at risk for M+ Opening Display

		Importance in curatorial narrative		
		Anchor	Medium	Lower
Role of Color Info	Important	A	A	B
	Average	B	B	C

2. BUDGETING CHANGE & QUANTIFYING RISK

Table 3: M+ Value-Based Preservation Targets

Category of Relative Value at Risk to Light	Time to Reach 1 JND
A	20 years
B	10 years
C	5 years
D	2.5 years

3. MANAGING LIGHT RISK

Table 4bis: Display Recommendations for M+ Opening Display

Relative Value at risk to light	BWE1.5	BWE3
	A	~350,000 lux.hours ~12% at 50 lux max (or 6 wks/year)
B	~23% at 50 lux max (or 12 wks/year)	No time restriction at 75 lux max
C	~47% at 50 lux max (or 5.5 mths/year)	No time restriction at 150 lux max

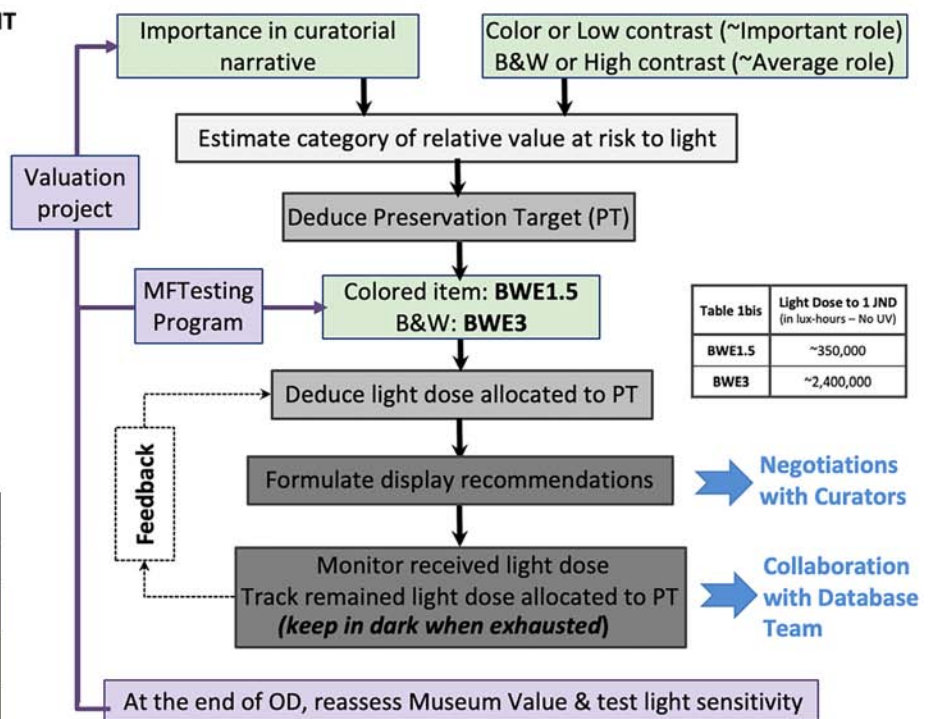


Table 1bis: Light Dose to 1 JND (in lux.hours - No UV)

BWE1.5	~350,000
BWE3	~2,400,000

Fig. 7. Adjustments to overall light risk mitigation decision framework to accommodate M+ opening circumstances.

- A proper method to assess the item’s museum value should be further researched, likely in a cross-departmental valuation project for the collection.
- A testing program using a microfader is expected to refine rough estimations of an item’s light sensitivity.

It is important to emphasize that the success of the proposed method to adequately mitigate light risk relies on two pivotal elements that ensure the continuity required for the rigorous monitoring of the remaining light dose allocated to the PT:

- The categories of relative value at risk to light and associated PTs as indicated in table 3 in figures 6 and 7 should be used consistently, before and after the opening exhibition.
- The light dose received during the opening exhibition needs to be adequately monitored to properly update the light dose allocated to the PT.

IMPLEMENTATION OF THE APPROACH TO THE M+ OPENING EXHIBITION

The implementation of the presented approach for the M+ opening exhibition required two collaborative processes. This article will now briefly show how rotations were discussed and negotiated with curators, and will also introduce the workflow used by the M+ databases manager to help ensure necessary tracking of the remaining light dose allocated to the PT.

Negotiating Rotations with M+ Curators

In the year leading to the beginning of the opening exhibitions’ install, the M+ conservation team launched a series of workshops with the curators. The decision-making process related to rotation developed during these workshops is presented in figure 8.

First, curators were briefed on the value-based approach and the PT. The rotations based on curatorial priorities for narratives were then carefully reviewed and corrected when ever needed. Once everyone understood the approach, it became apparent that some further refinement was needed considering how much, in some cases, curatorial priorities

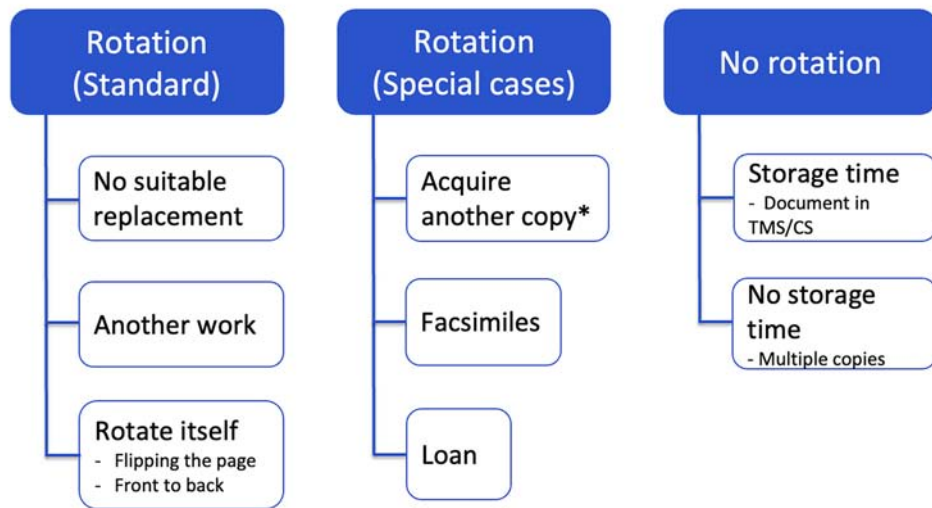
for narrative differed from what could be the item’s museum value. Relative value at risk to light was then updated accordingly using categories A, B, and C already mentioned. For each individual collection item, the annual light dose allocated by its PT was then calculated by Conservation along with the expected light dose received during the opening exhibition: any items with storage rest time of more than 3 years were selected for rotation. After reassessing museum values and PTs, the conservation and curatorial teams reconvened to discuss and agree on rotations before submitting the exhibition list to M+ management for approval.

The ways to rotate or not rotate is a constant negotiation. Curators carefully consider the impact of changing artworks that may be critical to their narrative or create an imbalance to the portfolio of artists they wish to represent, or the rarity of one artist’s work in the collection that makes it difficult to replace. M+ conservation and curatorial teams discussed the impact of extending exhibition time beyond the recommendations and explored whether there are other factors to consider, such as future loans or special exhibitions. The result of rotation decisions often falls into one of the scenarios presented in figure 9. It should be noted that although acquiring another copy for rotation has never been attempted in M+ history, it is now an option considered for further discussion within the organization.

The number of expected rotations for M+’s opening exhibition, following recognized best practices, was estimated to be 1835 rotations for about 800 highly light-sensitive items. This posed multiple challenges to an institution with a small collection and a growing team. Relaxing the international recommendations by including some adjustments related to the item’s material sensitivity allowed M+ to reduce the number of rotations significantly. Nevertheless, this latter approach does not factor in the curator’s assessment of the item’s value at risk to light, a core element for setting the PT, and results in the absence of any benchmarking behind the amount of storage time required and budgeting light exposure for the future. In contrast, the presented value-based approach allowed conservators and curators to negotiate the rotation of about 380 collection items while also taking into account the storage time post opening exhibition consequent to the decision made.

<p>1 Conservation to present lighting approach</p>	<p>2 Discuss rotation candidates (value at risk & material sensitivity)</p>	<p>3 Curators to confirm rotation list</p>	<p>4 Collection and exhibition team in M+ to assess rotation (i.e., manpower, schedule)</p>	<p>5 Endorsement by M+ management</p>
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Fig. 8. Steps of the decision process on rotation implemented during M+ opening exhibition preparation.



*In the future, can be flagged at acquisition after initial value assessment.

Fig. 9. Main scenarios used for decision on rotation.

Negotiation with curators is often educational and multi-disciplinary. It allows all parties involved to approach decision making from a holistic viewpoint, factoring in other considerations such as future loans, special exhibitions, limitations of the existing collection, and/or other intentions such as presenting female artists in narratives. The proposed rotation program will be reviewed by M+ management so that they can place adequate resources behind the effort. The decision to exhibit objects for a longer time than recommended and left unrotated needs to be justified and documented. For each item, associated storage time is logged into the collection management database until the museum implements a Microfade testing program, currently planned for 2022.

Recording and Tracking the Light Dose Allocated to the PT

Together with the collections database team, conservators are currently developing two different tools that will allow implementing the “light budgeting” approach in the museum’s everyday decision making. These tools will be incorporated into M+’s collection management system, Museum System (TMS) and Conservation Studio (TMS-integrated software).

The first tool is the “light dose recording sheet,” which allows recording of light dose received by a collection item during consecutive exhibitions (fig. 10).

The measurements will be taken during exhibition using a simple, multipurpose environmental monitoring device able to measure visible light. The light dose recording sheet allows recording multiple measurements during one exhibition. The light dose is calculated by multiplying the average visible light measured on the item and the time of exposure during consecutive exhibiting.

The second tool, presented in figure 11, is the “light exposure decision-making tool,” which allows for calculating recommended exhibition time and the maximum lux level for exhibition purposes. It consists of four different sections. The first section of the tool—estimated value at risk to light and associated PT—is where data required for all further calculations will be input: museum value, impact of color change, light sensitivity, and the year of the assignment of the PT. The second section shows exhibition recommendations calculated from data entered previously. Using the data recorded in the light dose recording sheet, the third section shows the light dose used so far and the annual light dose per given amount of time left until the end of the PT (1 year, 5 years, or 10 years—the timeframe will be gradually adjusted to museum operational needs). The fourth section is the “exposure calculator for exhibition planning,” which allows for informed decision making related to the time of exposure (and consequently rotations plan) for future exhibitions and advice on the required time in storage after the exhibition.

Once the design and implementation of the first tool (the light dose recording sheet) is finalized, it will be tested during the opening exhibition. The implementation of the second tool (the light exposure decision-making tool) within the rigid structure of the M+ database proved to be challenging, needing more time and labor. This tool requires interdepartmental collaboration and as such needs to be accessible to all the stakeholders involved in the decision making (curatorial, registration, and conservation). The M+ database team will be working on its development and implementation later this year.

CONCLUSION

Managing the light-induced change of an item over its PT allows some operational flexibility that permits reconsidering the rotation program planned for the M+ opening exhibition. For each item at risk to light, the decision was made while also considering the duration the item would need to stay in storage after exhibiting. The discussion resulted in reducing the number of required rotations to an operational manageable level during the opening exhibitions of M+ while still ensuring the preservation of the selected collection items for the set anticipated collection lifetime. Note that the method proposed assumes strict compliance to the exhibition limitations set by the item's PT and its material sensitivity to effectively mitigate light risk. A Microfade testing program is planned to refine initial estimations of light sensitivity for collection materials. Accountability for the decision made on the item's exhibition is also required. This relies on the management's involvement and its associated support and on the commitment of all stakeholders to stick to the decision made as documented and recorded in the collection database.

The M+ conservation team has seen how setting the PT according to the category of relative value at risk to light fits well with the specific needs of M+, its collection of contemporary visual culture, and expected uses. This effort should also be seen as the first step toward the implementation of a value-based collection care approach. Cross-departmental efforts to assess the value of collection items continue to develop. Once a method to estimate an item's museum value is set, the assessment of value at risk will probably be expanded beyond light risk and to various subsets of the M+ collection or processes. It is expected that a value-based approach to collection care helps increase the institution's sustainability as it permits to prioritize resources allocation on mitigating what is at greater risk.

This project is far from being finished and will require many other adjustments that will be shared in the future.

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From Book to Breechblock: A Preliminary Study of the Conservation of Waterlogged Paper Fragments from Site 31CR314, *Queen Anne's Revenge/La Concorde*

INTRODUCTION

North Carolina archaeological site 31CR314 was discovered in 1996 by salvage firm Intersal Incorporated, which was operating under a permit from the North Carolina Office of State Archaeology (OSA) to search for shipwrecks in the vicinity of Beaufort Inlet. During a magnetometer survey, a large debris field with heavy concentrations of iron was located. Since the wreckage lies within state waters, the management of the remains falls under the jurisdiction of OSA in accordance with state law (NC General Statutes Chapter 121, Article 3). Staff of OSA's Underwater Archaeology Branch examined the wreckage and dug exploratory excavation units to determine the extent of the debris field, the size of the ship, and a relative date based on artifact finds. This evidence coupled with historical research firmly established the identity of the shipwreck as that of *Queen Anne's Revenge* (QAR), the lost flagship of Blackbeard the pirate, which ran aground in June 1718.

Prior to its brief stint as a pirate ship, QAR had a much longer history as the French slave trade vessel called *La Concorde*. Over the course of three transatlantic slaving voyages from 1713 to 1717, *La Concorde* transported 1265 captive Africans from West African ports to the Caribbean to be sold into slavery. Blackbeard attacked and seized the vessel in November 1717 near Martinique at the end of the Middle Passage on its third slaving voyage. After renaming the ship, the pirate, with at least 300 men under his command and a purported 40 guns aboard his flagship, ransacked other vessels in the Caribbean before sailing north toward the mid-Atlantic. The ship eventually struck a sandbar outside the small town of Beaufort, North Carolina, and was abandoned to its fate.

In the three centuries since the vessel's loss, much of the organic matter constituting the ship proper has degraded due to the natural environment in the inlet. Warm water, dredging

activity, climate change, strong currents, large storm events, and the teredo nautilus, also known as the ship worm, have all contributed to the almost total loss of the hull structure, leaving behind a wreck mound comprising several hundred thousand individual artifacts that were once on board. Metals are the most abundant surviving material type, with the overwhelming majority being related to arms and ammunition, including lead shot, grenades, and cannon and their associated projectiles.

OSA established the QAR Conservation Laboratory (QAR Lab) in 2003 in partnership with East Carolina University in Greenville, North Carolina. The QAR Lab is tasked with conserving this unique collection while also conducting academic research and providing opportunities for student training and faculty collaboration. In recent years, the QAR Lab staff has developed outreach initiatives, such as lab tours, a project blog, classroom show-and-tells, virtual events, and public lectures, to broaden the project's reach. Following conservation, artifacts are transferred to the North Carolina Maritime Museum in Beaufort as the official repository. More than 400,000 artifacts have been raised from the wreck, with more than 112,000 objects having completed conservation and transferred for exhibit and curation.

QAR1445.000

The 29 cast iron cannon from the site are muzzle-loaders, meaning that the powder charge and projectile must be loaded from the front. Two wrought iron breechblocks, or reusable gunpowder chambers intended for use with breech-loaders, were found among a cluster of other objects relating to ammunition and may indicate the placement of a munitions locker (fig. 1). Breech-loading cannon are loaded from the rear and have a slot to accept the breechblock; no breech-loaders have been found on the wreck to date.

After x-raying it to assess its condition, conservation of the first breechblock (QAR1445.000) began with mechanical removal of the enveloping encrustation, typical of iron

Papers presented during the Book and Paper Group Session, AIC's 49th Virtual Annual Meeting, May 10-June 25, 2021

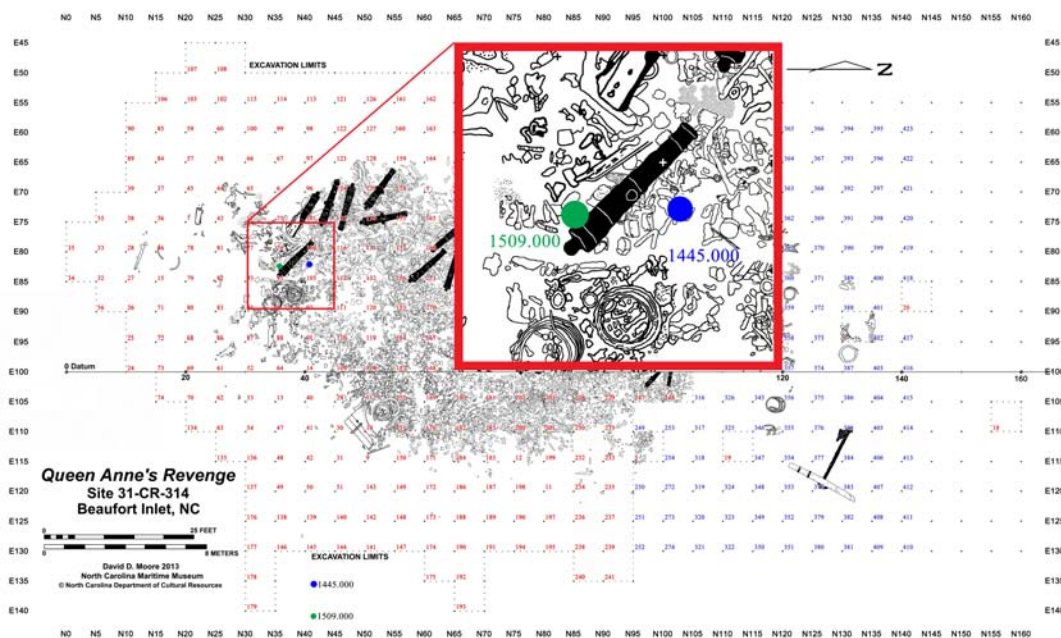


Fig. 1. Map of archaeological site 31CR314, showing location of two brechblocks. Courtesy of NC Department of Natural and Cultural Resources.

recovered from a marine environment. Once the underlying metal was exposed, further investigation revealed that the chamber was still sealed with a well-preserved wooden plug, or tampion. Despite the otherwise poor survival of organics from the site, excellent organic preservation is often seen within iron concretions, thanks to iron corrosion products effectively impregnating nearby fabric, bone, rope, leather, and, in this case, wood, and working to preserve them.

The sealed chamber indicated that the brechblock was still loaded with gunpowder and ready for use at the time of grounding. When the tampion was extracted, roughly woven fabric resembling canvas sailcloth was discovered acting as a gasket to further protect the chamber from water ingress, which would have ruined the gunpowder (fig. 2). The textile then began desalination to prepare it for impregnation and controlled drying. No attempt was made to flatten or unfold

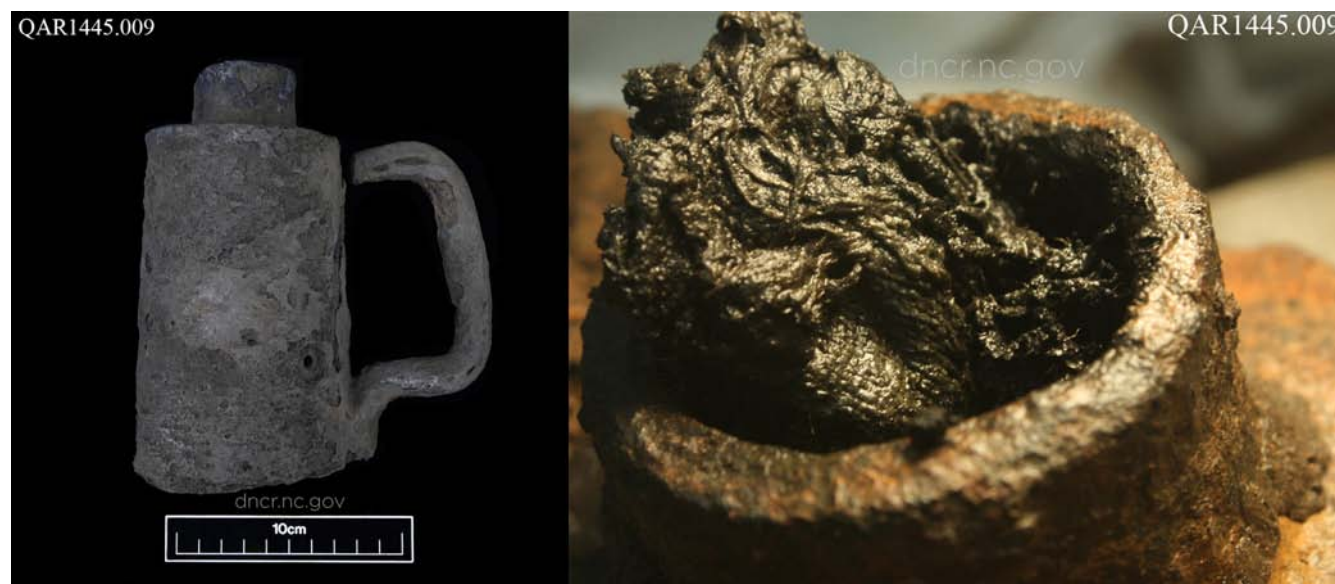


Fig. 2. Cleaned brech block (left) and textile gasket as discovered in mouth (right). Courtesy of NC Department of Natural and Cultural Resources.



Fig. 3. Printed paper while still wet. Courtesy of NC Department of Natural and Cultural Resources.

the textile, due to its fragility and retention of the shape of the chamber's mouth. After several months of desalination to remove harmful salts, a secondary material appeared in the water bath alongside the textile. Mild agitation of this extremely delicate mass of fibers revealed fragmentary text, signifying the discovery of printed material. Investigative microscopy confirmed the identity as paper (fig. 3).

Paper in any archaeological context is exceedingly rare, since most burial environments with moisture, acidity, and bacterial activity are not conducive to its survival. Archaeological paper from submerged sites, however, is almost wholly undocumented with very few exceptions, and no sufficiently detailed conservation reports could be located. Pages from a German bible were uncovered on a mid-17th-century shipwreck off the coast of Florida in 1964 (Harnett 1965), but present-day conservators at Florida's Bureau of Archaeological Research had no knowledge of their current disposition or previous treatment. A Dutch book on etiquette was found on the wreck of *Curaçao* (1729) in 1972. This was sent to the British Museum for treatment by Dr. Alfred Emil Anthony Werner, whose partial notes on their treatment were published (Sténuit 1977). Despite these sparse leads on the conservation of waterlogged paper, training as an archaeological conservator did not include discussions of paper; thus, it was deemed critical to speak with paper conservators for guidance on its proper treatment.

EMERGENCY CONSERVATION MEASURES

OSA conservators sought advice from several paper conservators, including Pam Young of Colonial Williamsburg and Lawrence Houston from East Carolina University's Joyner Library. The consensus was that water is the most damaging factor, and contrary to everything archaeological conservators who specialize in waterlogged materials are taught, the fragments must be dried immediately. Staff worked quickly to carefully examine and photograph the fragments, separate successive pages while still wet, and dry them.

Sixteen individual fragments were noted and given their own unique identification numbers (QAR1445.013–1445.028) for ease of reference during treatment (fig. 4). Each was placed between pierced Tyvek sheets, with absorbent Kimwipes applied to the exterior surfaces of the Tyvek. The packages remained in ambient temperature (25°C) and humidity (ca. 50%RH) although shielded from light while drying. The Kimwipes were changed the following day, and the packages were placed within a low-density polyethylene box with silica gel buffered to 50%RH to complete drying.

Once dry, they were photographed again under normal lighting to document any changes. Additional photography was attempted using UV and transmitted light, with varying results. Although generally too iron-impregnated to elucidate



Fig. 4. Sixteen individual paper fragments. Courtesy of NC Department of Natural and Cultural Resources.

further information using either technique, two fragments (QAR1445.013 and QAR1445.019) under transmitted light revealed distinct lines indicative of laid paper.

PARTNERSHIP

The OSA and the State Archives are both part of the North Carolina Department of Natural and Cultural Resources—separate divisions but sister institutions. In June 2016, State Archives conservator Emily Rainwater was invited to the QAR Lab to examine the paper fragments, which were still in their Tyvek sandwiches, and to provide guidance on their care and treatment. The two divisions decided to collaborate on the project, joining conservation knowledge, equipment, and resources to stabilize, analyze, and work on a plan for their long-term preservation.

It was decided that the paper fragments would come to the State Archives, where they could be better assessed. This also presented the opportunity to temporarily store the fragments in one of the State Archives' two microfilm security vaults where the average environmental reading is 13°C with 35%RH, and they are alarmed if conditions stray too far outside of those parameters. The project team was concerned that the orange staining may be iron corrosion from being in contact with the breech chamber for 300 years and that it would progressively worsen without strict environmental controls, namely a low relative humidity environment. The fragments were first carefully separated from the Tyvek and placed on mat board. The fragments did adhere to the Tyvek, depositing fiber samples for further analysis. A temporary housing was constructed for the fragments that would help cushion them during the drive from the QAR Lab in Greenville to the State Archives in Raleigh, North Carolina, 80 miles to the west.

DOCUMENTATION AND CONDITION ASSESSMENT

When first viewing the fragments under a microscope, it is apparent that this paper is very different from other contemporaneous paper samples. The fragments are incredibly soft and fuzzy, which is not very surprising after their eight-month bath as part of the routine desalination procedure. Any time the fragments are handled or moved, fibers become detached. The paper itself is stained black and orange, and some areas appear very thick and crusty. When viewed through transmitted light, only two showed any kind of transparency; the rest were black and dark.

The first step in this project was to document the fragments as much as possible. With the help of State Archives' photographer Mathew Waehner, micro-photographs of all 16 fragments were taken. These initial photos provided a baseline for the corrosion and could be referenced later to check for changes in appearance. A printed copy of each photograph was marked and annotated during the microscopic examination for the condition reports, noting areas of discoloration, unusual fibers, grains of sand, and, on several of the fragments, tiny gold-colored flakes.

About nine months later, a second set of micro-photographs was taken. These were again designed to capture the condition of the corrosion at that moment in time, and also provided the opportunity to take images of all of the fragments under UV light and in transmitted light. Although most of the fragments appear opaque in transmitted light, the images were still helpful, as they show how thin some areas of the paper support actually are due to loss of fibers. Fragment QAR1445.016 looks fairly complete in ambient light, but in transmitted light it is apparent that the top two pieces on the right and left sides are incredibly thin and almost detached (fig. 5).



Fig. 5. QAR1445.016 in ambient, UV, and transmitted illumination. Courtesy of NC Department of Natural and Cultural Resources.

As part of the efforts to document, research, and create a plan for these fragments, the project team reached out to the Winterthur/University of Delaware Program in Art Conservation (WUDPAC) for advice. Dr. Melissa Tedone and Dr. Jocelyn Alcántara-García spoke with the project team first over the phone and then arranged a visit to North Carolina to view the fragments in person and get a better sense of their unique characteristics. The team discussed their concerns about the stability of the iron corrosion, the possibility that the golden flecks were evidence of iron pyrite that can lead to pyrite decay, and the risk/benefit of various treatment options.

In July 2017, the project team was able to bring a few selected fragments to WUDPAC for analytical testing and fiber analysis. Fortunately, the ED-XRF analysis did not show an overlap of iron and sulfur. Iron sulfide would have indicated the presence of pyrite and furthered concerns about pyrite decay.

The project team worked with other external partners to image and holistically document the fragments with a primary goal of bringing out as much text as possible to help identify the volume from which the fragments came. Dr. Erich Uffelmann of Washington and Lee University brought a portable multispectral imaging (MSI) device, as well as two different IR cameras, to the State Archives in November 2016. In March 2018, the fragments were taken to Duke University Libraries, which had recently purchased their own multispectral imaging system. The Duke MSI team was able to take images of the fragments at a much higher resolution than Dr. Uffelmann's portable setup, and they provided some interesting manipulations of the image stack in their report.

TEXT IDENTIFICATION

The visible printed lettering on each fragment was transcribed while wet during the initial salvage and then again following drying, in case of loss. In addition to legible text, italicization and capitalization were noted, as well as cases where print was visible but not legible, distinguished with question marks or possible iterations. Most fragments only held singular or partial characters or were entirely devoid of print. Three fragments (QAR1445.016, QAR1445.019, and QAR1445.021), however, included the distinct words "South," "(f)athom," and "Hilo," which would be beneficial in determining a source.

A directional term (South) coupled with a depth reference (fathom) suggested the source text was a navigational treatise, an important type of document in a time where years-long sea voyages were critical in expanding European interests. The search began with identifying English-language voyage narratives printed prior to 1718, a *terminus ante quem* established by the loss of the vessel. Armed with "Hilo" as a unique search term, this helped narrow the possibilities. Since it was italicized, capitalized, and the Spanish-language

word for "thread," Hilo was thought to refer to a place along the Spanish holdings in the Caribbean or Central or South America. The modern-day city of Ilo, Peru, was a good candidate and focused research to a specific location.

When no satisfactory results were forthcoming, assistance was sought from codicologist Dr. Johanna Green at the University of Glasgow. Dr. Green provided advice on relevant databases such as Early English Books Online and Eighteenth Century Collections Online, and in her own searches discovered a possible connection to the writings of William Dampier, prolific seafarer, pilot, naturalist, and geographer.

Although none of Dampier's works matched the QAR fragments, his travels to the South Pacific in the late 17th and early 18th centuries led to the discovery of many other published accounts of those same voyages written by his fellow crewmen. The village of Ilo, Peru, was ransacked by English buccaneers led by Bartholomew Sharpe in 1680, the tale of which was published by several crew members on that voyage and retold in the accounts of later expeditions to the area. The spelling of Ilo varied between authors (Ilo, Hilo, Ely, Ylo, Heloe, and He lo he), which further aided in eliminating sources.

After a year of research, the "Hilo" fragment (QAR1445.021) was found to match lines 17 through 21 on page 178 of the first edition of Captain Edward Cooke's *A Voyage to the South Sea and Round the World* published in 1712 (fig. 6). Cooke was the second captain of the ship *Dutchess* on a privateering voyage led by Woodes Rogers that departed Bristol in 1708. Once the "Hilo" fragment was placed, several other fragments could be matched with text on pages 183 through 188, from the same central location on each page, suggesting that the pages were ripped directly from the bound book before being used secondarily in an artillery context.

The significance of this discovery is multifaceted. The use of printed paper as ammunition is unparalleled in the archaeological record, and the presence of books on board ships, although not uncommon according to historical research, may speak further to the prevalence of literacy among sailing crews. Additionally, Woodes Rogers, leader of the 1708 voyage described by Cooke, arrived in the Bahamas in 1718 as the new royal governor. Rogers was dispatched to eliminate the rampant piracy gripping the colony, and historians have speculated that Rogers's arrival may have directly sparked Blackbeard's departure. Although it is highly unlikely that a motive will ever be established for the use of pages from this specific book as ammunition, a possible link between an infamous pirate, a pirate hunter, and the series of events leading to the book's use in this context has inspired much lively discussion and theorizing.

TREATMENT

The project team completed a risk assessment with various treatment options including no treatment, a consolidation

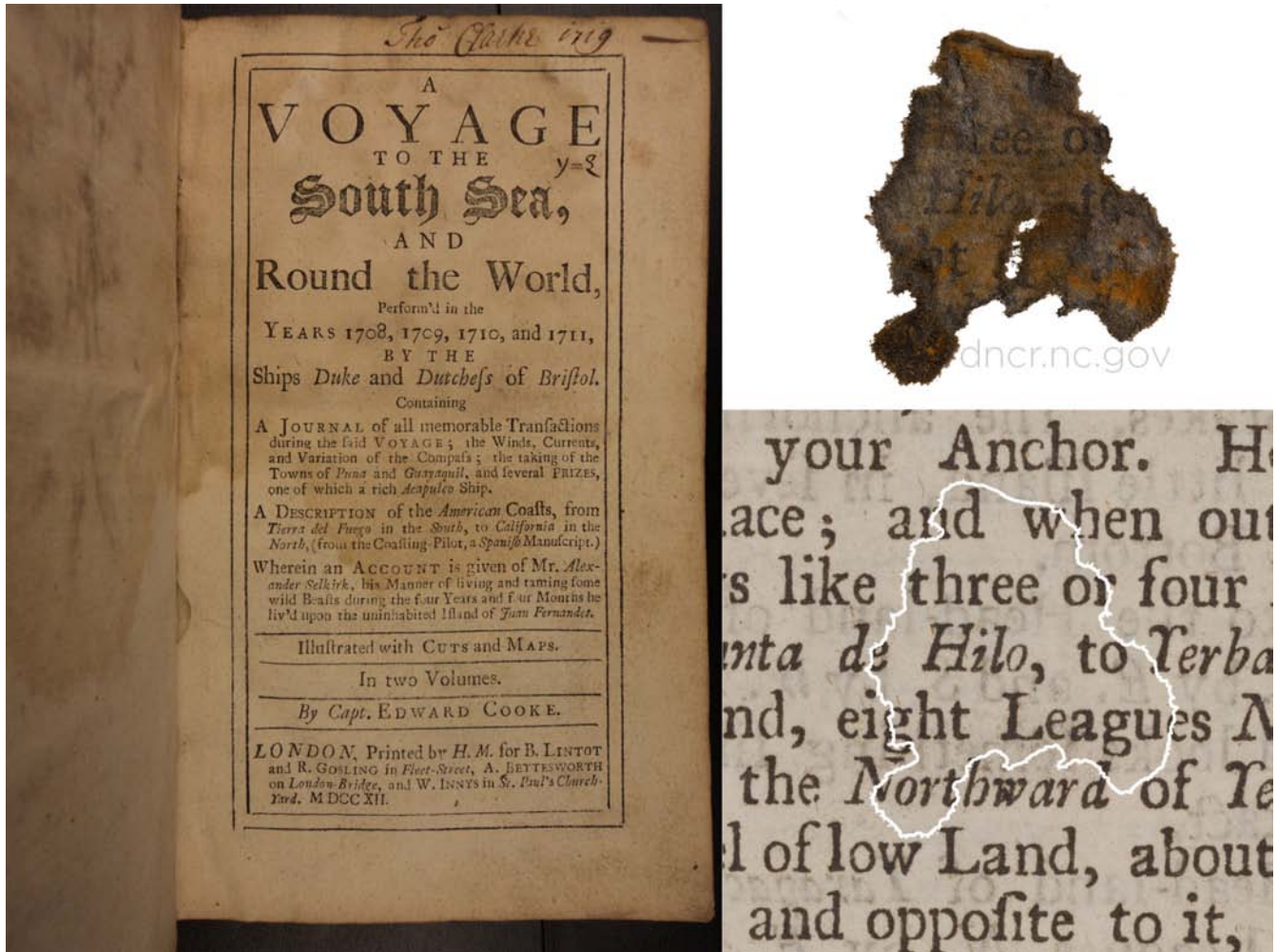


Fig. 6. Title page of *A Voyage to the South Sea and Round the World* (left) and the “Hilo” fragment with corresponding text on page 178. Courtesy of NC Department of Natural and Cultural Resources.

and/or sizing treatment, an aqueous treatment, and an aqueous complexing treatment. Although subjecting the fragments to any further aqueous treatment had already been ruled out, the project team wanted to document both the possibility and the reasoning against it. After further consultations with colleagues, it was decided to carry out a consolidation treatment with Klucel-G in ethanol on two of the fragments. Prior to the treatment, a set of color-calibrated images in a standardized setup was completed to provide as accurate and reproducible of an image as possible. QAR1445.014 was chosen because it was one of the smaller fragments without text that still had a good color variance; QAR1445.022 was chosen because of the heavy particulate layer, the slightly larger size, and the appearance of printing ink in one area that has not been tied to a known location in the text.

Before treatment, the fragment was first gently prodded with a paper point to assess current vulnerabilities. A 1% solution of Klucel-G in ethanol was applied with a 000

brush underneath the microscope (fig. 7). After drying, the fragment was again gently prodded with the paper point to assess friability and determine if a second coat of Klucel-G was needed. After-treatment images of both fragments were taken immediately (figs. 8, 9); after six months, the efficacy of the consolidation treatment will be assessed and another set of calibrated images will be taken to look for color shift. The project team can then decide if additional fragments will be consolidated in the same manner.

CONCLUSION

In January 2018, the QAR team announced the discovery of the fragments at the Society for Historical Archaeology conference, and the official department press release was published. The story got picked up by news outlets all over the world, and QAR conservators did multiple interviews. Once the news spread, staff spoke with several other conservators



Fig. 7. Applying a 1% solution of Klucel-G in ethanol to QAR1445.022. Courtesy of NC Department of Natural and Cultural Resources.



Fig. 8. QAR1445.014 after treatment. Courtesy of NC Department of Natural and Cultural Resources.



Fig. 9. QAR1445.022 after treatment. Courtesy of NC Department of Natural and Cultural Resources.

seeking advice on waterlogged paper, both within the United States and abroad. The discovery has also been published in the *North Carolina Historical Review* (Farrell et al. 2018) and presented at the Nautical Archaeology Society annual conference in the UK.

Since the initial paper discovery, remnants of paper cartridges have been recovered from 7 of the 12 cannon that have been fully cleaned and unloaded. This is clearly a different grade of paper, thicker and coarser. One cannon (QAR636.000) produced an extremely well preserved cartridge, representing about one-third of the original circumference. It retained the cylindrical shape of the chamber, as well as the thread used to sew the cartridge closed. Much like breechblock QAR1445.010, this cannon (C15) was well sealed with a tightly fitted wooden tampion, creating a protected environment that prevented extensive degradation of the organics within. Unloading and conservation of the second breechblock (QAR1509.010) produced neither textile gasket nor further paper.

With an established drying methodology in place, upon recovery, paper is now rinsed fully of gunpowder residue,

sandwiched between spun polyester and blotter paper, and placed in a desiccator buffered to 50%RH. The blotter paper is changed as soon as it is sodden. Most of these fragments are flat, but in the case of the cylindrical cartridge, a high-density polyethylene form covered in blotter paper was used to retain its original shape and provide support.

This project has proven to be a successful case study on collaboration across various subfields of conservation. The highest priority was always what was best for the paper, which led to building a qualified team of experts to achieve that goal. Collaborating with analytical scientists and paper specialists culminated in a firm strategy to progress the treatment of this unique find.

ACKNOWLEDGMENTS

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Defending the Diefenbunker's Murals: Conservation and Protection of Two Murals Displayed Three Stories Underground

THE HISTORIC SITE AND MUSEUM

In August 1958, at one of the highest tension points during the Cold War, Canadian Prime Minister John Diefenbaker announced his government's proposed construction of contingency bunkers across the country as part of a continuity of government program. This ensured that governments from a municipal to a federal level would be able to, theoretically, run the country in the event of a significantly destructive event in Canada, such as a coordinated nuclear attack. The term *Diefenbunker* was actually a political jab that was made by the opposition parties to refer to the structures, but the name was quickly picked up by the media at the time and has stuck ever since.

The official term for the site is the *Central Emergency Government Headquarters*, as it was meant to be the hub of all nationwide emergency bunker sites. It was constructed between 1959 and 1961 and was completed on time and on budget using the "Critical Path Method" in its engineering: each floor was planned while the foundations below them were already being built.

Workers labored around the clock to construct the 100,000 sq. ft. structure, all of which was made with hand-poured concrete (fig. 1). Once buried, the structure was 75 ft. underground from top to bottom and could withstand the blast of a 5 megaton (mt) nuclear bomb at a distance of 1.8 km (1.1 mi.). To put that into perspective, it is the explosive equivalent of five million metric tons of dynamite and is 250 times more powerful than the bombs that were dropped on Hiroshima and Nagasaki in 1945.

On the surface, the Diefenbunker was an active military facility for 32 years, from 1962 until it was decommissioned in 1994. For that period, there was a staff of 100 to 150 soldiers stationed on a rotational basis for mainly communications purposes (fig. 2). At its height in the 1980s, this site would process up to 100,000 messages per month, each one having



Fig. 1. Construction of the bunker, ca. 1960–1961. Courtesy of Diefenbunker: Canada's Cold War Museum.

to go through the lengthy process of decryption and encryption before entering and leaving the site.

Civilian personnel from Emergency Preparedness Canada would also participate in annual drills on-site in mock lockdown situations. Their role would be to assess the damage and needs of civil infrastructure and civilian population after a nuclear attack in Canada (fig. 3). The bunker was equipped to receive information from Emergency Preparedness Canada sites across the country to track fallout patterns and provide briefs to the government.

Underneath these routine operations, there was the true purpose of the site that was meant to be a secret. This true purpose was essentially an open secret before construction was completed. In 1961, toward the end of the Diefenbunker's construction, an intrepid reporter from the *Toronto Telegram* took aerial photographs of the site. The true scope of the project was revealed by one crucial detail in the photographs: 78 bathroom stalls were set up on the site for construction workers. The headline to this reporter's story was "Seventy-eight bathrooms—and the army still

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Fig. 2. Teletype operators at work in Canadian Forces Station Carp, ca. 1980. This is a staged photograph from inside the Bunker of military teletype operators who would write and relay messages through the Bunker to various military bases across the country. Courtesy of Diefenbunker: Canada's Cold War Museum.

won't admit that...This is the Diefenbunker." Even then, public speculations ran wild from joke suggestions that the site was where the government would bury tax dollars to the outlandish claim that the site would hoard the country's stockpile of bananas, to be sold at an exorbitant price once the country returned to normal.

Although many news stories and claims were published, the true purpose of the site was later revealed. At the first threat of a nuclear attack, the goal was to have 500 to 600 military and civilian personnel rushed to the bunker to direct the country's emergency procedures for the next 30 days. Each person was personally selected and was sworn to secrecy, never to reveal

their work to anyone. Of these, 10 to 12 government ministers would be in the bunker ideally, but in an emergency situation, only five people were needed to make up a complete government. In the War Cabinet Room on the bunker's second floor underground, the emergency government would meet to discuss and take actions based on information from Emergency Preparedness Canada and the military. This is where the country would be run. At the same time, relevant government departments and ministries would have had offices on this floor to run their mandates during a domestic conflict.

During a lockdown, the facility was equipped with all of the amenities required to stay underground for 30 days. Air



Fig. 3. Simulated exercise in the Emergency Government Situation Centre, ca. 1986. Courtesy of Diefenbunker: Canada's Cold War Museum.

was filtered into the bunker through a five-stage system that removed radioactive air particles while water was pumped from two deep wells. The country could be notified of ongoing public service information from a Canadian Broadcasting Corporation studio that broadcast from the site nationwide. For eating, the site had a sizable cafeteria that contained a regular supply of fresh food that would last for 10 days before switching to packaged rations. Soldiers and civilians could exercise at a fitness room in the hallway to the former Bank of Canada vault.

For sleeping, bunk beds were provided for other ranks and civilians on a rotational basis, whereas officers and directors were given private quarters. Only the prime minister and the governor general were given a private suite, attached to their offices and containing a bathroom with its own shower. One of the most telling features of these two suites are two single beds, highlighting the order that only chosen individuals came underground and not their families, whose fate would be unknown.

These dual purposes, one surface and one secret, dictated life in the bunker from 1962 to 1994. After the dissolution of the Soviet Union in 1991 and the presumed end of the Cold War, Canada began to decommission its line of emergency government buildings. Some of the bunkers were sealed off

with concrete or otherwise destroyed to prevent others from using them for their own purposes, some were sold in private auctions, and some are still located on existing military bases. The site closed in June 1994, in the same year it was designated a National Historic Site by the federal government. Over the course of three years, a group of dedicated volunteers were permitted to do fundraising tours of the site, which generated local interest. By 1998, the museum was founded and continues to give tours of the structure. The museum's mandate is "to increase throughout Canada and the world, interest in and a critical understanding of the Cold War, by preserving the Diefenbunker as a national historic site, and operating a Cold War museum." Through this, the museum intends to use the period as a lesson in de-escalation, diplomacy, and peace building. Prior to the COVID-19 pandemic, the museum received its highest visitor numbers at 80,000 in 2019. Although it has been a difficult period for the museum, the lessons taught to the public have been a learning experience in trusting resiliency and calm for moving forward in a time of crisis (fig. 4).

The stresses of underground confinement coupled with the stress of a conflict above ground and uncertainty



Fig. 4. Tour being given to the public, 2003. Courtesy of Diefenbunker: Canada's Cold War Museum.

over family and friends could be overwhelming. When the bunker was being constructed, planners partnered with psychologists to design the spaces people would be working in continuously. Because of its confinement, psychologists were inspired by submarine psychology and the extended periods underwater. Striped columns and floors were used, which were intended to trick the mind into thinking the space was wider than it actually was. Desks and chairs were fabricated in cheerful colors like bright orange, yellow, and blue. And finally, starting in the early 1980s, these “windows” were placed in the recreational areas of the bunker to simulate life above ground. Wide open scenes of nature were intended to stave off the monotony of the work and the confinement of space.

Although no evidence has yet been found, it is speculated that at one point there were four seasons on display, judging by the scenes currently known: spring or summer at the Bow River Valley in Alberta and waterfall at Yosemite, and another documented but now removed autumn scene of a wooden mill on a river.

The Bow River scene is found in the cafeteria, and the Yosemite waterfall is found in the Spy HQ Youth Room, which was once the senior officer's exercise area (figs. 5, 6). Over the years, they were exposed to functions and education programs, as well as the outside elements seeping in through the concrete. In 2020, it was decided someone needed to

come in to bring some tender love and care to the museum's scenes of nature.

THE MURALS AND THEIR CONDITION

These two “windows” had suffered from the usual culprits of damage witnessed in every historic site: people and climate. Both murals are composed of eight sheets of heavy-weight paper mounted to the walls with a rubber-based adhesive. The images are printed using half-tone, offset lithography. The Bow River mural measures 3.3×2.6 m, and the Yosemite mural measures 2.5×4.3 m. The works are posters mounted in a marouflage style; however, due to their large size, they will be referred to as murals, despite that they are not painted directly onto the wall. Both works are found on the second level of the building, or three stories below ground. There is no protective covering, making them vulnerable to mechanical damage. The Bow River mural is found in the cafeteria, where it has suffered from abrasions, scratches, and losses. Sixteen areas of mechanical damage were noted on this mural, ranging from less than an inch to 6 in., including areas with scratching. Most of the damage was from the center down, where people had likely abraded against the print and accidentally snagged it. Four areas of damage had been previously infilled with “printer paper” and inpainted with felt-tipped marker. Four areas of damage, oddly located at the top of the



Fig. 5. Yosemite mural in the programming room.



Fig. 6. Bow River mural in the cafeteria.

mural, had been inpainted without any infill paper beneath. Surprisingly, for a work of art in a cafeteria, there was only one stain, and that was way up above in the area depicting the sky.

As well as being subjected to mechanical damage, the Yosemite mural is mounted to an exterior wall and is suffering from climate fluctuations. Although the walls are thick poured concrete, and this room is three stories underground, moisture does seep through. No water or flooding has ever occurred; however, the author has previous experience with mold growth on artifacts stored at exterior walls in other areas of the museum. The moisture levels are high enough to cause minor and major bubbling of the paper. The largest area of bubbling was in the center, measuring $40 \times 43 \times 20$ cm, with a total of 50 bubbles found throughout the mural ranging from long narrow ridges to 1-in. round bulges. Bubbling in the wall paint alongside the mural confirms the source of the problem.

The Yosemite mural was also unprotected from the accidental abrasions, scratches, tears, and losses caused by visitors. About 30 spots of damage were documented, most of them likely due to the room's use as a children's educational programming space. This mural did have staining due to splashed liquid, as well as graffiti marks in the form of pen and marker streaks and a 3-in.-high "stick figure."

In addition, as with the Bow River mural, many areas of damage had been infilled with "printer paper" and colored with felt-tipped markers. These repairs were fairly well done, in the sense that they tricked the eye relatively well, and they are only noticeable when one closely examines the images.

TREATMENT

Treatment began with stain reduction. Since these murals are meant to be aesthetically pleasing, and their role within the site was as "windows" to the outside world from inside a Cold War bunker, the marks of wear caused by visitors were to be minimized as much as possible. The media was actually fairly friable when rubbed, as well as soluble in most solvents. Removing the sections for treatment and remounting was going to prove far too costly; therefore, a poultice was used to deal with the staining.

Neither gellan gum nor agarose gum was going to stay in place on a vertical wall, and methyl cellulose was too wet for most areas. The best solution was to apply Laponite RD to pull out the stains. A synthetic layered silicate product, Laponite RD is commonly used in book conservation to soften and draw out glues, as well as in object conservation for cleaning marble and alabaster. It is well known as a poultice for removing stains on stone. Commercially, it is used in toothpaste, paint, personal care products, and household cleaners (fig. 7).



Fig. 7. Laponite on a cotton swab showing products of staining absorbed by poultice.



Fig. 8. Before and after stain removal with Laponite.

Laponite is thick, stays in place, and is not as moist as methyl cellulose. It did a brilliant job of dissolving and wicking out the stains. It was applied with cotton swabs, left to sit for one to two minutes, then removed by a cotton swab, and the process was repeated until satisfactory results were achieved. The areas were given a final, light swabbing with slightly dampened paper towels to remove any possible residues (fig. 8).

This poultice also worked very well on the pen marks, although it left slightly white spots that had to be toned later on with watercolor pencils. Reduction of the stick figure took many applications of Laponite, followed by some blending of the area with watercolor pencils until there was only a slight hint left of the sightseer (fig. 9).

Once the stains had been addressed, removing the bubbles was the next challenge. The paper had actually expanded in these areas and required shrinking prior to re-adhesion. Evidence of the original rubber-based adhesive was visible at the seam lifts and at small areas along the edges of the printed paper. Rubber-based cement can be reactivated with heat, and heat would also dry and shrink the heavy-weight paper. This approach worked very well for the smaller bulges and the long thin bulges (fig. 10). A hair dryer was set on full blast, and full heat was held fairly close to the wall, and slowly but constantly moved over the bubbles while smoothing them with a Teflon folder. Due to the issues with moisture at the exterior wall, it is likely that this process will have to enter the



Fig. 9. Before and after removal of stick-figure graffiti.



Fig. 10. Using heat from a hair dryer and Teflon folder to remove minor bubbling.

museum's regular maintenance plan and be repeated every few years.

The larger bubbles required more than just heat to shrink the paper back and reactivate the adhesive. To ensure that the bulged paper stayed in place once shrunk, Jade 403 PVA adhesive was injected with a syringe at the top of the bubbles and spread out with a Teflon folder. Jade was selected for its instant stick, low reaction to moisture once set, and low moisture content. However, because of these desirable characteristics, the paper had to be shrunk with heat before the glue set and smoothed while it was cooled. The palm of the hand worked best for smoothing as the paper cooled, allowing for the detection of any voids that could be attended to immediately (fig. 11). Should the rubber-based adhesive get to a point where it fails all over, and the mural requires dismounting, isopropyl alcohol can be employed to soften the Jade 403 PVA adhesive enough to remove the panels.

Once the bubbles were taken care of, the lifting paper at the seams of the mural were secured and the losses infilled with Japanese paper. Kitikata cream was chosen for its weight and dual surfaces, one face being smooth to match the mural paper and the other being rough, providing grab for the adhesive. Jade 403 PVA was employed again for its low moisture

content, nonreaction to high-moisture environments, and instant stick. The losses were then colored using Faber-Castelle and Winsor & Newton watercolor pencils. These could be blended beautifully to mimic the half-tone printing process and applied in a variety of ways to produce the right sheen. Using a combination of wet pencils, blending with wet cotton swabs, and dry pencils ovetop, layers of coloring could be built up, creating the illusion of tiny multicolor dots (fig. 12). The watercolor pencils were also employed to smooth out the old inpainting, whose infills were left in place.

After the challenges of the Yosemite mural, the Bow River mural seemed easy. The losses were infilled in the same manner, coloring them with the watercolor pencils, and the previous inpainting was blended.

THE BARRIERS

Now that these windows were ready to be shown off again, a little protection was in order. However, being a historic building, no permanent alterations to the building's structure can be implemented. Nothing can be attached to the walls, the floor, or the ceiling. The barriers had to be free standing and yet sturdy and safe for the viewing visitors, including



Fig. 11. Before and after removal of larger bubbling.

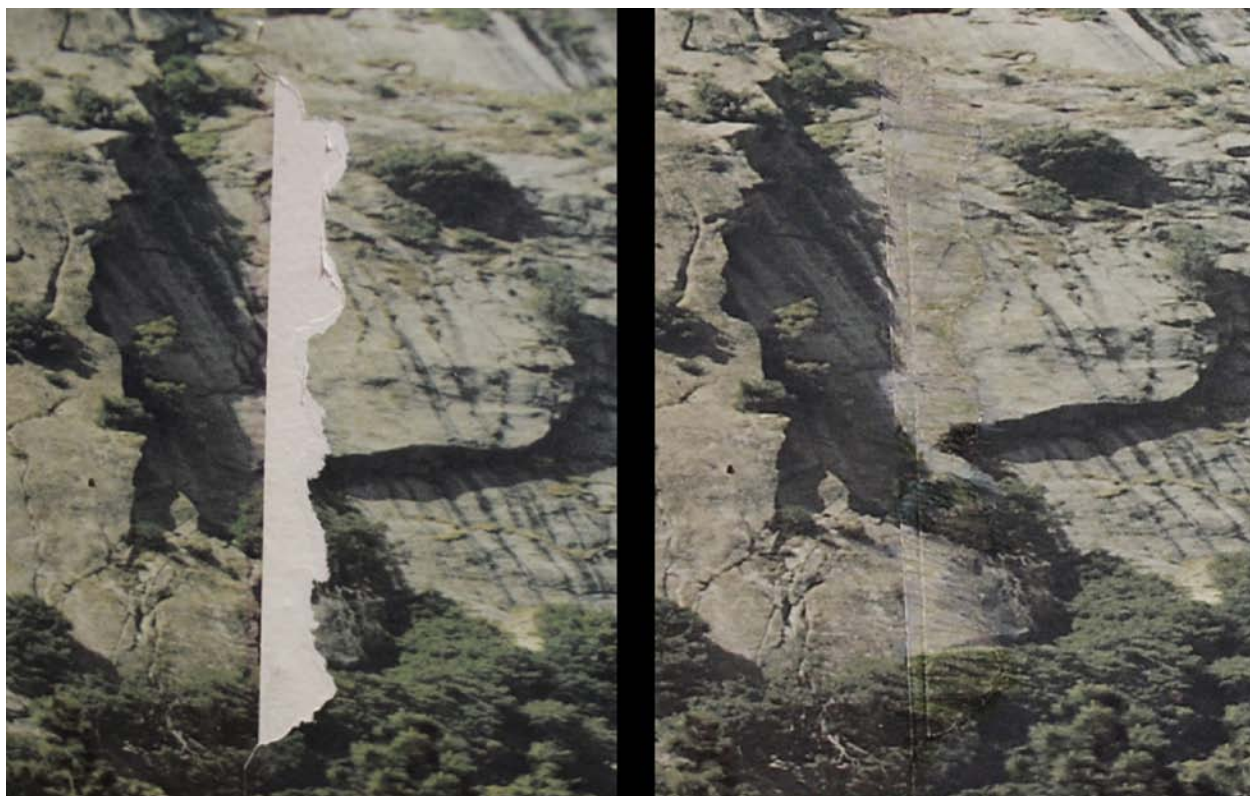


Fig. 12. Before and after infilling loss and inpainting with watercolor pencils.

children. It is imperative that they avoid creating microclimates, especially with the Yosemite mural mounted on the exterior wall. The barriers also had to be visually unobtrusive, in keeping with the feel of the site, and constructed with a limited budget based on grant funding.

The first concept met almost all of these needs. Clear Plexiglas sheets, in an aluminum frame, were slightly angled backward for safety, with concrete slabs in the base for stability. This proposal was ideal, but it presented several complications. The barrier would have to be assembled on-site and required exact engineering. It also called for oversize, custom-made Plexiglas sheets, which during the height of COVID-barrier installations at grocery and retail outlets might as well have been called *unobtanium*. These barriers were also going to cost about \$4000 each, and that was with the labor of making the frame and installation being donated. A simpler solution was called for.

A barrier only half the height of the murals, constructed of three standard-size, 4 × 8 ft. sheets of Plexiglas, bent to create arms for stands, and bolted together became the ultimate solution (figs. 13, 14). Although this barrier would not fully cover the murals, they would keep people at almost arm's length away, protecting the works from abrasions and scratches and hopefully ward off any future

stick-figure artists. These barriers minimally obstruct the visual effect of the murals and are reminiscent of barriers found at national park sites. They are also easily moved for cleaning and do not create microclimates. A steel kick-plate and feet were added to the bottom, creating stability and durability. These cost less than \$1000 each to have constructed and installed.

WORKING UNDERGROUND

Visiting this unique site is always exciting; however, working alone three stories below ground is a challenge. Peace and quiet when conducting a treatment is usually welcome, but the presence of others, natural light, and the ambiance play a huge role in preventing mental strain. The museum's employees all work on the fourth level, which is the top level. They have modern offices, where they grow plants, they have lounges, and many people are milling about and conversing. Although there are no windows, it is not a far walk to take a break outside. These steps have produced a pleasant working space for staff. For a conservator, working in isolation, three stories underground, in an atmosphere that resembles the set of a 1960s horror film, in the midst of a pandemic, the morale is different (fig. 15).



Fig. 13. Barrier showing bent Plexiglas sheets, feet, and kick plate.



Fig. 14. Barrier solution.



Fig. 15. At work.

The project only lasted five days on site; however, it was mentally draining. The work itself required high concentration, making music or podcasts overly distracting. All of the equipment and tools had to be carried in and thus limited what could be brought to what was deemed essential. In hindsight, bringing in additional lights to fill in the flicker of the fluorescents was a requirement. Regular breaks were needed; however, the elevator required a key, and climbing the three flights of stairs every time seemed very wasteful of the limited time on-site.

At the end of each day, the long path was taken up the stairs and through the tunnel toward the exit. Coming out into the bright sun caused painful adjustment for the eyes. Visitors, of course, do not experience this, as they are only there for a few hours and generally are not alone. Working in this situation makes one realize the importance of those murals for the mental well-being of those who were in the bunker on a daily basis. Even with many colleagues around, reminders of the outside world would have been extremely important.

CONCLUSION

A historic site commemorating and illustrating Canada's Cold War experience, the Diefenbunker: Canada's Cold War Museum is enjoyed by visitors of all ages. The two

murals on the second level attest to the forethought put into the psychological well-being of the people who worked here and remind us of the hardships faced by the dedicated military personnel trusted with the continuity of our nation's leadership. The conservation challenges presented by years of exposure to the damage of visitor traffic and climate issues were mitigated through careful and exacting treatments. A simple barrier, meeting the needs of the museum, the historic structure, and the murals was brought to fruition. Likely, the Yosemite mural will require frequent attention to keep the bubbles at bay, but in the meantime, these "windows" are defended.

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Does Paper with Iron-Gall Ink Corrosion Benefit from Nanocellulose-Phytate Treatment?

INTRODUCTION

Iron gall inks have been among the most common writing materials for centuries. Often, due to their mixture and complex chemistry, these inks cause ink corrosion—a complex degradation process of cellulose in the paper (Wunderlich 1994; Díaz Hidalgo et al. 2018). The ink components (iron[II] sulfate and acids), usually present in excess, catalyze two major degradation processes that usually occur simultaneously: (1) the high acid content causes hydrolytic degradation of the cellulose, and (2) free iron(II) and iron(III) ions trigger oxidative degradation of cellulose (mainly radical reactions). Damage to the cellulose chains at the molecular level alters the mechanical properties of the paper. It loses its mechanical strength and becomes fragile, but also brittle. Two processes are necessary as effective measures against ink corrosion: deacidification to neutralize the acids and inactivation of free transition metal ions (i.e., their complexation [iron(II) and iron(III) ions]). There are various approaches and protocols to chemically treat manuscripts damaged by ink corrosion (Haberditzl 1999; Dekle and Haude 2008; Albro et al. 2008; Sistach, Marín, and Garcia 2017). However, chemical treatment is only one aspect of an effective conservation process for manuscripts damaged by ink corrosion. Due to endogenous damage to cellulose, ink corrosion is often accompanied by severe mechanical damage, such as cracks, fractures, and breakouts. This requires additional physical stabilization of the paper. Depending on the extent of the damage, this is done with Japanese paper, either locally or as a full-surface lamination (Titus et al. 2009; Jacobi et al. 2011; Rouchon et al. 2012; Pataki-Hundt and Walter 2018).

Various types of nanoscale celluloses are of interest as novel stabilizing materials for paper due to their close structural relationship to cellulose fibers. For this reason, there is increasing research on the application of nanocellulose in the field of paper conservation. There are different types

of nanocellulose: bacterial nanocellulose, nanocrystalline, or nanofibrillated cellulose (Klemm et al. 2011; Dufresne 2018). This research focused on the use of nanofibrillated cellulose or cellulose nano fibrils (CNF). It is produced in top-down processes from pulp. In this process, the cellulose fibers are defibrillated by mechanical and chemical treatment steps, ideally exposing the elementary fibrils without shortening them. The material is obtained as a white fiber suspension with a high water content and a relatively low solids content.

Several approaches are being researched for use in paper conservation. One is to use them as dried films with adhesive to stabilize mechanical damage (Dreyfuss-Deseigne 2017). However, they can be applied directly as an aqueous suspension and stabilize the paper without the additional use of an adhesive (Okayama et al. 2016; Völkel et al. 2017). The reason is that the production of fibrils with diameters in the nanometer range and lengths in the micrometer range creates large fiber surfaces that enable strong interactions with substances from the environment. This makes a significant difference between plant cellulose and nanocellulose, which are otherwise identical at the molecular level, and leads to specific properties of the material. One can take advantage of these specific properties when using nanocellulose for stabilization. Due to the large surface area and hydrophilic properties, stabilization and attachment of CNF fibrils occur mainly via hydrogen bonds. Thus, damaged or vulnerable areas can be stabilized by the network formation without the need for an additional adhesive (Völkel et al. 2017).

Based on these positive results for stabilization of mechanical damage, the low optical interference of the objects, and their favorable aging behavior (Nechyporchuk et al. 2018; Völkel et al. 2017), the idea arose to stabilize manuscripts damaged by iron gall ink with CNF. In addition, the aim was to test whether the chemical and mechanical stabilization of papers could be combined. The stabilization with CNF was directly integrated into the calcium phytate/calcium hydrogen carbonate treatment process, and the results on the integrability were evaluated.

Papers presented during the Book and Paper Group Session, AIC's 49th Virtual Annual Meeting, May 10-June 25, 2021

DISCUSSION

Calcium phytate/calcium hydrogen carbonate treatment was chosen as the chemical treatment method because its efficacy has been proven at the endogenous level (Potthast, Henniges, and Banik 2008; Henniges et al. 2008; Henniges and Potthast 2008), and there is an effective, standardized treatment procedure (Huhsmann and Hähner 2008). The first project objective was to evaluate integrability according to the following criteria:

- Treatability and effective mechanical stabilization with CNF within the calcium phytate/calcium carbonate method, as well as preservation of the chemical efficiency of the process;
- Stabilization without intermediate drying, since intermediate drying leads to permanent changes in the material and aging properties, which has a negative effect on the object;
- Avoidance of migration processes of the metal transition ions, which can be induced by the renewed influence of humidity.

The standard treatment protocol of calcium phytate/calcium hydrogen carbonate treatment, according to Huhsmann and Hähner (2008), includes five steps. CNF was integrated into this treatment process either by adding the CNF to the treatment baths or by applying the CNF as an additional treatment step before or after chemical stabilization (fig. 1).

The sample material used was rag paper from a handwritten collection of sermons from 1839 and 1840. The condition of the ink corresponded to condition rating 2 (Reißland and Hofenk de Graaff 2001). The optical, haptic, and endogenous treatment results were evaluated before and after artificial aging (in a closed system at 80°C and 75% humidity for 10 days) (TAPPI 2003).

The following section presents the main results of the combined treatment. For a more detailed account of the treatments and analyses and a broader discussion of the results, the reader should refer to “Combining Phytate Treatment and Nanocellulose Stabilization for Mitigating Iron Gall Ink Damage in Historic Papers” (Völkel, Prohaska, and Potthast 2020).

Visual and Haptic Results

After CNF treatment, manuscripts show no to minor visible changes. Influencing factors are the amount of CNF applied and the color of the paper or ink, as the CNF layer tends to be perceived as whitish on darker substrates. Due to the homogeneous distribution on the surface, the writing of the manuscript is only slightly affected. In addition, no fibrous structures are visible on the lettering, as is the case with Japanese paper, which is particularly positive for readability on densely written papers.

In a CIELab measurement, the color changes of the unaged and aged samples in the form of yellowing could be compared and quantified. Here, ΔE (Euclidean distance) represents the average color change and is calculated from the change in brightness and the color gradients (International

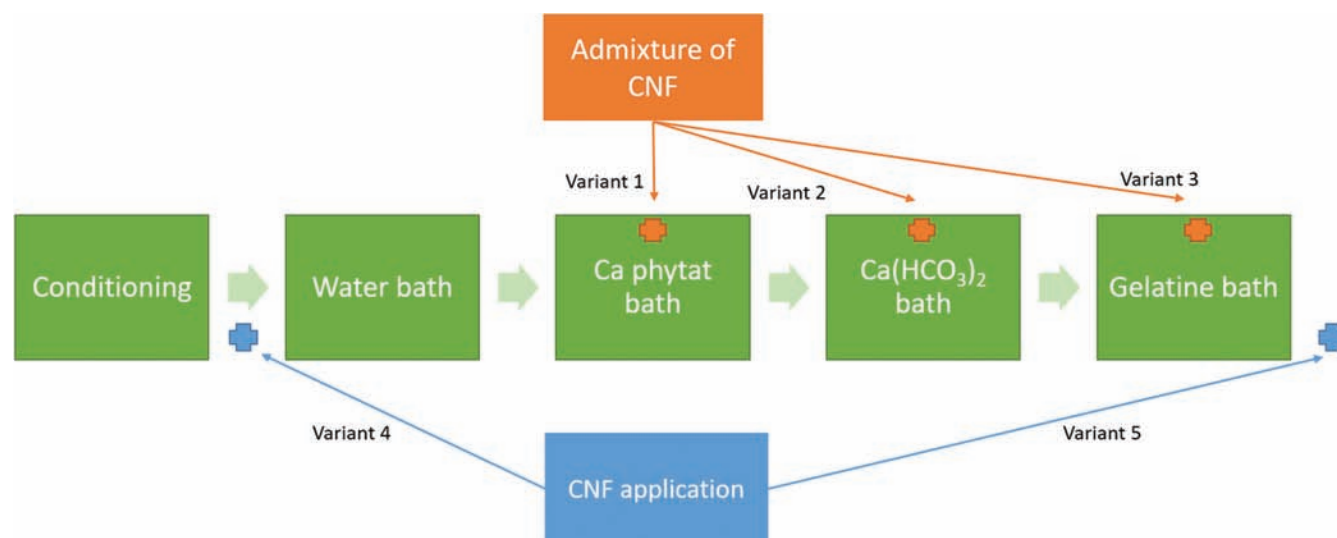


Fig. 1. The application of CNF was integrated into the calcium phytate/calcium hydrogen carbonate treatment at various stages. Either it was added to the treatment solutions as an additive (Variants 1–3) or it was integrated as a separate treatment step (Variants 4 and 5).

Commission on Illumination [CIE] 2020). The untreated references show high color changes ($\Delta E \uparrow$) and are clearly yellowed (fig. 2). For the treated reference, the yellowing has been significantly reduced by the chemical treatment ($\Delta E \downarrow$). The same is true for the treated samples combined with CNF phytate (fig. 2). The CIELab values are comparable to those of the treated reference, so the optical integrity of the samples is not affected by CNF.

The haptic properties are also slightly affected as a function of the application amount. No changes in thickness or flexibility were observed in the treated samples. No stresses occurred in the paper, and the paper structure remained visible.

Microscopic Results

The microscopic results are closely related to the individual treatment process that is carried out. Generally, there is a stabilizing layer on the surface of all samples, which also settles in the pore structure and covers the paper fibers. At the same time, the paper fibers remain visible under the fibril network. It was interesting to observe that in the samples, the CNF network formed both in the ink region (fig. 3, green arrows) and on the blank paper. In the backscattered electron (BSE) image, a piece of a writing loop can be seen as the ink region. In the secondary electron (SE) image, this region is also homogeneously coated with CNF, as is the blank paper area. Accordingly, the network formation was not disturbed by the different areas of the surface. A contact angle measurement showed similar and rather hydrophobic surface properties in all areas—ink and blank paper. This result was also obtained for the samples treated in Variant 5, in which the CNF was

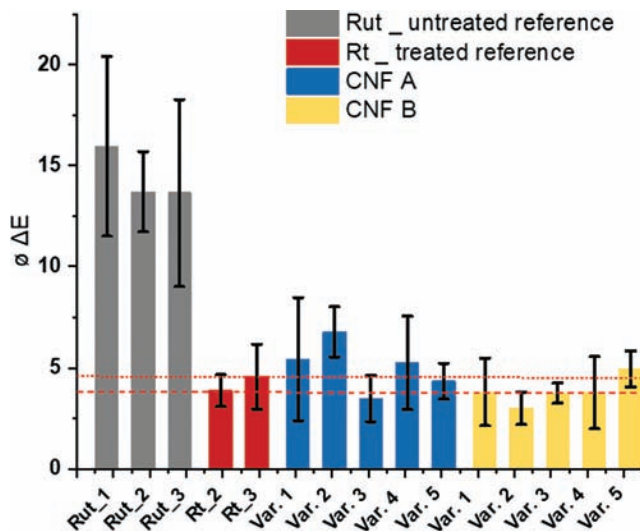


Fig. 2. Results of the CIELab analysis according to EN ISO 11664-4—sample yellowing was effectively reduced by phytate treatment. Therefore, the ΔE values are used as reference values for evaluation (dashed lines).

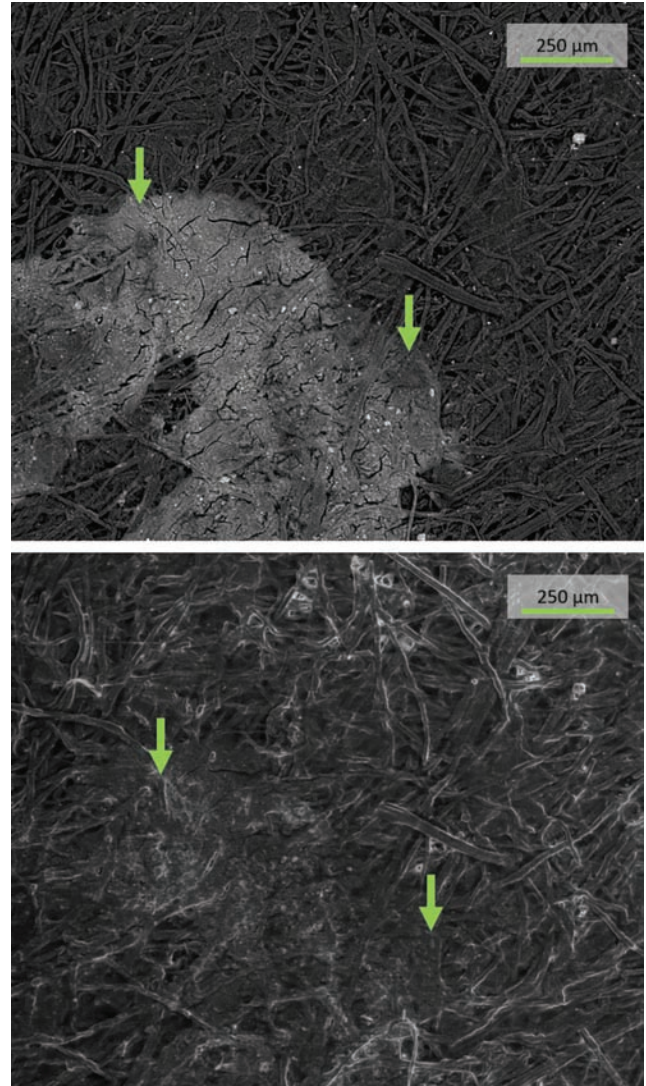


Fig. 3. The CNF forms a homogeneous layer regardless of whether the area is written on with ink (green arrows mark writing loop) or whether it is pure paper. In the BSE image (top, 150 \times), the ink areas and the blank paper areas can be clearly distinguished. In the SE image (bottom, 150 \times), everything is evenly covered with a CNF layer.

applied first, and then the chemical treatment was carried out. It can be deduced that the formation of a closed, stabilizing CNF layer is supported despite the hydrophobic surfaces. This is mainly due to the conditioning and gentle prewetting with decreasing alcohol content. Van der Waals interactions likely played a crucial role in the formation and adhesion of the CNF network.

Specific results are obtained with respect to the accumulation or distribution of solution components, such as calcium phytate or calcium carbonate particles on the surface. In

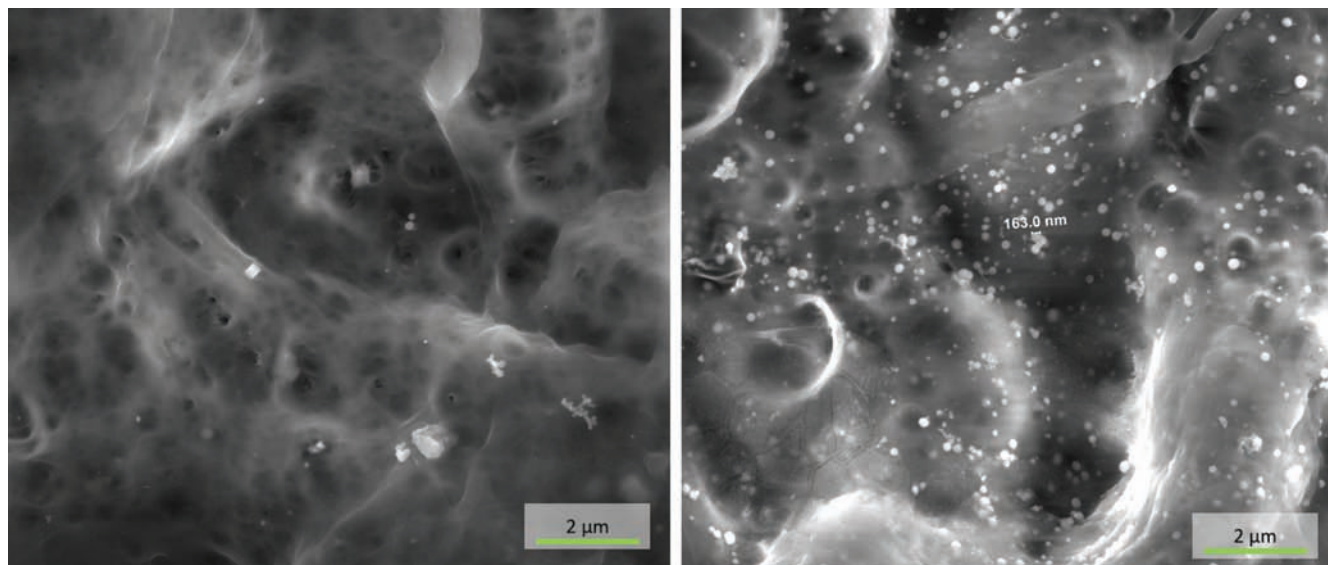


Fig. 4. Different treatment procedures produce individual results with regard to the CNF network. Comparing the samples of Variant 4 (*left*) and Variant 5 (*right*), the different degrees of enrichment of the components of the treatment solutions are apparent. In Variant 4 (*left*), the CNF network is formed as the last step, which is why only a few particles can be seen on the surface. In contrast, Variant 5 (*right*) has many particles deposited on the surface, as the CNF network is formed before the chemical treatment. These are calcium and phosphorus particles.

Variant 4, the CNF is applied as the last step, and the fibril network is formed on the surface after chemical treatment. There are only a few crystals on the surface, presumably introduced by transfer (fig. 4). In comparison, Variant 5 shows small, white crystals homogeneously distributed on the surface. They have a size between 100 and 200 nm, and energy dispersive x-ray spectroscopy (EDX) analysis determined calcium and phosphorus in the crystals. Considering that in Variant 5 the CNF is applied as the first step after conditioning, the stabilizing fibril network is already formed on the surface before chemical treatment. Within the treatment baths, calcium phytate and calcium carbonate attach to the network (fig. 4). In further analyses, no negative side effects due to these crystals could be determined.

Integrity of Cellulose

To evaluate the effectiveness of the chemical treatment with integrated stabilization, the cellulose was analyzed at the endogenous level. The molar mass and carbonyl group content were determined before and after aging using size exclusion chromatography with multiangle light scattering. These are key factors to describe the changes in the material and to evaluate the effectiveness of a new treatment. To make a meaningful comparison, the number of cellulose chain cleavages after accelerated degradation was calculated from the mean molar mass (Potthast and Ahn 2017). This allows data evaluation independent of the initial molar mass of the historical papers, which differ slightly within a sheet due to sample inhomogeneities.

After aging, all untreated reference papers showed a high number of chain cleavages (approximately 0.76) and an increase in carbonyl groups by an average of 34.5% (fig. 5). There was significant degradation of cellulose during accelerated aging without treatment measures. The results of the treated reference samples demonstrate the effectiveness of

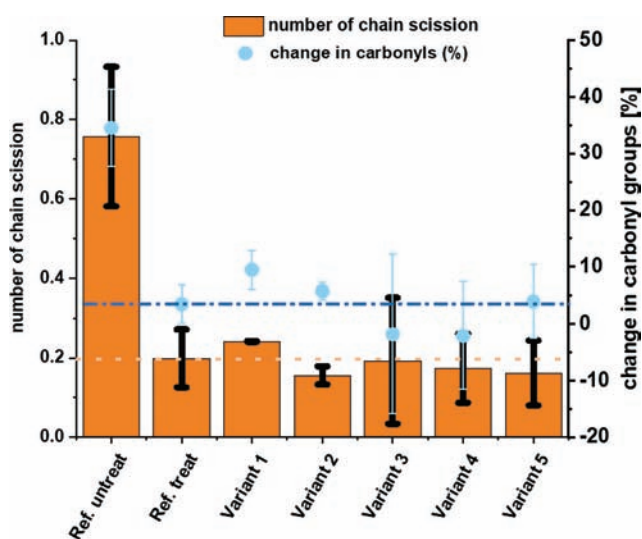


Fig. 5. Average number of chain scissions and carbonyl group contents of reference and treated samples after accelerated aging. Lines indicate average numbers from the reference treatment with phytate only.

the calcium phytate/calcium hydrogen carbonate treatment performed. As expected, both hydrolysis and oxidation were significantly slowed down. The chemical treatment reduced the number of chain cleavages to 0.20 and the formation of carbonyl groups to 3.5%. The data were used as a reference for the combination treatments. In these, it can be seen that no increased cellulose degradation occurred in four out of the five treatment variants. Treatment variants 2 through 5 behaved like the regular phytate treatment in terms of cellulose protection; efficacy was fully maintained, even when CNF was used. An exception was Variant 1, which showed a slightly increased number of chain cleavages and an increased formation of carbonyl groups. This can be attributed to the lack of a complexation bath and the shortened treatment time. The sole application of the calcium phytate/CNF suspension could not effectively mask all the iron ions.

Migration of Iron Ions

For the treatment of ink corrosion, it is always important for conservators to know how the treatment affects the migration properties of free metal ions. Therefore, the influence of additional CNF application at different stages was investigated using laser ablation inductively coupled plasma mass spectroscopy (LA-ICP-MS). The measurement method is a powerful analytical tool for monitoring the spatial movements of chemical elements and showing their distribution on the paper surface. For the selected samples, the laser was passed over the ink lines at two positions each. The untreated reference showed no migration before (fig. 6) and also after aging. This can be seen in the clear and abrupt increases or decreases in iron intensity that match the ink line. Migration would be noticeable by a wider iron distribution next to the original inks.

These distinct iron profiles corresponding to the ink lines were similarly observed in the samples treated with CNF application. In the example shown (Variant 5), no broader distribution was observed in the paper either before (fig. 6) or after aging. This confirms that no water-induced migration of iron ions occurred due to the additional application. This was also found for the other variants.

Transfer Tests into Practice

Based on the successful verification of the combination treatment, work is currently under way on the transfer of this research result into practice—this project's second objective. The main intention here is to create a workflow for the treatment of severely damaged manuscripts of condition ratings 3 and 4 (Reißland and Hofenk de Graaff 2001). In addition to the application in the single-sheet process, the aim is to add a treatment as a batch process. The following section offers some insight into practical transfer results. The transfer tests are carried out with severely damaged manuscripts of condition ratings 3 and 4. They show mechanical damage, and the cellulose is degraded.

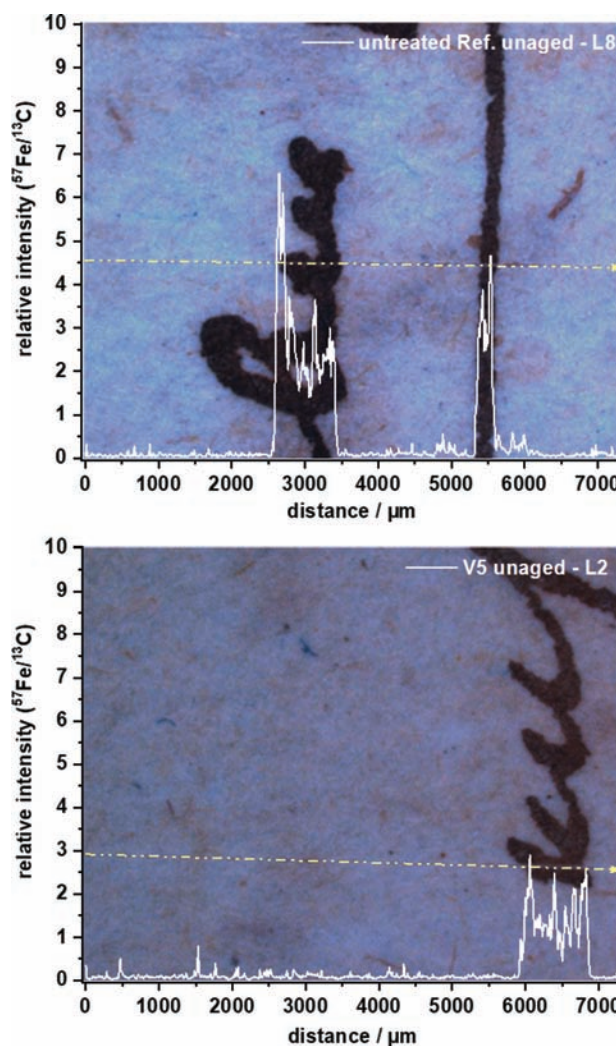


Fig. 6. No migration tendencies of the untreated reference (*top*) and the Variant 5–treated sample (*bottom*) were detected before aging. The lines visualize the course of the laser ablation.

Treatment variants 3, 4, and 5 were successfully applied to the severely damaged papers. Their workflows proved to be feasible, and they did not cause any side effects or further damage to the manuscripts.

The transfer results of Variant 4 will be presented in more detail as an example to show the possibilities and functionalities of CNF. In addition to the ink bleed-through and halos, the sample sheet showed mechanical damage in the form of breakouts and small, fine cracks in the ink lines. The treatment was carried out in a single-sheet process, and the CNF was applied as the last step.

After the chemical and mechanical stabilization treatment, the edge of the manuscript (which was also mechanically damaged due to storage and use) and the mechanical damage in the manuscript have been stabilized.

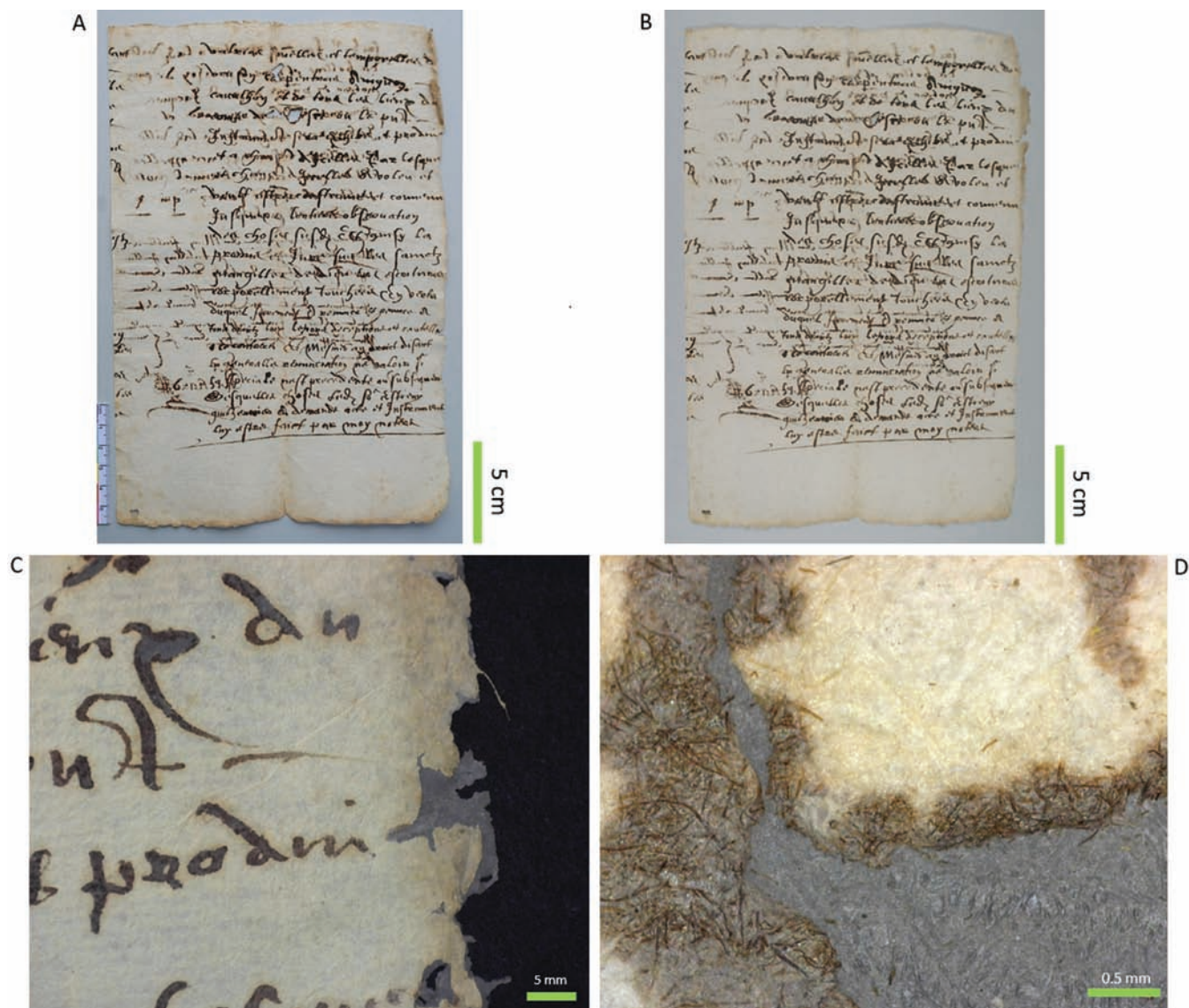


Fig. 7. Treatment Variant 4. Sample of condition rating 4 before (A) and after (B) chemical phytate treatment and mechanical stabilization by CNF. The application of CNF stabilized fine cracks, mechanical damage (C), and breakouts in the ink area (D). No further mechanical damage occurred during the treatment. Other than that, the good stabilization performance of CNF is clearly visible at the edge area and the breakouts.

The sheet itself is more stable after treatment and can be handled more easily again, as both strength and flexibility in the weakened areas have improved. Visually and haptically, CNF leaves little impression. In the ink area, it looks like a light, whitish layer, whereas in the paper area, it blends in completely and is not visually noticeable. If one recalls handwriting areas stabilized with Japanese paper, the influence due to the CNF can be assessed as low to very low.

In areas where mechanical damage has been stabilized and closed, such as ink breakouts, CNF stands out as a

thin layer (fig. 7). In an image with higher magnification (10× and 150×), the film-forming properties of the CNF can be well visualized. The CNF layer forms in the paper and in the ink area. Depending on the amount and type of application, the layer closes thin cracks or fills small voids throughout.

Aspects of application optimization and treatment in higher quantities were also investigated. Unfortunately, the analytical results on the issues of transfer, optimization, and further development in the second half of the study are still pending and can only be presented later.

CONCLUSION

In the present study, a combined treatment of manuscripts damaged by ink corrosion was developed. The manuscripts can be effectively treated chemically and mechanically in a workflow of calcium phytate/calcium hydrogen carbonate treatment and CNF application. Treatment is possible in various combinations and without intermediate drying. Of the combinations reviewed, Variants 2 through 5 proved effective, whereas Variants 4 and 5 were of particular interest from a conservation science perspective. It is particularly positive that the chemical treatment penetrates and acts through the thin fibril networks. On the one hand, this allows mechanical prestabilization of severely damaged manuscripts with CNF prior to chemical treatment. On the other hand, it shows the inherent potential for re-treating of manuscripts even after stabilization with CNF.

The workflows of Variants 3, 4, and 5 could be successfully transferred to manuscripts of condition category 4. CNF acted as a stabilizing network for mechanical damage and caused only minor visual and haptic impact.

Open questions for transfer, optimization, and further development will be investigated in the second half of the study. On the one hand, this is the analytical monitoring of development and optimization tests to obtain treatment efficacy. Here, important results are currently pending, which will provide essential information for practical application. On the other hand, feasible treatment procedures are to be developed, especially for severely damaged manuscripts, which allow the treatment of several objects in addition to single-sheet treatment. Last but not least, the development of a practice-oriented workflow must always consider quality control.

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Recentering the Bench

INTRODUCTION

This article describes work done throughout 2020–2021 in Stanford Libraries’ Conservation Services unit to revise documentation practices to promote more inclusive, anti-racist, and accurate descriptions in conservation documentation.

This work was motivated by two projects. In 2019, Conservation Services participated in a pilot project to share conservation documentation through linked data. This coincided with revisions to internal conservation documentation forms.

Following the murder of George Floyd and the anti-racist uprisings of the summer of 2020, the authors of this article began to see work on these two projects as an opportunity to align internal projects with a desire to promote anti-racism, to examine Eurocentric practices, and to seek greater accuracy in documentation.

This work was informed by the institutional context and anti-racist work being done in libraries and archives. The article explores how anti-racist and Eurocentric biases can be defined and identified in conservation. The article also discusses what was done to revise forms, terms, expectations, and projects. A summary of work to date and suggestions for future action conclude the article.

ANTI-RACISM IN LIBRARIES AND ARCHIVES

Over the past decade, libraries, archives, and affiliated organizations like the Digital Library Federation and the Association for Computers and the Humanities have begun in-depth reviews of their metadata standards with an eye for developing more inclusive practices that respectfully and accurately describe their collections (note 1). A few notable actions concerning anti-racist and inclusive description in libraries and archives include a 2014 Dartmouth-initiated petition to the Library of Congress to replace the subject heading “illegal aliens” with the phrase “undocumented immigrants” and the 2017 article “Teaching to Dismantle White Supremacy

in Archives” by Michelle Caswell, associate professor in Archival Studies in the Department of Information Studies at UCLA (DeSantis 2016; Peet 2016; Caswell 2017). In her article, Caswell considers the outcomes from a discussion with students about the pervasiveness of white privilege in archival practice and suggests corrective actions, including training in cultural humility for archivists. In 2019, Princeton University Library Rare Book and Special Collections Technical Services, one group inspired by Caswell’s work, formed an Inclusive Description Working Group after completing a “description audit project.” They published a “Statement on Language in Archival Description” stating their goal to describe collections “respectful to the individuals and communities who create, use, and are represented in the collections” (Suarez 2020). In 2020, there was a groundswell of description review activity in libraries and archives in response to the murder of George Floyd. Many libraries and archives developed public statements on harmful language in cataloging records and finding aids that have been compiled on the [Cataloginglab.org](https://cataloginglab.org) (2021) page “List of Statements on Bias in Library and Archives Description,” including the Stanford Special Collections and University Archives Statement on Potentially Harmful Language in Cataloging and Archival Description.

Recognizing that conservation is not a silo but part and parcel to libraries, archives, and other cultural heritage institutions, the authors felt it incumbent upon them to stop and reflect on the language being used in their conservation documentation, especially as departmental linked data and conservation documentation projects were under way. The authors wanted to consider not only how language used in their work contributes to the systematic racism that pervades all aspects in the United States but also how it contributes to racism and bias in the conservation field.

During the evaluation of documentation practices for the linked data project and the revision of in-house documentation forms, the staff realized the need to discuss specific terminology, including even the most basic terms like *recto* and *verso*. The authors wanted to evaluate if their documentation practices were inclusive and respectful. Did their documentation include the practices and traditions of global cultures? Or did the existing terminology

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used “other” these diverse practices and traditions into a monolithic non-Western grouping that relied on an assumed European baseline, where European practices and timelines set the standard against which all other cultures are defined? Staff asked how and why terms were used with special attention to terms that are defined in exclusionary, Eurocentric, and/or colonialist language. They asked how they could reject white-centric, Eurocentric, orientalist, and colonialist practices of description. What changes to current documentation practices are necessary? And last, were other conservation labs already asking these questions or implementing change?

OUR PROJECT

Linked Data

In 2018, Stanford Libraries joined the Linked Conservation Data Consortium, a project aiming to develop and promote the use of linked data for the sharing of conservation documentation. In the fall of 2019 Stanford Libraries participated in a pilot project with three other research libraries to share 30 to 40 conservation treatment reports from the past 40 years that describe conservation treatment to books that needed boards reattached. The goal of the project was to model information from the reports so they could be searched across institutions to answer research questions about trends in treatment types over time and materials in use.

Linked data is a set of standards and protocols used to generate machine-readable information out of structured data such as checkboxes or prepopulated fields in a conservation treatment report. If other reports are organized similarly, searching across large groups of documentation for items, materials, or activities can be efficient.

To create linked data, each term referenced in a report needs a unique identifier (e.g., a URL). When varying terms are used for the same concept, it is possible to align them by pointing to a shared concept. This improves searching across institutions that may use different terms for the same concept.

In conservation, this alignment is desirable, as often different conservators use different terms for the same structure, material, or concept depending on their training, educational programs, and/or employers. Examples can be referring to a type of paper as “blotter” or “blotting paper” or referring to a particular book feature as a “headband” or an “endband.”

Alternately, some conservation specialties use the same word to mean different things. “Grain” is defined in one way by a paper conservator but has a different meaning for an objects conservator working with a wooden item. Although a conservator will most often recognize these distinctions, a machine will not, hence the need for unique identifiers.

As preparations for the pilot got under way, Ryan Lieu, operations coordinator for Conservation Services, prepared a spreadsheet of terms used in current (fall 2019) documentation forms. Documentation forms consisted of Word documents with checkboxes for major topics/categories and room for notes and diagrams. The spreadsheet recorded all terms used for checkboxes but did not include or anticipate terms that might be used in narrative notes.

In December 2019, staff met in a half-day session to identify concepts through scope notes or definitions that matched the use of the term in documentation. Sources that were already available for use in linked open data were preferred, although other sources were acceptable when definitions could not be found (note 2).

For most terms, staff found acceptable matches, but in quite a few cases, scope notes and definitions were not satisfactory. A few months later, as staff in the department began to explore how Stanford University’s Inclusion, Diversity, Equity, and Access in a Learning Environment (IDEAL) initiatives could be implemented in departmental work, the authors of this article decided to revisit the terminology spreadsheets and to examine more thoroughly what definitions and scope notes were contentious and how that could be addressed.

As a more extensive review began, repeated patterns of Eurocentrism were identified. Four areas with examples from the departmental spreadsheets are presented next.

Ignorance/lack of representation of practice. Eurocentrism can be evident from the absence of terms in vocabularies or glossaries to adequately describe materials or structures found in collection items created beyond European or North American practice. Broader research on these collections and work with scholars will add additional terms to vocabularies.

Eurocentric definitions may also exclude or ignore practices. One example is this definition for *manuscript*:

Manuscript: Handwritten documents, particularly books and other documents created before the invention of the printing press. May also be used to distinguish certain documents from published or otherwise printed documents, as in the cases of typed personal letters or a typescript from which printed versions are made. (<http://vocab.getty.edu/page/aat/300028569>)

This scope note fails to recognize that the manuscript tradition was the dominant method of text-based information for centuries after the invention of the European printing press in many areas of the world. It centers a Western narrative of technological progression that excludes much of actual global practice.

Definitions that define practice narrowly. A closely related type of Eurocentrism is defining a material or practice so specifically that it excludes examples that could readily be described

by the same term. An example of this is found with this definition for *wooden board*:

Wooden board: *Plank-like wooden boards ranging in thickness from approximately 4 to 20 mm (and occasionally thicker).* (<https://www.ligatus.org.uk/lob/concept/3699>)

This range of measurements may apply to wooden board bindings in the European tradition, but it ignores other practices such as thinner boards that are common to many Armenian manuscript bindings. The inclusion of a specific thickness range without direct connection to specific traditions or examples does not lead to a more accurate definition.

Date ranges without geographical reference. Another common bias is to offer date ranges in definitions without specifying a location. *Gouache (paint)* is an example:

Gouache (paint): *A matte, opaque watercolor paint typically having gum arabic, gum senegal, or dextrin as a binder . . . Gouache was used for miniature paintings in the 16th–18th centuries, for decorative paintings on interior walls, and for printing wall paper patterns.* (<http://vocab.getty.edu/page/aat/300070114>)

This scope note describes its use on miniature paintings in the 16th to 18th centuries—but does not specify where. In definitions like this, the date range may be accurate for Western European items but not for practices in other parts of the world.

Descriptions of physical positioning of books. Because the Roman alphabet (reading left to right) is the dominant alphabet in North America and Europe, many of the terms used to orient a text result in ambiguity or confusion when describing volumes read from right to left. References to the front of the book or the top board can be used accurately with either text orientation, but forms or diagrams may not reflect the other orientation. One solution may be to indicate left board or right board, but is the need for this clarification an additional reflection of Eurocentric practice?

The terms *recto* and *verso* have been used to describe the sides of leaves within a text. They frame the *recto*, or right side, of the text as the carrier of primary information. This fails to acknowledge that for other text reading practices, the left side may hold the primary information.

Some scope notes or definitions orient the parts of the book to how they are positioned on the shelf, presuming that books stand upright on shelves rather than being stored lying down on their sides.

This analysis of sources and definitions does not seek to diminish the work of colleagues who have compiled these thesauri, glossaries, and vocabularies. The time and expertise that compilers have put into building resources usable by conservators and others is significant, as is the benefit to having these resources within the conservation field.

However, failing to broaden terminology and address Eurocentric biases presents challenges. Ambiguity in terminology and definitions can lead to confusion and misunderstanding. It limits the ability to generate quick and accurate descriptions of a conservator's work. It makes it harder to search documentation. Not only within the records held within a specific institution, but as institutions share documentation more openly among peer institutions and outside researchers, clarity and inclusive accuracy will be even more important.

Documentation Forms

In addition to the linked data scope notes project, the conservation staff at Stanford Libraries also undertook a project in 2019 to revise the lab's conservation documentation forms. With the linked data project under way and an upcoming shift to a searchable database system this year, the conservation department hoped to refresh and solidify a semistructured hybrid documentation form with checkboxes for searchability and narrative for flexibility. The narrative sections of the documentation forms allowed space for these variations, for the unusual, and for further explanation of the item being treated, its condition, and the treatment.

In the creation of the form's checkboxes, conservation staff realized the limitations of specific terminology available and being used within the lab and conservation, the lack of consensus of certain terms, and the lack of knowledge to include more expansive terms. For example, in creating the unbound documentation form, several terms were included that could help distinguish between papermaking techniques and traditions. Initially, terms that had been used in the past and/or were frequently being used in the profession were included, such as the terms *machine-made*, *handmade*, *Western*, and *non-Western*. Although possibly convenient, the terms *Western* and *non-Western* caused some discomfort, concern, and a desire to pause and reflect. Discussions emerged among the conservation staff around book and paper conservation terminology in the context of an anti-racism framework, the need for re-evaluation, and how the conservation unit wanted to move forward in an inclusive, respectful, and anti-racist direction.

Conservation staff believed there was value in including specific terms that could be used to search against in researching treatments. For example, when wanting to see how conservators have treated paper from Japan, being able to distinguish between papers from different parts of the world would be helpful. Yet using "Western" and "non-Western" categories that resulted in lumping all the world's papermaking traditions other than Europe and North America—and the cultures and people who contributed to these traditions—into a single "non-Western" box seemed inappropriate, disrespectful, and Eurocentric. More questions among the staff were raised: What were the other options? Should the

form include boxes for “European paper” and “East Asian paper,” or should the checkboxes be even more specific like “Korean paper” or “Japanese paper”? Do the lab’s conservators feel they have the knowledge to use these checkboxes? With questions surfacing, it was decided that in addition to evaluating the lab’s documentation terminology and scope notes, there was a need to reach out to other conservators and specialists, as these questions were bigger than one lab. Were others confronted with these quandaries, and were others thinking about and discussing current terminology practices?

COLLEAGUE INTERVIEWS

During February and March 2021, colleagues at seven other research library conservation labs were interviewed. Additionally, five individuals with expertise in specific regional practice were interviewed (note 3). All interviewees were sent the same set of questions in advance with some additional questions for experts reflecting their area of expertise. These questions may be found in the appendix to this article.

The interviews provided a lot of valuable and interesting information, and a few major themes were noted. When it came to current documentation practices, most conservators were using a mixture of both narrative and checkbox formats. Most were interested in the possibility of searchability; however, currently, checkbox formats were used primarily for time efficiency and less for searchability, as few participants had searchable databases. Many institutions and individual conservators did have some type of preferred terms list. No one preferred terms list was used across the board, and some institutions had multiple preferred terms lists among different individuals. Both in-house and published guides were used. Among the published guides, there were a few like the Philadelphia Museum of Art’s *Descriptive Terminology for Works of Art on Paper* (Ash et al. 2014) that were referenced by several participants.

Opinions about specific terminology varied in the context of geographic or cultural identification of practices and materials. Some found terms like *Western* and *non-Western* discomfiting or problematic and did not use those terms, whereas others found the terms problematic but still used them out of convenience, and some disagreed and did not find using the terms *Western* and *non-Western* problematic at all.

Examining more specific naming practice, trends in conservation did appear to follow associated fields to some degree. Shifting language trends dealing with materials produced under Muslim-ruled areas in history, art history, codicology, and the art world have been taking place over the past decade (Lawrence, n.d.). Where paper produced in areas under Muslim-ruled empires has been referred to as “Islamic paper” or sometimes grouped incorrectly as “Arabic paper,” more nuanced terms such as *Islamicate paper*, *paper from the*

Muslim world, *paper from the Islamic world*, and *paper from the Islamic heartland* are progressively being favored. Sometimes terms with more specificity such as *Central Asian Islamic-style paper*, *Kashmiri paper*, or *Persianate paper* are also being used when expertise is present.

Throughout all the interviews, a consistent theme was interviewees’ desire for precision and accuracy in documentation. How this is interpreted varied particularly in reference to geographic or cultural attribution for historic materials or binding styles. Some conservators prefer to limit their description to physical characteristics alone. They might describe a historic paper as white, laid, and burnished. This is seen as neutral and precise. Other conservators are more comfortable in attributing geographic origin based on their experience and knowledge. They suggest that noting material and geographic differences shows respect for the context of the individual creators of items that fill collections. Regarding contemporary repair papers, most interviewees were interested in documenting their geographic origin. However, discussions surrounding the complexity of vendor information and fiber origin, such as papers manufactured in Japan or Korea with kozo fibers from Thailand, sometimes complicated documentation of geographic origin.

Institutional resources can be a key component of the ability to be precise. For those at institutions with catalogers or curators who have expertise in area studies or other languages, conservators may rely on that expertise and limit their description to physical characteristics alone. If items are well described by catalog or finding aid records, they report less need to provide that information. However, other conservators do not have those resources to rely on if they are in smaller institutions or do not have a breadth to the technical resources in their library. Conservators may have knowledge that exceeds that of catalogers or curators, particularly in terms of materials and structures. A conservator’s expertise can be useful to curatorial staff.

During the interviews, there was also engagement around the description of evidence of use as “damage” and if the geographic, cultural, or temporal context of an item affects its description. Anecdotally, there appears to be a shift away from using the descriptor “damage” and growing preference for the descriptors “use” or “wear,” or the phrase “shows signs of wear from possible use.” Some conservators and curators prefer neutral language that does not carry blame, or apply agency or intentionality, coinciding with a shift toward more conservative and thoughtful treatment approaches.

Finally, in our interviews, we found that overall most interview participants felt that terminology and language within the library conservation community was worth evaluating. A continuing theme that echoed throughout the interviews was a need within the conservation field for more accurate and accessible information on terminology and description of materials outside of Europe and North America. Yet there

were also concerns that the creation of specific terminology and language rules can be in and of itself exclusionary and undemocratic at the price of being accurate. The question is: Can there be a balance?

These conversations have begun, as well as projects, at institutions and within the field. Several labs that participated in the interviews felt that a terminology evaluation project was timely for them, often because they were shifting to a new documentation system as well as wanting to participate in anti-racist action within the library field. Some conservators have been participating in terminology discussions and projects that are impacting both the conservation field and related fields, like Karen Scheper and Paul Hepworth's work on the *Terminology for the Conservation and Description of Islamic Manuscripts* (Hepworth and Scheper, 2020) that is being used by codicologists, conservators, and other collection specialists.

ACTION PLAN

The research and interviews provided valuable information capturing concerns and ideas of colleagues. This information has been instrumental in planning how Stanford's Conservation Services unit will move forward with terminology projects.

Linked Data

The terminology work for linked data will continue to develop in conjunction with the evolution and revision of lab documentation forms. Terms with scope notes and definitions available for use in linked open data sources will be used where possible. When terms are evaluated to be Eurocentric or otherwise display bias, two different approaches have been and will continue to be used. In the first, existing definitions will be edited for internal use. This is preferred when terms are too detailed and can be easily modified. A second approach involves writing new scope notes or definitions.

The authors also hope to work with terminology projects where feedback can be given to offer more inclusive scope notes, although the authors have not had time to undertake this phase of vocabulary development to date.

Documentation Forms

Work on the documentation forms is currently ongoing, both to finalize terms and format structure for the transition into a searchable database later in the year. The opportunity to speak with colleagues at the beginning of the year has helped inform the direction of the lab's conservation documentation and terminology checklists.

Terms considered to be convenient but problematic or discomforting, including overarching terms like *Western* and *non-Western*, will be removed from checklists and documentation forms. The unbound documentation forms' checkboxes

will shift away from geographic emphasis for historic materials to a focus on visual characteristics like burnishing and the presence of a watermark as an aid for possible geographic regions and papermaking traditions. The shift in emphasis does not nullify the importance of acknowledging papermaking traditions and the people and cultures that make up these traditions. The lab's documentation will attempt to balance this shift by continuing to provide space in narrative sections for such observations and further notes when knowledge or expertise are present.

For contemporary repair papers, discussions among the conservation staff surrounding documentation of vendor information are ongoing.

Last, the conservation unit will aim to keep up with and evaluate current scholarship's use of language and terms. The lab intends to shift away from the terms *Islamic paper* and *Islamic bindings* to *Islamicate* or *paper/bindings from the Islamic world*, both because staff believe the shift is currently appropriate and staff try to stay concurrent with not only conservation but other related fields.

SUGGESTIONS FOR BROADER ACTION

Through this local review of documentation, conservation staff learned not only where descriptive practices could be more inclusive but also how reflection on description processes, transparency around practices, self-education, and research fuel process improvement. From this experience, the authors recommend that conservators develop internal glossaries, support research and education in anti-racist practice, and be mindful of subjectivity in description practices.

But a move toward more inclusive and respectful documentation requires more than local review of practices in labs and studios. Substantive change needs support and action in the profession at large, including increased opportunity for education on bindings and papers from Africa, Asia, Latin America, and the Middle East at the graduate and postgraduate levels and continued development of shared terminology lists and wikis. Through combined efforts at the local and wider professional level, moving the conservation field toward more inclusive and anti-racist practices is possible.

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APPENDIX. COLLEAGUE INTERVIEW QUESTIONNAIRE

Stanford Libraries Conservation Services Anti-Racist Conservation Terminology Project Questions for Interviewees

Thank you for agreeing to discuss these questions with us.

We began our inquiries into this area when we started examining our own documentation practices. We found ourselves questioning our use of terms like *Western paper* and *non-Western paper* in our documentation forms. As we got more involved with linked data work and were selecting conservation terminology and definitions, our dissatisfaction grew looking at scope notes for terms as straightforward as *manuscript* and *recto and verso*, which struck us as Eurocentric and exclusionary. Along with examining our practices, we decided to see how others are considering these issues to see if your work could help us resolve questions we still have.

We have more questions than we have time, so we have put the questions **in bold** that we would like to prioritize in our conversation. We are including other questions should we have time and to let you know our particular areas of reflection. We would welcome written feedback after our call if you would like to share additional thoughts.

General

1. **Have you had or are there currently any projects to evaluate/address terminology or creating in-house guidelines at your lab or even institution in general (for example, in your curatorial, cataloging, or metadata departments?)**
2. **Do you feel it is a subject that is worth evaluating at your lab, institution, or within the book/paper conservation field?**
3. **Have you noticed or are you aware of shifts in the terms that are being used in your lab?**
4. **Do you have/keep a list of preferred terms for your documentation?**
5. Have you heard of or do you know of any similar projects occurring at other institutions or among other conservators?
6. How greatly do catalog/registrars records determine or influence terminology within the lab?
7. Do you use existing vocabularies/thesauri for your documentation? AAT? RBMS vocabularies? Other?

Book and Paper

8. **What are your current practices in describing historical papers/bindings from different parts of the world? What terms are used and when? (e.g., *Western paper*, *Eastern paper*, *Islamic paper*, etc.). Does that vary from how you describe contemporary papers/bindings?**

9. Do you ever use terminology beyond general categories of “Western,” “European,” “East Asian,” and so forth, such as “French,” “Korean,” “Vietnamese,” “Persian”? If so, when do you use these terms? If not, why don’t you use more specific terms (lack of knowledge, time for identification, lack of available information on these materials, etc.)?

10. What is the primary factor in identification terminology for a complex book or paper item? Is it based on structural, material, geographic, cultural, or temporal qualities? Do the qualities you name shift for items from different parts of the world? Examples could include:

- a. **an Armenian text bound in a standard 19th-century Persian binding**
- b. **a Qur’an written in Arabic produced in Nigeria with a leather satchel binding**
- c. **a four-hole sewn binding from China that has been rebound into a library binding**
- d. **a contemporary paper made with kozo fibers using traditional Japanese techniques but manufactured in the United States.**

11. In your area of expertise, do you find how other conservators describe items lacking, incomplete, inaccurate, or otherwise problematic?

12. Do you describe signs of use as damage? Does the geographic, cultural, temporal context of the item change your description?

13. Is the term *Islamic*, *Muslim*, *Arab*, *Middle Eastern* paper/book used? If so, when and why?

14. What are your current terminology practices for describing books and paper from Asia, the Middle East, and Africa?

15. When you use a date range in a description for a material or process, is that based on a Western historical timeline?

Paper

16. Do you use a broad term for pounded/pressed fiber leaves such as *amate* and *tapa*? For example, *proto-papers*?

Book

17. What are your current practices in describing books from different parts of the world? What terms are used and when?

18. How do you describe opening or text orientation for books from around the world?

Final Questions

19. Are there specific conservation terms that you find limiting, inappropriate, uncomfortable, Eurocentric, etc.? Do you still use these terms? If so, why? No other option, lack of knowledge, no consensus or discussion for a better term, etc.?

NOTES

1. For further reading on descriptive language reviews and the movement toward more inclusive description in libraries, archives, and related organizations, please see the Tufts University Digital Collections and Archives bibliography *Additional Reading: Potentially Harmful Language in Archival Description* at <https://dca.tufts.edu/about/policies/Additional-Reading-Potentially-Harmful-Language-in-Archival-Description/>. The Digital Library Federation Cultural Assessment Working Group posts project updates from their Inclusive Metadata Task Force to their wiki at https://wiki.diglib.org/Assessment:Cultural_Assessment/. The Association for Computers and the Humanities published an online terminology guide that they will update with terms as contributed at <https://ach.org/toward-anti-racist-technical-terminology/>.

2. Thesauri, glossaries, and other terminology sources with conservation content that are available as linked open data include *Art & Architecture Thesaurus Online* (J. Paul Getty Trust 2017) and *the Language of Bindings Thesaurus* (University of the Arts London, n.d.) For the terminology sprint, second-tier choices included a broader range of sources that are structured so that only moderate effort would be needed to make them available for use as linked data. These include the *AIC Conservation Wiki*, *CAMEO: Conservation and Art Materials Encyclopedia Online*, *Bookbinding and the Conservation of Books* by Etherington and Roberts, and Rare Books and Manuscripts Section: *Controlled Vocabularies*.

3. The authors interviewed conservation staff at the following institutions: the Bodleian Library, Oxford; the British Library; Dartmouth College; Duke University; the Getty; the Library of Congress; and Yale University. Our subject experts were Michaelle Biddle, University of Hamburg; Kazuko Hioki, University of Hawaii; Eryn Kropf, University of Michigan; Radha Pandey, artist, papermaker, and letterpress printer; and Karin Scheper, Leiden University.

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The Jessie Fuller Scrapbook: Balancing Access and Context in the Treatment of an Important Black Sorority Scrapbook from 1949 with a Unique but Damaging Structure

This article issues from a presentation given from Charlottesville, Virginia, on the ancestral land and waters of the Monacan Nation. The authors extend their respect and gratitude to the Monacan Nation elders and hope the reader will have a chance to look at their website (<https://www.monacannation.com>) to understand more about their culture and community. In addition, the authors work on the Grounds of the University of Virginia (UVA), which was built upon and thrived off of the labor of enslaved workers. Please consult <https://slavery.virginia.edu/> to read more about the history of slavery and enslaved workers at UVA. Black and indigenous lives and the lives of people of color matter, and it is the authors' hope that this presentation contributes to that.

BACKGROUND

Scrapbook Creator

The Jessie Fuller scrapbook was created between 1946 and 1949 by a young woman attending Hampton Institute (now Hampton University), a historically Black college in Hampton, Virginia. The scrapbook has significant teaching and research value for several disciplines, including African American history, women's studies, the history of education, Virginia history, and photography. However, the scrapbook's multimedia materials affixed with failing adhesives present obstacles to its use.

Jessie Fuller was born in Chicago in 1926 (fig. 1). Her parents, S.B. and Lorena Fuller, were born in Louisiana but settled in Chicago in the 1920s. They were part of the Great Migration, a shift in population when about 6 million African Americans left the South for better work and educational opportunities available in northern cities. Fuller's father, S.B. Fuller, had grown up in poverty, quitting school after sixth grade to earn money for

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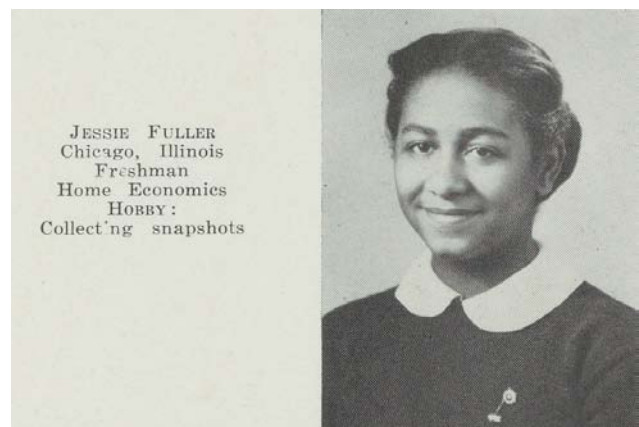


Fig. 1. Jessie Fuller, Phyllis Wheatley Annual, 1945–1946. Jessie Fuller Scrapbook, 1946–1949, Accession #15005, Special Collections, University of Virginia Library, Charlottesville, VA.

his family. After moving to Chicago, he started his own business, selling soap and cosmetics door to door. By 1950, he had grown this business into a successful multi-million-dollar cosmetics company, with more than 3,000 sales agents in 38 states (Narvaez 1988; *Jet Magazine* 1988, 16).

By the time Fuller matriculated at Hampton, her family was well able to fund her attendance at such a prestigious institution (note 1). At Hampton, Fuller plunged herself into a variety of social activities. She pledged and was accepted into Alpha Kappa Alpha, the oldest national historically African American sorority. She was also a member of the Phyllis Wheatley Literary Society, a Hampton women's club that held literary events, as well as hosted dances, sports, and parties. Over the course of her undergraduate years, Fuller held several leadership roles in the Phyllis Wheatley Society, including as the treasurer and basketball team manager (fig. 2).

The scrapbook's photographs, invitations, cards, and other mementos support study into various research topics,



Fig. 2. Homecoming. Jessie Fuller Scrapbook, 1946–1949, Accession #15005, Special Collections, University of Virginia Library, Charlottesville, VA.

including the Black women's club movement, Black sororal societies, amateur photography, and mid-century college life (fig. 3). As a result, the scrapbook illuminates a facet of African American history beyond slavery or the Civil Rights Movement. Jessie Fuller is not an activist but an ordinary middle-class Black woman experiencing joy with her friends and creating social bonds that would last a lifetime.

Of course, Fuller would have been aware of the racist violence and discrimination rampant in the United States, even in the North. She was born 7 years after the terroristic events of Chicago's Red Summer that began when a white man killed a Black swimmer who had crossed an invisible racial segregation line on the beach in 1919. Over the course of a

week, 38 people were killed, most of them Black, and more than 1,000 people lost their homes. Much of the violence was centered in Bronzeville, a predominantly Black Chicago neighborhood, which the U.S. Census lists as the Fuller residence in 1940 (Jones 2019). Although some years had passed since the devastating attacks, the emotional and physical scars on her neighborhood and neighbors were likely still present in Fuller's lifetime. This may explain why Jessie and her older sister Mary attended Hampton instead of going to one of the dozens of colleges in Chicago or other northern locations. Her family likely found it appealing to send their daughters to an institution with a goal of helping Black students thrive socially and academically.

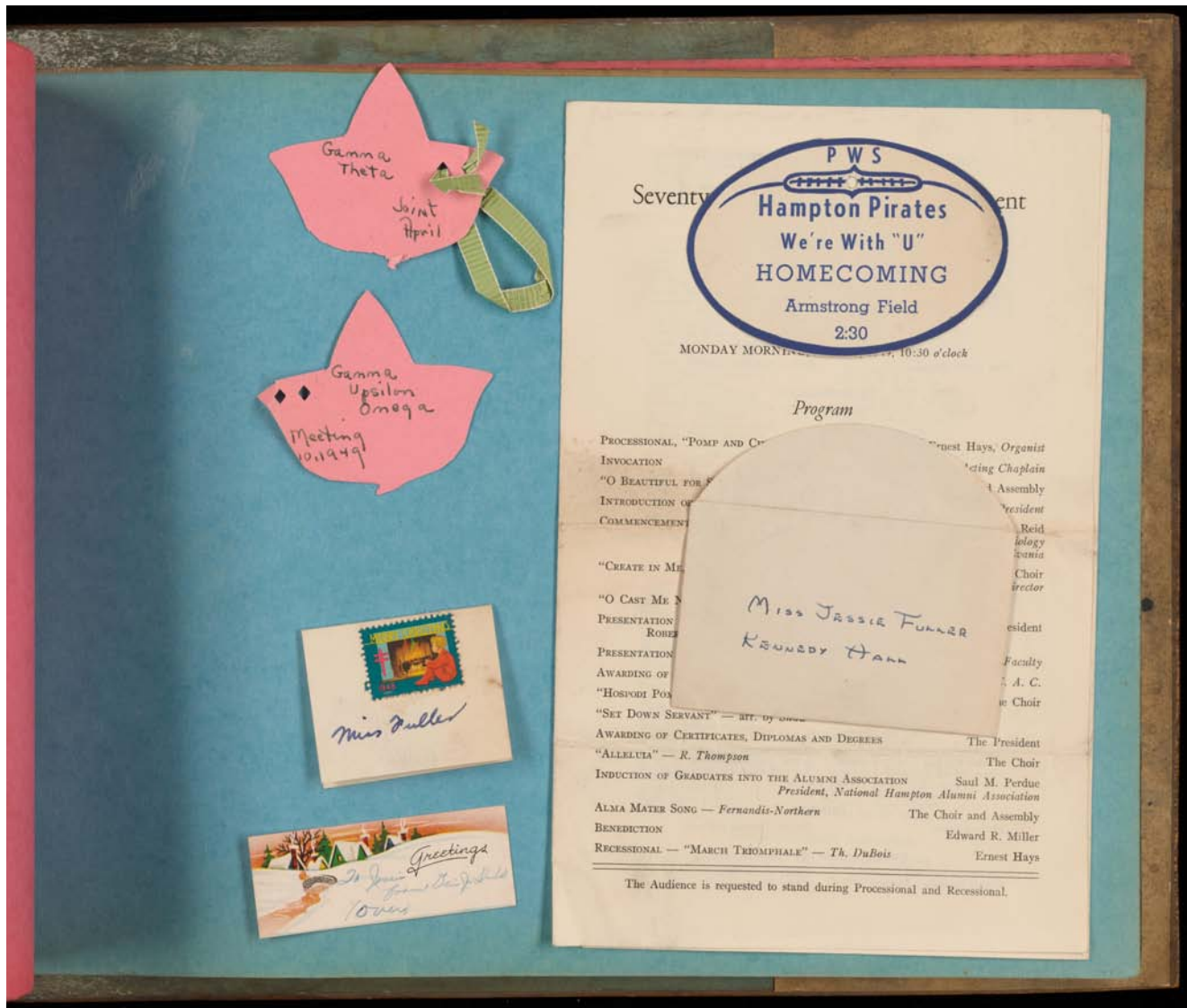


Fig. 3. Hampton Pirates event. Jessie Fuller Scrapbook, 1946–1949, Accession #15005, Special Collections, University of Virginia Library, Charlottesville, VA.

After Fuller graduated with a degree in home economics, she returned to Chicago, where she married businessman William J. Spraggins. Due to her family’s financial and social status, she likely did not work from home after her marriage. However, she appeared periodically in the society pages of Black newspapers in their reporting of middle-class women’s social engagements and charity work.

INSTRUCTION CHALLENGES

Despite the Fuller scrapbook’s potential, it is not used as extensively for teaching and research as it could be. Scrapbooks in archival repositories have often been ignored in teaching and

research due to their fragility, as well as to the lack of cohesion in their content.

The Fuller scrapbook is an engaging item for teaching because students respond well to items that document their historical age group. Although fascinated by the content, novice student researchers have often been reluctant to handle the Fuller scrapbook due to features inherent to its materiality such as failing adhesives, hard-to-turn sheets of construction paper, mixed media, and loose slips of paper. Instruction Librarian Krystal Appiah would want them to wear gloves when turning pages where photographs were present because it was not possible to flip certain pages without touching a photograph. However, she would not want

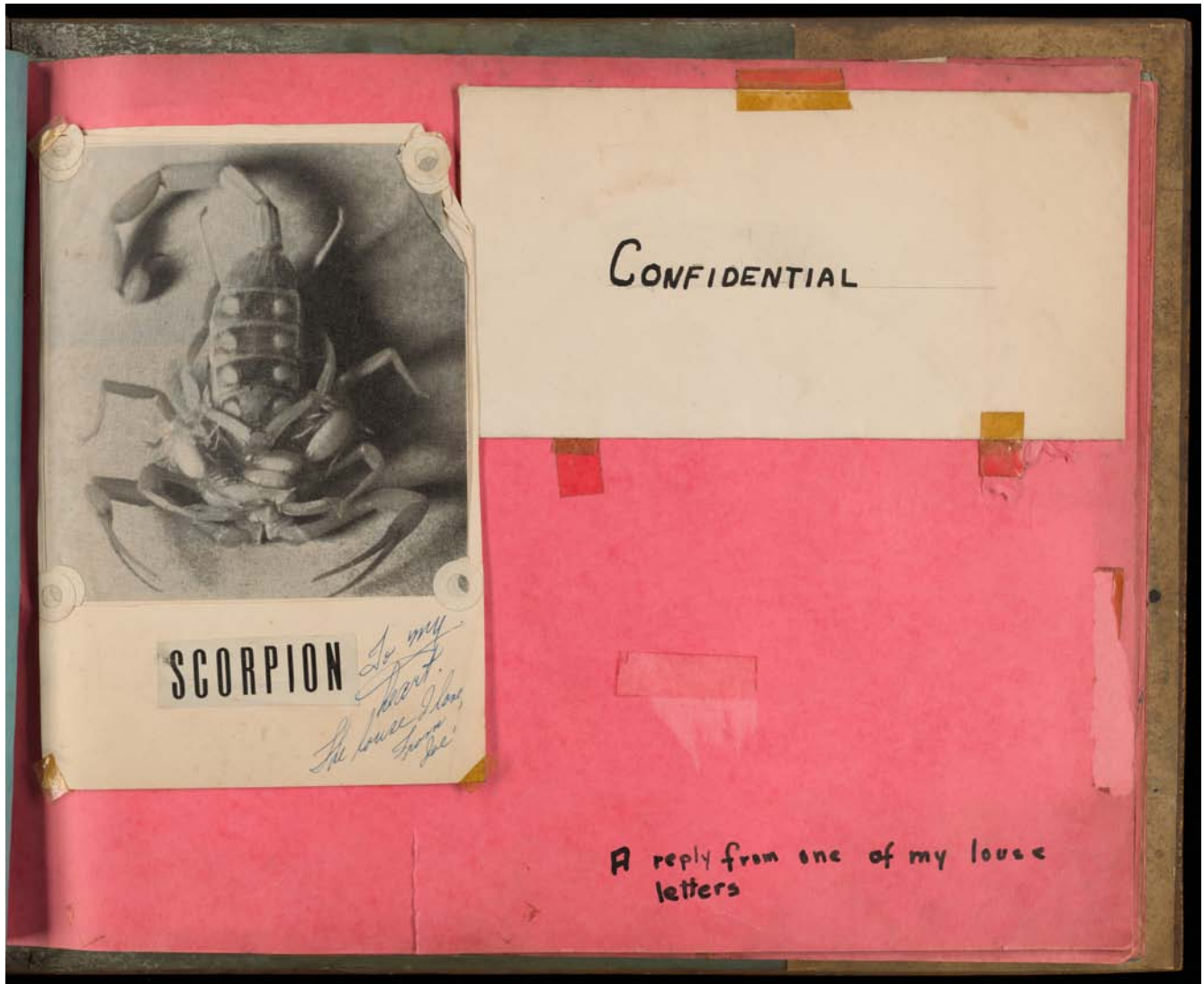


Fig. 4. Page with missing item. Jessie Fuller Scrapbook, 1946–1949, Accession #15005, Special Collections, University of Virginia Library, Charlottesville, VA.

them to wear gloves when turning pages without photographs because users need the manual dexterity of bare hands to turn 70-year-old construction paper safely. It was also hard to view the album's contents considering that so many items were detached and loose (fig. 4). The unusual post binding also makes it difficult to turn pages and hold them open. Krystal would sometimes turn pages for students, but that mediation interfered with her methods for immersive, active learning.

Furthermore, the scrapbook format can stymie interpretation. Bibliography scholar Jesse Erickson (2020) acknowledges that scrapbooks are “elaborate and convoluted artifacts that defy straightforward analysis” and “have been treated with intellectual derision or downright contempt.” However, in the past 10 to 15 years, scholars have increasingly appreciated

the genre of scrapbooking as a valid source and have worked to develop methodologies to interpret them.

This is particularly important in the case of people from marginalized backgrounds where there is often a dearth of traditional archival sources by and about them in mainstream libraries and archives. Literary scholar Ellen Gruber Garvey (2012, p. 227) notes that “scrapbooks are a democratic form of archives . . . Writing with scissors and cheap newspapers allowed many who did not write books or diaries to record something about their thinking.” Garvey and Erickson are among a growing cohort of scholars and librarians who are “seeking to realize [scrapbooks’] pedagogical potential” (Erickson 2020).

However, Garvey (2012) cautions that “preservation [of scrapbooks] in a larger brick-and-mortar archive has been

less democratically distributed” (p. 227). Even if they make it into the archives, scrapbooks, even those created by individuals from marginalized groups, may not be prioritized for preservation. However, their value to research and teaching helps make the case for libraries to devote resources to preserving and digitizing scrapbooks. This was the case at UVA, where Krystal flagged the scrapbook for preservation review by Sue Donovan, conservator for Special Collections, due to its potential for classroom use.

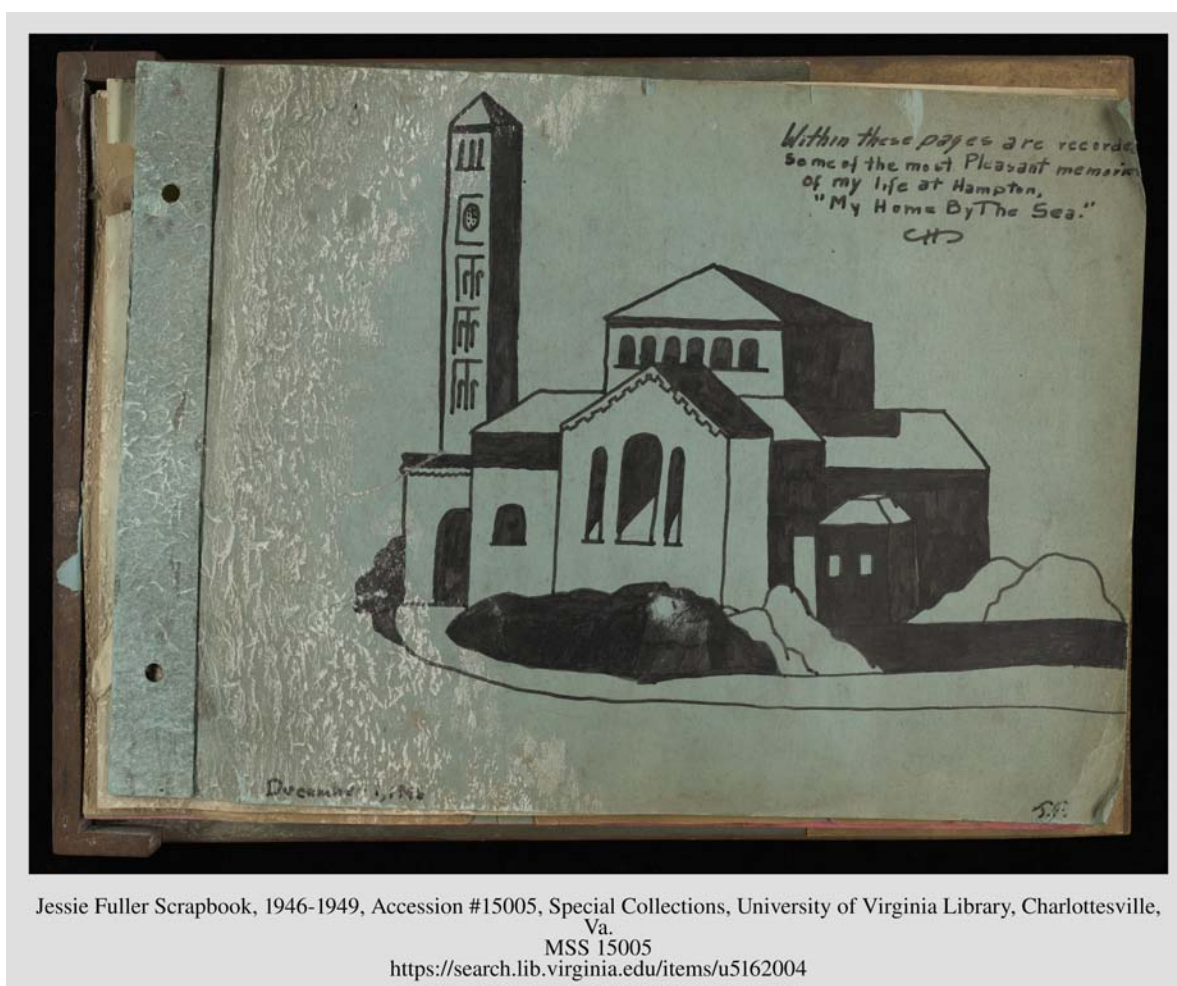
DESCRIPTION AND CONDITION OF THE SCRAPBOOK

Krystal first brought the scrapbook to Sue’s attention in mid-2018 with concerns about its condition. The scrapbook has a wooden lower board with a bracket-shaped wooden spine piece that is half an inch thick nailed to the left side of

the board. This lower board functions like a cradle for the pages that rest on top. Blue, pink, and tan calendared pages of almost card-like thickness are attached together and held onto the wooden board via two iron machining screws that pass through the back board and are secured with square iron nuts. There is no extant front board, and the first paper page is reinforced along the margin and decorated with an image of Hampton’s Memorial Church, indicating that this page functioned as the front cover (fig. 5).

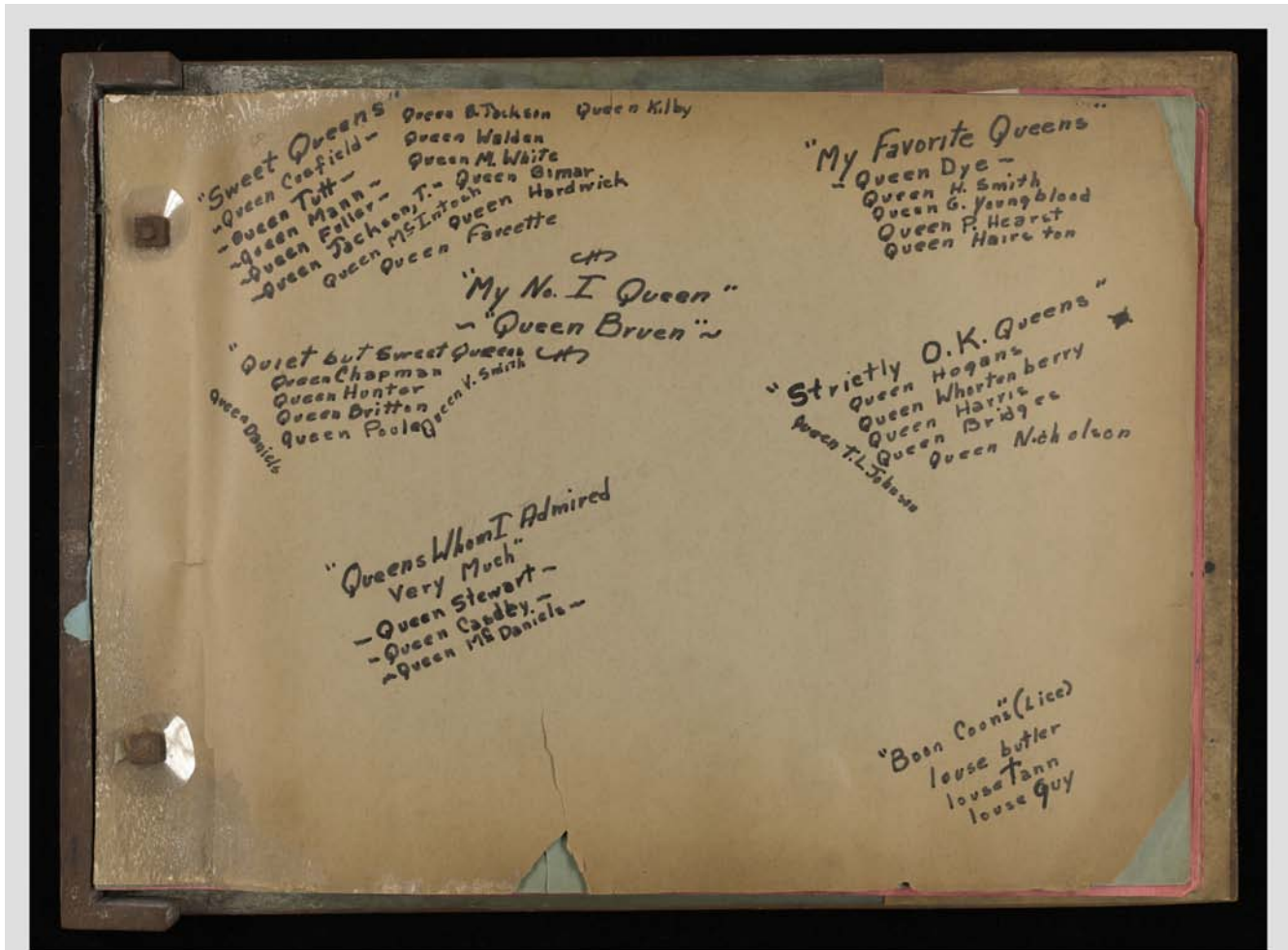
The first few dozen pages are heavy with memorabilia of Fuller’s rich social life at Hampton, including photographs, playbills, an annual, dance cards, and even wax candles. These are attached with different types and sizes of pressure sensitive tape from 1946 to 1949. After the first 23 pages, the memorabilia were inserted loose into the scrapbook.

The first two pages were detached, having torn at the holes punched for the iron screws. The structure itself



Jessie Fuller Scrapbook, 1946-1949, Accession #15005, Special Collections, University of Virginia Library, Charlottesville, Va.
MSS 15005
<https://search.lib.virginia.edu/items/u5162004>

Fig. 5. Before treatment, upper cover of the scrapbook, showing detaching pages and tight screws. Jessie Fuller Scrapbook, 1946-1949, Accession #15005, Special Collections, University of Virginia Library, Charlottesville, VA.



Jessie Fuller Scrapbook, 1946-1949, Accession #15005, Special Collections, University of Virginia Library, Charlottesville, Va.
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Fig. 6. Before treatment, third leaf of the scrapbook, showing detaching pages and mechanical damage to the paper. Circles of silicone-release Mylar were added underneath the rusted nuts when they were loosened to permit better scanning. Jessie Fuller Scrapbook, 1946-1949, Accession #15005, Special Collections, University of Virginia Library, Charlottesville, VA.

was damaging: the iron nuts were screwed tightly onto the paper, creating a breaking edge in the machine-made, short-grain paper between the condensed tight spine and the expanded thickness of the text block where the memorabilia was attached (fig. 6). The iron screws and the nuts were rusted, although this did not seem to be damaging the surrounding paper. The adhesive from the tape inside the scrapbook was yellowed and clearly differed in makeup from one page to another, with some areas still showing signs of tackiness. There had also been adhesive creep or a retraction of the tape carrier over the years, with the adhesive mass exposed beyond the edge of the carrier. Sections of tape had been accidentally pulled up over the years,

resulting in skinning of the paper surface around taped memorabilia and a loss of some content.

Nevertheless, the overall condition of the pages was surprisingly good, especially for scrapbooks. The damage on the first few pages seemed to be a result of repeated use combined with stiff paper, leaving the rest of the calendared pages that had received less handling still glossy and strong.

CONSERVATION OF THE SCRAPBOOK

Main Concerns and Approach to Treatment

Krystal's main concern was the ability of the item to be used and paged through as a scrapbook. In its current condition,

only the first few pages could be viewed since Krystal and her students were worried about causing further damage when turning the pages. Wax birthday candles taped to one of the pages were revealed during scanning because the condition of the scrapbook had previously obscured them from view. The primary problem was clearly the screw-post structure that put too much pressure on the spine edge of a stuffed scrapbook. The tape was perceived as another problem since it could cause more damage if left alone, and the parts that were already torn away left memorabilia at risk of loss or further damage.

Since the original structure was damaging, with screws that were too short to allow for the spine edge of the text block to appropriately expand to accommodate the thickness of the added memorabilia, there was not an obvious way at first to replicate the structure. Complicating this determination was the fact that the wooden board structure was quite unique. Patent research on Google patents, thanks to UVA librarians, did not reveal evidence that this scrapbook style had been a commercially-available item, meaning the scrapbook could have been made by hand in the carpentry shop at Hampton. It was thus very important for the text block to fit back onto the lower board.

At first, Gary Frost's method of reconsolidating the thick plates of failed 19th-century adhesive bindings seemed like it could be a solution for the thick construction paper pages of the Fuller scrapbook. This method involves attaching Japanese paper guards to each spine edge, leaving a quarter-inch of feathered edge that extends past the paper spine. The feathered edges are then consolidated together with PVA, forming a flexible and strong spine when dry. The resulting text block would rest in the cradle of the wooden board so

that students could see how the scrapbook had once been assembled. Neither Krystal nor Molly Schwartzburg, the curator for 20th-century materials, or Sue were entirely thrilled with this solution. However, at the time, it appeared to be a good compromise between access and respecting the original structure.

The secondary issue for the scrapbook's condition was the tape removal. It was important to remove the tape carrier and the adhesive mass to prevent further damage, but Krystal and Molly did not feel strongly about removing the tape stains. Furthermore, it became apparent while drawing up the proposal and during treatment that the tape functioned as evidence of how Jessie Fuller interacted with the scrapbook and how she curated her memories. In the end, all involved agreed that removing the staining would not be part of the treatment, especially after solvent testing on the adhesive proved that stain removal would be difficult and time intensive on the thick, colored paper.

After the initial assessment and treatment proposal, for which the rusted nuts were loosened with a bit of microcrystalline wax and then moved as high up the screw shaft as possible to relieve pressure on the paper, the scrapbook was fully digitized by UVA Library's Digital Production Group. The scans entered the UVA Digital Library so that the images can be seen in the scrapbook's online record (note 2). Upon its return to the lab, the tape carrier and adhesive were removed using a hot air pen and a Casselli spatula. The tape stains aided in realigning the memorabilia into the position that Jessie Fuller had chosen, and pasting detached items back in place with toned tengucho maintained the scrapbook's appearance (fig. 7).



Fig. 7. One page of the scrapbook, showing deteriorated pressure-sensitive tape, before treatment on the left and after treatment on the right. Lightweight, toned tengucho was used to reattach the memorabilia after tape removal. Jessie Fuller Scrapbook, 1946–1949, Accession #15005, Special Collections, University of Virginia Library, Charlottesville, VA.

Change in Approach

At this point, there was a long period when treatment on the scrapbook had to be abandoned. Sue's maternity leave, followed by the COVID-19 pandemic, and then projects with pressing deadlines such as the salvage of a time capsule, delayed progress on the Jessie Fuller scrapbook. It was not until December 2020 that tape removal and mending were finished, and it was time to think about reassembling the scrapbook. By this point, more than a year had passed since work had begun, and after dedicating more than 20 treatment hours, the Japanese paper guard method no longer seemed like the right approach. Replicating the screw-post structure without replicating the damage now seemed like a better method. After spending about 30 minutes in the fasteners aisle of the local hardware store one day, a machining screw of the same diameter and an additional half inch of length was located.

After finding this replacement screw, Krystal, Molly, and Sue conferred over Zoom about the progress with the scrapbook, and Sue proposed replicating the original structure. The instruction and curatorial staff both agreed wholeheartedly with the change, thrilled that there was a way to replicate the structure without perpetuating the damage it had caused. With the new machining screws, the depth of the text block could be expanded while still using the same attachment method. Molly suggested that reusing the original square nuts would further maintain the original impression and impact of the scrapbook. Adding spacers of different thicknesses would bulk up the spine to allow for tightening without putting pressure on the paper, and the rust from the nuts would not damage the original paper (fig. 8). In this way, the scrapbook would retain some of its pre-treatment qualities without significant changes to the structure.

Of course, the treatment did change aspects of the physical appearance. The machining screws had a Phillips head groove instead of a flathead groove, so the screw heads look different on the lower cover. More visible is the spacer on the upper cover that protects the paper underneath from any potential rust and appropriately secures the text block.

Krystal felt that the visibility of the spacers actually serves as a reminder to those using the scrapbook that it is an item that has been treated and needs to be handled with care. The scrapbook opens well, and all pages that have attached memorabilia can be viewed, although some pages do need more support, so Permalife interleaving pages were added to stabilize floppy memorabilia or protect photographs while turning pages (fig. 9).

Takeaways from Treatment

Working on the scrapbook was certainly a learning experience in a lot of ways. As with every tape removal project, there is often a recurring theme of "I wish I had known then what I know now." Primarily, using a higher heat setting from the beginning would have helped avoid using solvents that created blue tide lines on greeting card papers with optical brighteners. Sue would also have avoided using the hot air pencil on the page with the candles, since applying heat to work on the verso, even with protective layers of board covering the candle, caused the wax in one candle to melt slightly.

The preceding complications notwithstanding, this treatment ended up even better than anticipated, with less intervention on the structure. Key to the success of this treatment was the open communication and collaboration among Krystal, Molly, and Sue. Feedback from Krystal and Molly about using the scrapbook and what would be best for students and researchers, as well as frank conversations about the amount of time tape removal can take and the limits of what could be done with such thick paper, allowed for a satisfying outcome for all and set the bar for productive discussions in the future. And although there were significant delays in the treatment, this ultimately led to a change that was more respectful of the nature of the item. Furthermore, the revised treatment means that there is the option to revisit treatment in the future, since the screws can be removed and the pages lifted off. Individual pages could even be put on exhibition, which would be a wonderful way to share the joy and friendship that Jessie Fuller documented in her scrapbook.



Fig. 8. After treatment, the thickness of the scrapbook increased past the wooden spine bracket, but with the added support of the spacers at the spine, the pages are safely secured. Jessie Fuller Scrapbook, 1946–1949, Accession #15005, Special Collections, University of Virginia Library, Charlottesville, VA.



Fig. 9. After treatment, view of the upper board of the scrapbook, showing the visible blue board spacer at the spine edge. Jessie Fuller Scrapbook, 1946–1949, Accession #15005, Special Collections, University of Virginia Library, Charlottesville, VA.

REPARATIVE ACQUISITIONS AND CONSERVATION

With its insights into mid-century Black life, the scrapbook also supports the Albert and Shirley Small Special Collections Library's goal of acquiring and highlighting materials by historically marginalized groups. UVA was founded in 1826 and remained largely segregated by race and sex until 1970. As a result, Small's collections, as well as the University Archives, overwhelmingly represent the experiences of white people, ranging from items that exclude the lives and personhood of Black people to those that document active hostility and disparagement of African Americans. The library has few materials by or about African Americans that are not related to the violence of slavery or Jim Crow. Thus, it is challenging for Black students and community members to find meaningful materials about their histories and experiences in Small's collections. In presenting the joyful life of a Black college student, the Fuller

scrapbook is one of the few items that presents an alternative to those traumatic histories.

Acquiring this scrapbook represents a first step toward showing our students, staff, and community that we cherish them, and conserving and preserving it is another stride in this direction. Along with exhibitions, research, or instruction-driven conservation requests, preserving and conserving items in Small's collections that uplift Black, Brown, and indigenous experiences is one of Sue's highest priorities. It was truly an honor to have Jessie Fuller's scrapbook in the lab, to be able to share space with the joy and fellowship that her memories evoke. And although the predominantly white collections in the library and archives mean that items like Fuller's scrapbook are rare, this means that it is even more important to be actively working to expand access to the lives of people who have been historically marginalized. It is not enough to wait for others to identify items to work on from exhibitions and research queues. Sue is going into

the stacks and asking the advice of staff members who know these collections by heart to put her labor and time into treating collections that show the experiences and lives of Black school teachers, students, and citizens of Charlottesville and the surrounding area, as well as those of enslaved workers. Treating the Jessie Fuller scrapbook is a wonderful example of conservation working with Special Collections staff to identify a creative strategy that balances providing context and expanding access to the unique voice of Jessie Fuller.

NOTES

1. Hampton is a historically Black college (or HBCU) that was founded in 1868 as Hampton Normal and Agricultural Institute to educate African Americans after the Civil War and during the era of legal segregation in the South. Hampton's notable alumni include Booker T. Washington and Mary Jackson, one of the mathematicians depicted in the 2016 film *Hidden Figures*.
2. The scrapbook record and images before treatment can be accessed using the following link: https://search.lib.virginia.edu/sources/uva_library/items/u5162004.

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Camera Work: One-Size Treatment Does Not Fit All

INTRODUCTION

The magazine *Camera Work*, published between 1903 and 1917 by Alfred Stieglitz (1864–1946), is a crucial artifact to understand the development of American photography and its recognition as art. Numerous institutions in the United States hold a copy of the 50-volume set in their collection. However, the inherent vice of the materials makes the preservation of the journal a challenge. The yapp edges of the cover, the brittle text block, and the machine sewing of the journal contributed to its deterioration. Handling and housing are complicated due to the fragility of the magazine. Despite their historical importance, *Camera Work* sets are often in a poor condition, making exhibition and access difficult.

The Saint Louis Art Museum owns a complete set of the journal and selected two volumes for the exhibition “Architectural Photography from the Collection, 1850–2000” (July 2021–January 2022). To carry out the necessary conservation treatments, it appeared essential to survey what other museums did and why. Indeed, the object status of *Camera Work* changes depending on the institution type (museum, library, archives), which affected the preservation measures taken. This conservation treatment was also an opportunity to revise the housing of the magazine.

STIEGLITZ AND *CAMERA WORK*

As Green (1973, 7) states, “*Camera Work* is a portrait. It is a portrait of Stieglitz, for it documents each step in his transition from a youthful experimenter preoccupied with a range of subject matter and technique to a mature artist able to express the intimate and the spiritual through an extraordinary perception of the people and the places close to him.” Stieglitz indeed played a central role in the conception of *Camera Work*. The photographer was the creator, main editor, and publisher of the magazine. It was an outlet for “The Cause,” as he called it, which was proving photography as a medium of artistic

expression. By the time the magazine was in the making, Stieglitz was already an internationally famous photographer. After studying in Berlin with Professor Hermann Wilhelm Vogel (1834–1898), he gained status by winning hundreds of medals in photography competitions. In 1890, after his return to the United States, he became a partner in a photoengraving business: the Heliochrome Company. The latter eventually became the Photochrome Engraving Company, with which Stieglitz maintained a close relationship. In 1896, Stieglitz became vice-president of the New York Camera Club and created the quarterly *Camera Notes* (Stieglitz and Margolis 1978, 9). The journal was successful in attracting serious photographers, but in doing so it created factions within the New York Camera Club. In 1901, Stieglitz created an exhibition at the National Art Club, titled “An Exhibition of Photography Arranged by the Photo-Secession.” After several power struggles, Stieglitz finally resigned his editorship of *Camera Notes* in 1902. In the same year, he went on to found the Photo-Secession movement and created *Camera Work*.

In the early years of *Camera Work*, Stieglitz featured mostly artists of the Photo-Secession. These included James Craig Annan (1864–1946), Frank Eugene (1865–1936), Gertrude Käsebier (1852–1934), Edward Steichen (1879–1973), Frederick Evans (1853–1943), Alvin Langdon Coburn (1882–1966), Clarence White (1871–1925), among others. In parallel, Stieglitz started running “The Little Galleries of the Photo-Secession.” The gallery later became “291,” the name of which was based on the address of the gallery (291 Fifth Avenue in New York City). As 291’s exhibition program moved beyond photography to include painting and sculpture, the journal began to cover modern art and took on a more international focus. With these changes and the advent of World War I, subscriber numbers decreased and the publication schedule became increasingly irregular (Plate 2016). The last issue of *Camera Work*, dated June 1917, featured early work by Paul Strand. The artist writes in an essay for the journal that “the whole development of photography has been given through to the world by *Camera Work*.” He concludes, “Whether a watercolor is inferior to an oil, or whether a drawing, an etching, or a photograph is not as important as either, is inconsequent. To have to despise something in order

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to respect something else is a sign of impotence” (Strand 1917, 3).

Camera Work represents a pinnacle of accomplishments for art publications and periodicals alike. The magazine is a combination of visual and literary art, in the service of an artistic ideal. In that sense, it followed in the tradition of *The Yellow Book*, *avant-garde* in England, and the pre-Raphaelite magazine *The Germ*. The influence of German magazines such as *Pan* and the Austrian *Vier Sacrum* should also be considered given Stieglitz’s German background (Abid 1976, 101).

THE MAKING OF CAMERA WORK

Camera Work (fig. 1) was designed carefully, with materials that remain consistent throughout its publishing. The paper cover is applied as a case binding, with a yapp on the head, tail, and fore edge. These yapp edges are quite large, about 8 to 10 mm on average. The Yapp style, named after William Yapp, an English bookseller of the second half of the 19th century, is mostly associated with books of devotion (Etherington and Roberts 1981). This type of binding may have been chosen for that reason, as *Camera Work* was meant to quite literally be the bible on photography. The cover paper is adhered to the endleaves and glued onto the text block spine, with hide glue possibly modified with glycerin. The magazine has an unsupported machine sewing. It appears to have been bound together by two different binderies: the Knickerbocker

Bindery and Otto Knoll. They were both located in New York City, according to advertisements found in the journal. Stieglitz took the production of every issue as “a serious business” (Peterson and Knauff 1985, 30). In 1916, he wrote a complaint that the Knickerbocker Bindery delivered only 450 issues of the magazine instead of the 475 issues he was expecting. The loss of even a single copy of *Camera Work* was of great importance.

The cover of *Camera Work* is made of a gray, wove, heavy-weight, machine-made paper. The typography was designed by the artist Eduard Steichen (1879–1973), who worked for a few years as a commercial printer and designer. Printed in light gray by letterpress, the design remains unchanged throughout the 50 issues. The layout of the magazine was conceived by both Steichen and Stieglitz. The text block is made of a heavy-weight, cream, laid paper, bearing the watermark ENFIELD S.CO 1887 (fig. 2). The edges of the text block remained untrimmed, retaining the delicate deckled edges. This is another reason for the yapp edges, which were likely meant as a protection to the deckles. The papers used in the making of *Camera Work*—the text block paper, cover paper, and other mounting papers found in the magazine—were sourced at the Seymour Company. At the time *Camera Work* was produced, the Seymour Company was the largest supplier of paper for books in New York City (Valente 2010, 69). The firm started as a printing establishment and bookselling shop. It became so successful that it purchased the failed Persee &



Fig. 1. Alfred Stieglitz, *Camera Work: A Photographic Quarterly* (before treatment), No. 14, 1906; Saint Louis Art Museum, Museum Purchase and Gift of Dr. Paul S. Dewald; 212:1975.14.



Fig. 2. Watermark of the text block paper, in transmitted light.

Brooks Mills in Windsor Locks (Connecticut) around 1860 and renovated it to produce their own papers. The presence of the deckles and the laid lines were key in emulating the look of handmade paper. This was done in an effort to reference the Kelmscott Press (Peterson and Knauff 1985, 29), directed by William Morris (1834–1896). However, the visual features of the text block paper, along with the development of papermaking in the United States at that time (Clapperton 1967; Hunter 1943, 368), pointed toward a sulfite pulp, cylinder-mold, machine-made paper. This would explain why the text blocks of most *Camera Work* sets show severe brittleness. Gray Fabriano paper was also identified in some volumes. Based on the advertisement pages of the magazine, the text block was first printed at Fleming & Carnrick, which became the Fleming Press in 1907. In 1908, the Fleming Press went out of business (*The Sun* 1908). Frank Fleming, the previous owner, started working for Rogers & Company, which may have inclined Stieglitz to start using them (Stieglitz 1916). Rogers & Company printed *Camera Work* until the end of the magazine in 1917.

The 50 issues of *Camera Work* contain more than 500 illustrations, most of which are photogravures. This photomechanical process is printed in ink, in the same fashion as intaglio prints. The photogravures were printed on handmade Japanese paper. It is possible that Stieglitz sourced the Japanese papers from the Japan Paper Company, which was the main supplier of Japanese paper in New York City at that time. The photogravures were printed on several kinds of Japanese papers, and they were also used as mounting

papers. Comparison between papers from the Paper Sample Collection at the National Gallery of Art and *Camera Work* may indicate that one of the Japanese papers used for the majority of the photogravures is a kozo paper from the Gifu prefecture. Ms. Dewald, who donated her *Camera Work* set to the Saint Louis Art Museum as discussed in the following, remembers Stieglitz complaining about the difficulty of acquiring the particular Japanese paper needed for the photogravures.

The plates were grouped together, usually at the front of the magazine. They were set off by a blank facing page, creating the effect of a portfolio (fig. 3). Each photogravure was tipped in the magazine by hand often by Stieglitz himself. For the first two years of the journal, they were printed by the Photoengraving Company, where Stieglitz had previously worked. His brother-in-law, Louis Schubart, was still in charge and made sure that Stieglitz's voice was heard. The photochrome department eventually became the Manhattan Photogravure Company, which produced most of the photogravures for American contributors up until the last issue. Stieglitz also turned to foreign printers, such as T. and R. Annan and Sons in Glasgow, and the F. Bruckmann Verlag of Munich, particularly when dealing with European artists. Stieglitz was in close correspondence for decades with the printers J. Craig Annan for Annan and Sons, and Frederick Goetz, working at Bruckmann Verlag.

Camera Work's photogravures have a peculiar status. Stieglitz had incredibly high standards for their production and was constantly reminding his readers that they were

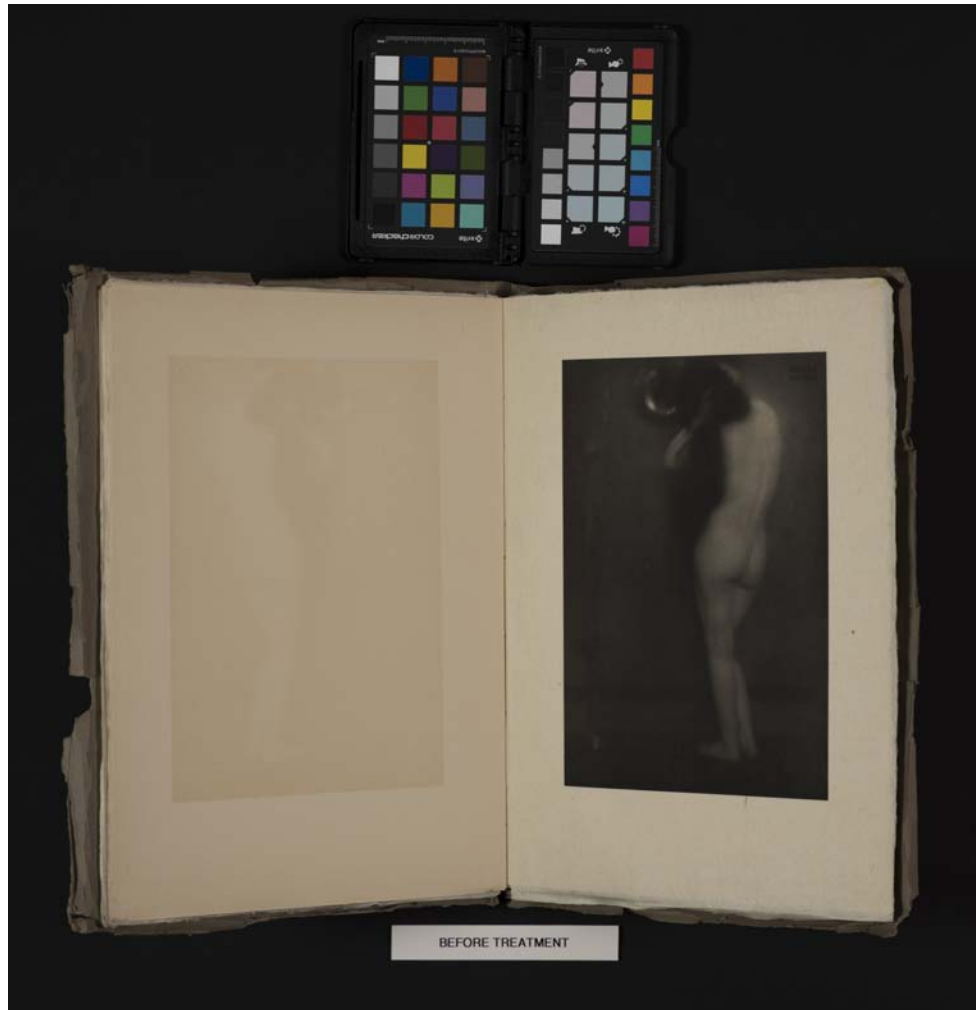


Fig. 3. Alfred Stieglitz, *Camera Work: A Photographic Quarterly* (before treatment), No. 14, 1906; Saint Louis Art Museum, Museum Purchase and Gift of Dr. Paul S. Dewald; 212:1975.14.

acquiring original works of art in the form of photogravure illustrations. For example, Stieglitz announced in a special insert from *Camera Work* number 12 that the *Societe l'Effort* (Brussel), in lieu of the Photo-Secession section that was originally planned for their 1904 exhibition, mounted and framed photogravures from *Camera Work* instead. This event was used to further impress on his readers the importance of the photogravures. Most of the time, he secured the original negatives from the photographers, from which the copper plates were made (Peterson and Knauff 1985, 14). In his early studies of the Photo-Secession, Robert Doty (1960, 33) goes as far as saying that “the reproductions . . . quite often surpassed the quality of the original.” His opinion is echoed by Estelle Jussim (1979, 81), who asks: “How is it possible for ‘reproductions’ to *exceed* ‘original prints’? In what conceivable way might it be said that a reproduction could be finer than an original?”

Other methods of image reproduction were used for *Camera Work*, but they never received nearly as much attention as the photogravures. In that respect, the journal can be considered as a small encyclopedia of the mechanical printing processes available at the turn of the 20th century, containing duogravures, one-color halftones, duplex halftones, four-color halftones, and collotypes (Green 1973, 13). The Photochrome Engraving Company produced most of the halftones for *Camera Work*, along with Bruckmann Verlag.

CONDITION CHALLENGES OF *CAMERA WORK*

The Saint Louis Art Museum is fortunate to have received an almost complete set in 1975, from Ms. Elsie Dewald and her son Dr. Paul Dewald, through partial gift and purchase. Their set lacked four issues and 12 plates. However, it also contained eight duplicate editions of the magazine. Ms.

Dewald and her husband, Jacob Frederick Dewald, were friends of Stieglitz along with other modernist artists such as Georgia O’Keeffe (1887–1986), Paul Strand (1890–1976), Stanton MacDonald-Wright (1890–1973), Thomas Hart Benton (1889–1975), and others (Abid 1976, 101). She was also a collector of their works. The relationship between the Dewalds and Stieglitz is evident in the portrait that the artist took of his friend Jacob Dewald, exhibited in 1921 at the Anderson Galleries (note 1). The Dewalds, along with the Strands, Paul Rosenfeld, and other members of the Stieglitz family helped backing financially “An American Place,” a gallery Stieglitz directed between 1929 until his death in 1946 (Burke 2020, 206). After acquiring the Dewald set, the Saint Louis Art Museum sought to exchange its duplicates to form a complete run of the magazine. This goal was achieved in 1981 with the help of Dr. Paul Dewald.

The Saint Louis Art Museum set shows typical alterations often seen with *Camera Work* in their original case binding. An overall assessment of the condition issues can be seen in figure 4. Tears in the yapp edges are extremely common (98%), as well as losses (85%). The construction of the binding itself, as well as the brittleness of the gray cover paper, explains these issues. The machine sewing and the crystallization of the hide glue on the spine resulted in failed sewing and splitting text blocks in most of the volumes (96%). The adhesion of the cover paper directly onto the spine contributed to the mechanical issues as well. The images within the volumes are in a good condition, but most of the opposite pages (98%) show ghost images, due to the migration of fatty acids from the prints. PhotoTex tissue interleavings are currently in place to prevent further degradation. The paper of the text block shows signs of discoloration and brittleness in all of the journals.

The two volumes (numbers 14 and 32) selected for the exhibition “Architectural Photography from the Collection,” curated by Eric Lutz, are no exceptions to the condition issues cited previously. Volume 14 shows losses, tears, and folds in the cover along the head, tail, and fore edges. Volume 32 has lost the majority of its yapp edges. The paper tore at the joint on volume 32, whereas the endsheet split along the joint on volume 14. The adhesive on the spines failed, causing the gatherings to separate. However, the sewing is in good condition on both volumes.

CAMERA WORK IN AMERICAN INSTITUTIONS

Camera Work is a crucial artifact to understand the development of American photography and its recognition as an art. As such, sets of this important publication are commonly found in institutions across the United States. However, their preservation is rendered difficult by the inherent vice of the materials used in their construction. Institutions owning *Camera Work* can be museums, libraries, or archives. These institutions have different needs that may result in different decision making when caring for the magazine. During this research, the author reached out to 20 institutions in the United States in the hope of getting an overview of condition issues, binding state, place in collections, and preservation methods.

These institutions included the Art Institute of Chicago, the Baltimore Museum of Art, the Cleveland Museum of Art, the George Eastman Museum, the Georgia O’Keeffe Museum, the Harvard Art Museums, the J. Paul Getty Museum, the Library of Congress, the Metropolitan Museum of Art, the Minneapolis Institute of Art, the Museum of Modern Art, the National Gallery of Art, the New York Public Library,

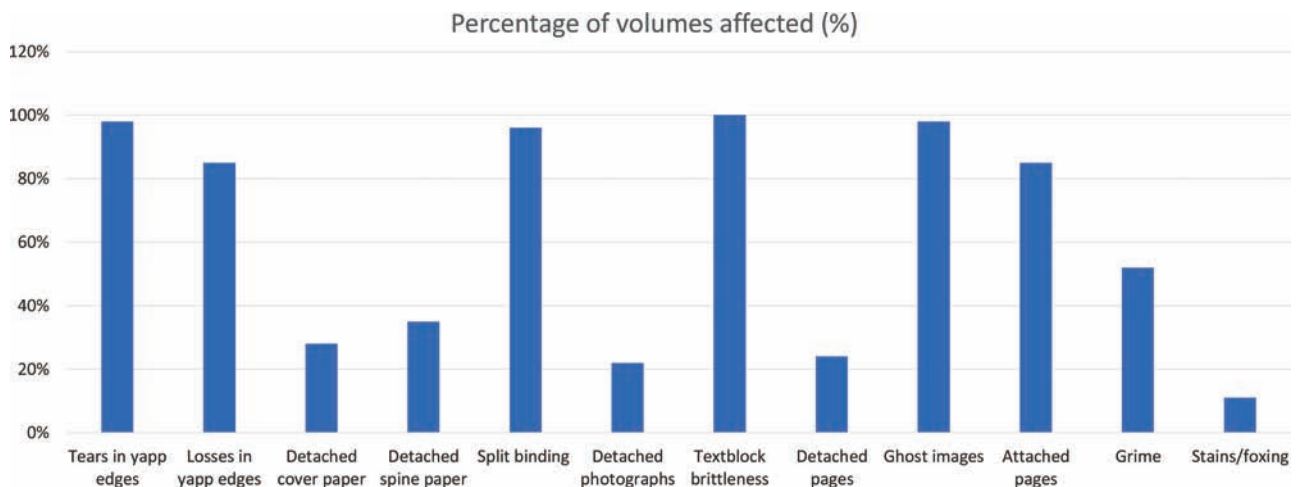


Fig. 4. Graph showing the types and percentages of alterations on the Saint Louis Art Museum set.

the Philadelphia Museum of Art, the San Francisco Museum of Modern Art, the Smithsonian Archives, the Toledo Museum of Art, the University of Virginia Library, and the Yale University Library. Additionally, the author was able to travel to four of these institutions, including the Art Institute of Chicago, the Metropolitan Museum of Art, the National Gallery of Art, and the New York Public Library. This was made possible by the FAIC Carolyn Horton Scholarship. This project was inspired by a survey of the *Camera Work* set owned by the Harvard Art Museums performed by the author in 2015.

Because *Camera Work* is at the crossroad of several disciplines, its status varies depending on the institution owning it. It became clear that understanding the place it had in collections was key. Whether it was considered an artwork, a research tool, or a housing for the photogravures within, the frame of reference would influence access and treatment approaches. About half of institutions surveyed reported having multiple *Camera Work* sets, whereas less than 10% had incomplete sets. For example, the New York Public Library owns three sets, and multiple duplicates, as well as detached plates.

In the museums surveyed, *Camera Work* was not systematically part of the art collection. About one-third reported that their set was part of their museum library's special collection. More often than not, sets in the art collection were transferred from the library collection at some point in the past. About one-third of institutions did not receive a complete set at once. Trade was happening among these institutions, particularly in the 1980s and 1990s. Stieglitz and O'Keeffe were integral to the dispersal of the magazine in American institutions. During his lifetime, Stieglitz intentionally donated or sold several sets to specific institutions. For example, one set was sold directly by the artist to the Ryerson Library at the Art Institute of Chicago in 1923 to serve as a reference for the art students coming to the library. A second set was donated by O'Keeffe in 1953 as she dispersed Stieglitz's collection.

Most of *Camera Work* sets are still in their original case bindings. However, about 20% are in bindings of historical significance as they were rebound during Stieglitz's lifetime. The *Camera Work* set owned by the National Gallery of Art is the most important example of this kind of rebinding. Several issues were bound together to form larger volumes with a suede cover, stamped with *Camera Work*'s mark. This set, donated by O'Keeffe in 1949, contains an inscription by Stieglitz's hand in volume 1. It states that all photogravures were signed by the artists in person and that no other equivalent volume exists. This further reinforces the importance of the photogravures and their status as independent works of art.

More than a third of *Camera Work* sets are in commercial bindings, generally dating from the 1930s and done before

acquisition by institutions. The Metropolitan Museum of Art owns two sets, including one that shows an array of commercial rebinding. This set was sold by Stieglitz in 1922 to the Watson Library. The volumes were eventually transferred to the Department of Prints and Photographs in 1976. The second set was gifted by O'Keeffe in 1953 and is currently in a conservation rebinding. Only about 10% of sets are currently in this configuration. Certain university libraries also undertook rebinding of the magazine upon acquisition to promote access.

All institutions surveyed that did not take treatment measures reported condition issues that rendered the magazine unexhibitable and inaccessible for researchers. More than half of surveyed institutions undertook a minimal treatment approach when caring for *Camera Work*. About 10% chose a more interventive approach: a complete dissociation between the magazine and the photogravures within. Some institutions kindly shared treatment reports from the 1970s that recommended that option and executed it. The peculiar status of the photogravures understandably led some institutions to prioritize their preservation over the magazine as a whole. To this day, numerous museums regularly decide to separate the photogravures from the magazine for exhibition purposes and do not reintegrate the gravures in the binding after the fact. In light of this survey, the Saint Louis Art Museum set that is still in its original binding appears to be in relatively good condition. This is a rare configuration, as most of *Camera Work* in their case bindings are today in a deteriorated and fragile state.

TREATMENT AND HOUSING OF *CAMERA WORK* AT THE SAINT LOUIS ART MUSEUM

The treatment protocol was inspired by the ones gathered during the survey and was designed with accessibility in mind (note 2). The Saint Louis Art Museum is the only institution in Saint Louis that owns a set of *Camera Work*, and its strategic plan mandates accessibility. Therefore, availability of *Camera Work* for the Print Study Room is strongly desired. Treatment was started with dry surface cleaning of the cover and the text block, performed with cosmetic sponges and soft brushes. The yapp edges were then consolidated with wheat starch paste, cooked at 10% (w/v). The concentration of the wheat starch paste was chosen high to avoid darkening of the gray paper. The yapp edges were then flattened after a brief humidification under Gore-Tex. The crystallized adhesive on the spine was removed mechanically, with a combination of scalpel blades and tweezers. The adhesive was further removed from the threads with methylcellulose at 6% (w/v). The spines of volumes 14 and 32 were lined three times with Hanji paper (Hiromi Paper Inc., 13 gsm) and paste, cooked at 15% (w/v).



Fig. 5. Lining of the yapp edges (toned Usu-Gami, 15 gsm, and 10% wheat starch paste).

The method with which the yapp edges were repaired was given careful consideration. Simple tear repair was rejected, thanks to feedback from the Harvard Art Museums. These repairs were too strong, causing new damage to occur next to them due to the brittleness of the paper. To avoid this issue, the yapp edges were lined overall, without tear repairs first (fig. 5). An Usu-Gami paper (Hiromi Paper Inc., 15 gsm) was selected and toned to make the lining as discreet as possible. Most of the yapp edges were lost on volume 32. To re-create them, a Teflon spatula was inserted between the pastedown and the cover paper. The same Usu-Gami paper was inserted and adhered with paste (10% w/v). Inserting the Usu-Gami repair between the pastedown and the paper cover was not attempted on volume 14, as their adhesion was too strong and the risk of further damage was too great.

Once the yapp edges were lined, the losses were filled. Because of the number of volumes in each set, the methodology employed was designed to enable the treatment of an entire set at once. A traditional toned Japanese paper fill can be time consuming, and it was important to create a fill that would be weaker than the original paper. To achieve the desired texture and color, a blend of Canson paper was used (note 3). The Canson Mi-Teintes Felt Gray, Dark Gray, and Sand were selected, and different blends of pulp were tested. A close match was obtained with a mix 1:2:2 of Felt Gray: Sand: Dark Gray. The papers were torn into small pieces and soaked

overnight in water. They were then blended into a pulp. The pulp was used to make small sheets of paper with a paper mold. They were dried on a wooden board overnight (fig. 6).

Small adjustments were still needed to be a perfect match with the cover. This was attained by adding a wash of viridian green and bone black watercolors to the custom paper. The losses were then filled and adhered on top of the lining paper with paste (10% w/v). Adjustments will likely always have to be made, as numerous institutions reported differential fading of the paper cover. Finally, detached fragments of the yapp edge that could be tied to a particular loss were reattached (figs. 7–9).

Housing also represents a challenge in caring for *Camera Work*. The Saint Louis Art Museum set was initially stored in a cabinet, in five-wall clamshell boxes. These boxes may have been contemporary to the acquisition of the magazine and stored on average seven to eight magazines per box. Individual volumes were wrapped in Photo-Tex tissue. Clamshell boxes cannot be considered appropriate housing for *Camera Work*. There was little space around the volumes to handle them safely and get them out of the box without damaging the yapp edges. This is a common problem that was reported by most of the institutions surveyed during this project.

Feedback from the Straus Center for Conservation and Technical Studies at the Harvard Art Museums enabled



Fig. 6. Small sheets of paper were casted with the paper pulp mix and dried on a wooden board.



Fig. 7. Before and after treatment, front cover of *Camera Work: A Photographic Quarterly*, No. 32, 1911.



Fig. 8. Before and after treatment, back cover of *Camera Work: A Photographic Quarterly*, No. 32, 1911.

the development of better-suited housing. After treatment of the Harvard set, the use of clamshell boxes was initially planned, with a foam insert to compensate for the thickness of the text block and support the yapp edges. However, this system resulted in new damage, as one can be tempted to tilt

the box and create pressure on the yapp edges. A tray system was created by Adam Baker, senior conservation technician, with the idea in mind to make the fragile state of the object immediately noticeable to art handlers. The Saint Louis Art Museum's project preparator, Nathan Poetzcher, took



Fig. 9. Before and after treatment, side view of *Camera Work: A Photographic Quarterly*, No. 32, 1911.



Fig. 10. Housing designed by Nathan Poetzsch, project preparator at the Saint Louis Art Museum (based on the Harvard design).

inspiration from that design and adapted it to suit the specific needs of the museum (fig. 10).

This resulted in a more compact tray that could be stacked to fit the current cabinets. The Saint Louis Art Museum, like many other institutions, is dealing with a shortage of storage space. It was paramount to improve housing while not significantly increasing occupied space. Trays can be stacked eight high, with clear labels on two sides to help identify where individual volumes are stored (fig. 11). To get a volume out of its housing, the hinge on the right side is used to tilt the board support onto which the magazine lies (fig. 12). The board support has a small edge to maintain the spine and prevent sliding. It is taken out of the tray and directly placed on a book cradle (fig. 12). This board should not be separated from the magazine while handling, as it helps prevent any contact with the yapp edges. The Saint Louis Art Museum art handlers and curators will receive training on proper handling for *Camera Work* that will enable safe access of the treated volumes to staff and researchers at the Print Study Room.

CONCLUSION

Camera Work itself “is a work of art: the lover’s touch having been lavished on every aspect of its form and content. Spacing, printing, and quality of the paper, the format of the pages, the format of the advertisement, even, are simple and magnificent” (Rosenfeld 1934, 82). Here, Rosenfeld explains clearly the importance of Stieglitz’s endeavor, which was beyond the publication of a magazine. Thanks to *Camera Work*, the status of photography was irrevocably changed. Despite its challenging materials, the journal should be preserved as a whole. Although the photogravures within often received more attention, separating them from their original binding should be discouraged. It is important to develop appropriate housing to alleviate most problems encountered when accessing the magazine. Treatment should consider the original structure, with consolidation and reinforcement of the yapp edges. *Camera Work* was conceptualized as a work of art from start to finish, and it is the hope of the author that this research has given some pointers toward its care.



Fig. 11. View of a stack of trays. Shifting is prevented by a board insert on the bottom of the tray, slightly smaller than the tray itself.



Fig. 12. From left to right: The hinging system is used to lift the board support; the board support is removed from the tray; the board and the magazine are placed on a book cradle, and the magazine can be opened while keeping the board underneath.

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NOTES

1. The Anderson Galleries, "An Exhibition of Photography by Alfred Stieglitz [145 prints, over 128 of which have never been publicly shown, dating from 1886–1921]," opened February 7, 1921, in New York City. The portrait of Jacob Dewald is dated from 1920 and was placed in the section "A Demonstration of Portraiture."
2. The author would like to acknowledge feedback from the Harvard Art Museum with regard to treatment done by Liz Sorokin, Laura Panadero, and Victoria Bunting. Eliza Gilligan also generously shared her experience treating the magazine at the University of Virginia Libraries.
3. Complies with ISO Standard 9706, acid-free and without optical brightness additives.

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SOURCES OF MATERIALS

- Usu-Gami and Hanji paper
Hiromi Paper Inc.
9496 Jefferson Blvd., Suite 117
Culver City, CA 90932
- Canson paper
Canson
Grand Murier, 67 rue Louis et Laurent Seguin
07100 Annonay, France
- SOPHIE BARBISAN
Associate Paper Conservator
Saint Louis Art Museum
Saint Louis, MO
sophie.barbisan@slam.org

Lord Fitzwilliam's Print Albums as Evidence

INTRODUCTION

The Fitzwilliam Museum houses one of the world's most important print collections. At its core is one of its great treasures, the 198 print albums compiled by the museum's founder, Richard, 7th Viscount Fitzwilliam (1745–1816) (fig. 1). Containing approximately 40,000 prints collected over 50 years, the albums are a rare survival of an extensive print collection amassed from the end of 18th and into the 19th century. The bound volumes of prints fall into two categories: those that Lord Fitzwilliam acquired fully assembled from disparate sources, and those compiled by him from scratch, which form the majority.

In 1832, before the collection had a permanent home, an article in Arnold's *Library of the Arts* magazine reported, "For the last twenty years of his life [Lord Fitzwilliam] lived in almost complete seclusion [in his house in Richmond, London], not even seeing his former most intimate friends, and absorbed in the pursuits of high taste and learning" (Arnold 1832, 178). Fitzwilliam wrote his will in August 1815, leaving his collection and funds to build a museum to house it, to the University of Cambridge. Shortly afterward he fell from a ladder in his library and broke a knee; he died on February 4, 1816. His collection was moved from Richmond to various locations in Cambridge before it was transferred to the new museum site in 1848. There, as had been the case in his own house, the print albums formed part of the larger library (Burn 2016, 17–27).

It is uncertain when Fitzwilliam started collecting prints. He had a habit of adding his name and the year to the front of his books and print albums, and the appearance of early dates suggests his interest was lifelong. One of the earliest annotations appears in an 18th-century edition of the *Iconographie* by Anthony van Dyck (1599–1641), which Fitzwilliam bought ready-bound when he was 20 and signed *R. Fitzwilliam* above

the date, 1765 (Van Dyck 1720, 30.H.8). In contrast, the annotations in the volumes he compiled are more likely to be post-1800; we can better understand these as binding dates rather than dates of acquisition. The peak of binding activity occurred in 1813, but Fitzwilliam continued collecting single prints up until the end of his life.

Fitzwilliam was interested in prints as objects in themselves, not as facsimiles of other artworks: he reveled in their "printy-ness"—in counter-proofs, progressive states, and unusual supports. He tried to be consistent in his approach to grouping, arranging, and mounting his collection, but the sheer volume and variety of the acquisitions he was making, as well as the long period over which he was making them, led to inevitable anomalies and compromises.

In March 1816, shortly after Fitzwilliam's death, an inventory of the print albums was drawn up by Samuel Woodburn (1780–1853). Woodburn came from a family of picture framers and bookbinders, and he went on to become one of the most successful picture dealers of his day. Binder's tickets on some of the volumes in the library show that Fitzwilliam was one of the family's customers, and we know that Samuel was acting as Fitzwilliam's agent at auctions as early as 1809 (Ling 2010).

Woodburn was one of four expert advisers contracted to itemize Fitzwilliam's collection for the inventory. He listed 198 albums and four portfolios, including the number of prints contained within each binding. The inventory separated the print albums from the bulk of the rest of the library, including the illustrated books, which Fitzwilliam had included in his own fuller list of the print collection (note 1). The albums vary dramatically in size, with a number small enough to hold in one hand containing a dozen or so prints, and other large volumes that require two people to maneuver them.

The founder's will stipulated that once the museum was constructed, objects from the bequest should not leave the premises. The largely well-preserved state of the albums is at least partially a result of the prohibition on loans. It is also probable that the sheer size of the collection and the space that would be required to store sheets mounted individually are key reasons behind the survival of the albums. This article draws on evidence found in the albums, which are much

Papers presented during the Joint Book and Paper + Photographic Materials Session, AIC's 49th Virtual Annual Meeting, May 10–June 25, 2021 have been jointly published in volume 40 of the *Book and Paper Group Annual* and volume 19 of *Topics in Photographic Preservation*.

greater than a sum of their parts, to present information that would certainly have been lost had they suffered the fate of so many other similar collections.

APPROACHES TO ACQUISITION

In the museum archives, only one draft letter sheds light on the way Fitzwilliam went about acquiring prints (fig. 2). The

document is dated April 15, 1802, and although the space for the recipient is left blank, it is most likely addressed to John Boydell (1720–1804), the foremost print dealer and publisher in London, or someone working for him. Fitzwilliam writes:

[W]ith many thanks for your offer of service, will beg of you to bring back with you the well known engraving of Bossuet. I forget by whom and perhaps mistaken in saying that it is from



Fig. 1. Charles Turner after Henry Howard, *Richard, 7th Viscount Fitzwilliam of Merrion*, 1809, mezzotint, plate size 453 × 313 mm, 33.A.temp.28.

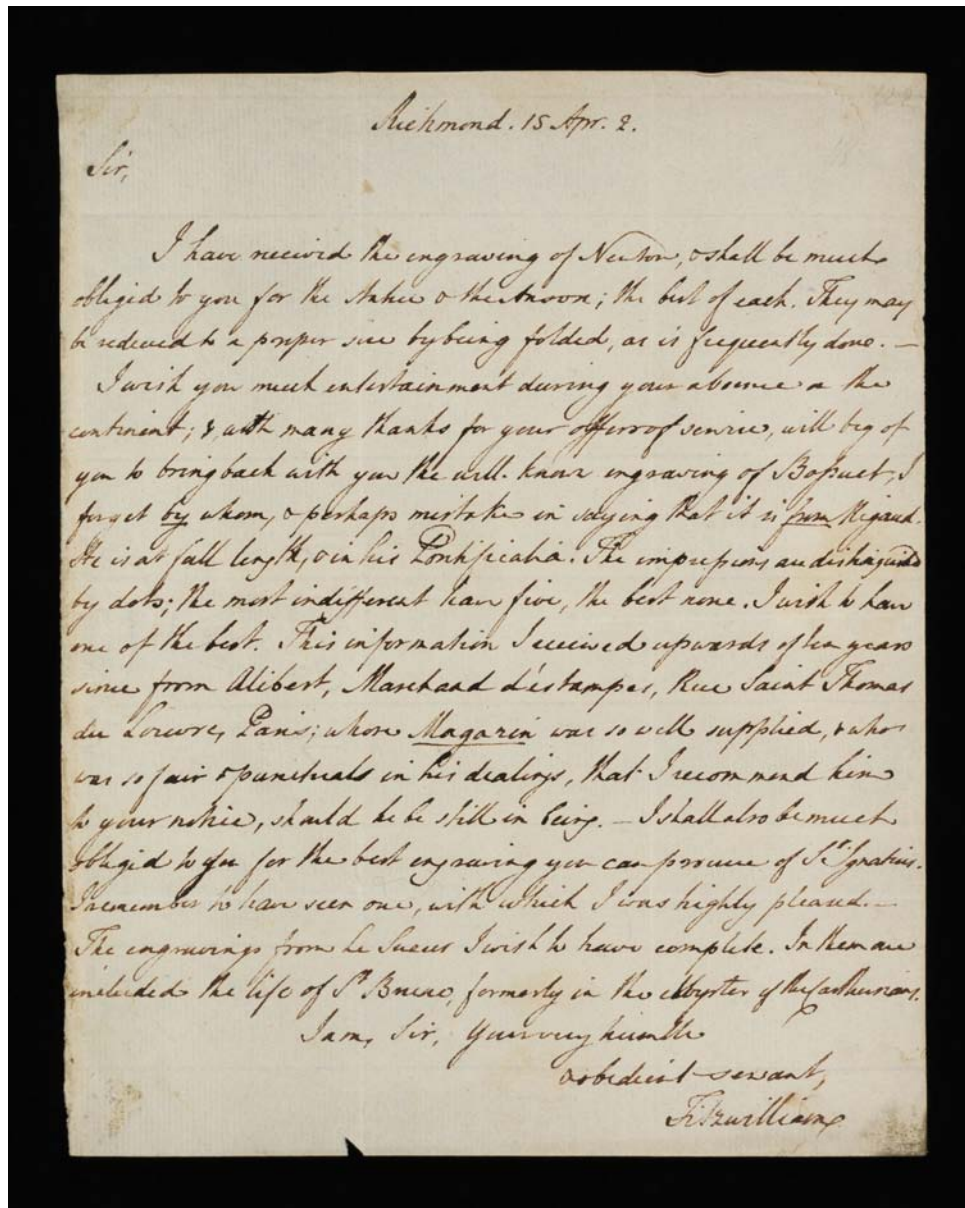


Fig. 2. Letter, Fitzwilliam Museum, Cambridge, Ashcombe Collection. © The Fitzwilliam Museum, Cambridge.

Rigaud ... the impressions are distinguished by dots; the most indifferent have five, the best none. I wish to have one of the best. This information I received upwards of ten years since from Alibert, Marchard d'estampes (Burn 2016, 26)

The engraving referred to is indeed after Hyacinthe Rigaud (1659–1743), by Pierre-Imbert Drevet (1697–1739). Small marks were added incrementally from the fourth state onward after every subsequent hundred pulls, so five dots signal that an impression was printed well into the plate's lifetime. The immaculate impression supplied to Fitzwilliam and placed in the album devoted to the Drevet family is one

with no dots (fig. 3) (Petitjean and Wickert 1925, 75–79). Although short, this letter is revealing of Lord Fitzwilliam's knowledge of print shops and sellers, and his desire to acquire the best impressions.

The only other snippets of acquisition information are present in the albums themselves. The volume devoted to the French contemporary artist Jean-Jacques de Boissieu (1736–1810) contains a note in Fitzwilliam's hand that alludes to now lost correspondence with printsellers in London and Paris. The inscription reads, "a print wanting, promised to be sent to Mr Boydell / by his correspondent on the Continent in March, 1806." We believe that it is likely, due to the fact the



Fig. 3. Pierre-Imbert Drevet after Hyacinthe Rigaud, *Portrait of Bishop Jacques-Benigne Bossuet*, 1723, engraving, 511 × 351 mm, 34.A.1-33.

inscription is written underneath an inlaid print, that it refers to the pasted-down print on the previous page, showing that Fitzwilliam did indeed receive an impression (De Boissieu, n.d., 30.K.7).

Fitzwilliam acquired whole albums intact from various sources, including volumes that had belonged to, for example, Joshua Reynolds (1723–1792) and Thomas Gainsborough

(1727–1788). Comparing these bindings with his own shows that neatness, symmetry, and the integrity of the prints were not always important concerns for other collectors. One example is the album devoted to prints by and after Claude Gillot (1673–1722), from an unidentified, probably French, collection. The binding is an amalgamation of sewn-in whole sheets and pages that have been heavily trimmed down after



Fig. 4. *Engravings by Claude Gillot* album containing 384 etchings and engravings by and after Claude Gillot. 24.K.12-180-182.

the prints had been pasted. In some instances, this alteration chops off significant amounts of the prints within (fig. 4).

APPROACHES TO ARRANGEMENT

Woodburn's posthumous inventory suggests that Fitzwilliam kept his prints loose in portfolios until he felt that his representation of a particular artist was complete, or sufficiently complete. With the help of his valet's son, Thomas Key, the prints were pasted by their edges onto one side of sheets of English plain wove drawing paper. The Earl of Pembroke noted in 1816 that "he [Thomas] always lived in the house and Lord F was in the habit of employing him in the arrangement of his books and his prints" (Burn 2016, 26). In general, it is clear that Fitzwilliam paid great attention to the decorative effect of the finished sheet: neatness, symmetry, and elegance are characteristic qualities across all his albums, especially for pages displaying numerous smaller prints (fig. 5). Pale-yellow wash was often applied to the recto of the album pages to better unify the prints and their mounting. Sorting or mounting numbers in Fitzwilliam's

hand have been found on the versos of some prints lifted from album pages, which correspond to matching numbers written beneath.

One of the portfolios Fitzwilliam used to compile his collection survives. The title page is dated 1810 and contains 55 engravings by the Swiss artist Jacob Frey (1681–1752) adhered to English wove paper (Frey, n.d., 34.A.13). There are some Whatman sheets, but the majority are paper made by Joseph Ruse at Tovil Mill in Maidstone, dated 1803 and 1806. Watermark evidence suggests that these are from larger sheets cut in half.

Fitzwilliam then sent the mounted sheets to bookbinders in London. We know the names of three: the French émigré binder, the Comte de Caumont (1743–1839), a German, C. Meyer (d. 1809), and H. Woodburn (active 1808–1810), a relative of Samuel Woodburn. Erased graphite instructions to the binders have been recorded on title pages of three albums—indentations are legible in raking light. They have been observed on the album devoted to Adam Elsheimer (1578–1610) (see the following) and that of Allart van Everdingen (1621–1675). The third inscription, in the Paulus



Fig. 5. Engravings by Etienne De l'Aulne album containing 169 engravings by Étienne Delaune. 22.I.11-6-28.

Potter (1625–1654) album, is written in a combination of English and French. In translation it reads, “Engravings by / Paul Potter / Complete / hot pressed / Portrait wanting, in half-Russia, yellow-tinted pages, three blank sheets added at the front and at the back, and the word ‘Potter’ for the spine” (Potter, n.d., 30.I.6).

Fitzwilliam’s preferred style of binding made use of tanned calfskin with an impressed diamond pattern known as “Russia” calf, which was popular in the early 19th century. The albums have marbled endpapers with leather joints, blind and gold tooling to the spines and boards, and gilt or pigmented paste decoration to the edges of the leaves. Recessed cord sewing was typical of these bindings, which are structurally very weak, and the elaborately colored frontbead endbands are also decorative rather than structural. Where raised bands occur, they are generally false. The spines were heavily glued and lined, making them firm to tool on but very inflexible. As a result, all the stress of opening the albums is focused on the joints. Unfortunately, “Russia” calf also degrades quickly through acid-catalyzed hydrolysis of the fibers (“red rot”), so the combination of heavy boards, decaying leather, and the mechanical damage to the joints results in detached boards. Some volumes have also been forced to open flatter, resulting in splits to the spines, and there is significant shelf wear to the edges of the boards. Evidence of rebacking is common. Mention should also be made of the significant reduction in the quality of the paper used for the album pages from 1815.

On occasion, Fitzwilliam added to an album after it had been bound, which disrupted the symmetry of the page. More rarely, he moved the prints around, or even had an album rebound with new pages inserted. Fitzwilliam’s three albums

devoted to Robert Nanteuil (1623–1678) are a clear example of the latter. In 1788, Fitzwilliam purchased two albums, containing 232 prints on numbered pages, from the collection of the Duc de Mortemart (1681–1746). He had the original pages rebound into three volumes, ignoring Mortemart’s page numbering, and supplemented the contents with variant states he had purchased elsewhere (Griffiths and Hartley 1994).

The sheets from the Mortemart collection are made of French laid paper with the Pierre Gourbeyre countermark, on which the prints are laid down and double sheets have been beautifully inlaid and attached on thrown-out guards (fig. 6). Prints on the additional sheets have been adhered in Fitzwilliam’s usual manner on English wove paper with “J Ruse 1802” countermarks. Although many of the sheets are laid down, four of the prints have visible Pierre Mariette II signatures, and it is highly probable that the Mortemart collection was supplied, arranged, and constructed by the preeminent Parisian firm.

Fitzwilliam’s print albums are, with relatively few exceptions, arranged “by printmaker”; that is to say, the person who made the print. The names on the album spines usually correspond to the work of the person, or family of artists, contained within, regardless of who designed the image. This method of arrangement gained currency during Fitzwilliam’s lifetime, and so his approach was in tune with the scholarly emphasis of recent publications dedicated to prints and in auction house catalogs. The new breed of collector eschewed the former encyclopedic functions of a collection, and aspired to a path dominated by close observation and selective acquisition. Fitzwilliam was interested in a broad spectrum of prints: engravings and etchings by



Fig. 6. Robert Nanteuil *Portrait of Jean Baptiste Colbert*, 1670, engraving, 640 × 545 mm. 23.K.8-344. Inlaid and attached on thrown-out guard.

well-known artists, as well as more unfashionable types of print sometimes called *reproductive*, by printmakers who translated the designs of other artists. Fitzwilliam treated all printmakers in the same way: he clearly wanted to represent all schools.

The challenge in arranging collections in this manner was the dearth of information on what printmakers had produced. One influential and transformative publication was *Le Peintre Graveur* (Bartsch 1803–1821), the work of the Viennese scholar and Keeper of the Imperial print collection, Adam Bartsch (1757–1821). Only 15 of the 21 volumes of Bartsch's opus were published in Fitzwilliam's lifetime, but the work exerted a considerable influence on Fitzwilliam's efforts to arrange his collection. Bartsch separated out the work of individual printmakers, using clear numerical sequences, and assigned a title and often a brief description of what could be seen in each image, including printed inscriptions or the form of an artist's monogram.

Published catalogs offered their readers the opportunity to aspire to own a printmaker's entire oeuvre; we find evidence

for this in Fitzwilliam's albums where several title pages feature the word "Complete" in addition to his name and date. In 1803, the year the first of Bartsch's volumes was published, Fitzwilliam signed and dated print albums of two of the featured artists: Anthonie Waterloo (1609–1690) and Karel Dujardin (1626–1678). Their contents reveal that Fitzwilliam not only referred to the catalog to ascertain that he had an impression of every print, but that he arranged the contents exactly to Bartsch's ordering.

Other albums devoted to printmakers featured in the 1803 volume were bound years later, suggesting that Fitzwilliam realized the need to make further acquisitions. The small album devoted to Joseph van Aken (ca. 1699–1749) contains only 22 prints, but it was bound as late as 1814, complete except for one impression (Van Aken, n.d., 23.I.12).

By following *Le Peintre Graveur*, the symmetry-conscious collector was afforded flexibility in mounting prints. The albums reveal that in many instances Fitzwilliam left blank spaces where he hoped to insert a missing print at a later date (fig. 7). Bartsch also described different states of a given



Fig. 7. *Gravures de Paul Potter* album containing 56 etchings by Paulus Potter. 30.I.6-2-12.

plate as well as known copies to help prevent collectors being deceived by imitations.

Many of the printmakers featured in *Le Peintre Graveur* produced only very small numbers of prints, which posed a problem for collectors compiling albums devoted to individual printmakers. In many cases, Fitzwilliam solved this by placing these prints in a large "Miscellaneous" album, but in one instance he combined the work of two printmakers into one volume. In the album labeled "Saftleven," containing etchings by Herman Saftleven (1609–1685), we also find prints by another artist, Jan Almeloveen (1656–1684). The explanation is found in Bartsch's introduction to the latter artist where he states, "[Almeloveen] has so beautifully captured the essence of Saftleven that we could take them for engravings made by this very artist" (Bartsch 1803, 287).

Further evidence of Lord Fitzwilliam's close attention to the catalogue raisonné is revealed in other albums: in the Herman van Swanevelt (1603–1655) album, the etchings are arranged by Bartsch, but toward the back of the album, a considerable number of prints are separated out, preceded by a triumphal inscription on the facing page: "The engravings which follow are not in the catalogue of The works of Swaneveldt (sic)," meaning they are not in, and therefore not known to, Bartsch (Van Swanevelt, n.d., 31.I.9).

HISTORIC ALTERATIONS TO THE ALBUMS

For their current inventory or accession number, each album is referred to by the old pressmark from their former position in the museum's library. For example, for 23.K.5, "23" is the press number, "K" is the shelf position, and "5" is the place along the shelf from left to right. Each print within the album is numbered consecutively, and this becomes a suffix (e.g., 23.K.5-76 is the 76th print in 23.K.5). Although the number reveals this much, it does not provide full context: for instance, one cannot tell from a print's number the exact position on a page, or what prints might surround it. This is important when we consider albums that have been altered or disbanded entirely and information has been lost.

Marcantonio and the Scultori family

In 1824, two albums devoted to Marcantonio Raimondi and the Scultori family were disbanded and their contents added to when Samuel Woodburn was given £1000 to purchase prints from the spectacular sale of the politician Mark Masterman Sykes (1771–1823). Woodburn bought 200 prints by Marcantonio, his circle, and the Scultori family. The museum's syndicate body authorized the dismantling of the two relevant albums and the integration of the new acquisitions. This action was carried out by Woodburn according to Bartsch's numbering, and the new support sheets were

annotated below the prints with "S" or "F" to denote their provenance (fig. 8). The original order and layout of Fitzwilliam's prints is irrevocably lost (note 2).

German, Dutch, and Flemish Old Masters

In the 1870s, the Fitzwilliam Museum acquired significant numbers of Old Master prints by bequest, transfer, and purchase: in 1872, 56 volumes of engravings were bequeathed by Reverend Richard Edward Kerrich, comprising the collection of his father, librarian Thomas Kerrich (1748–1828); in 1876, 19 albums of unknown provenance, 17 of them containing prints, were transferred from the Cambridge University Library; in the same year, authority was given by the University Senate to purchase prints at the sale of Karl Eduard von Liphart (1808–1891) in Leipzig. These acquisitions prompted a more thorough rationalization of the Fitzwilliam print collection by the director, Sidney Colvin (1845–1927) (note 3).

Prints of the Early German and Netherlandish Schools, including those by Rembrandt and Dürer, were removed from the albums and sent to the British Museum for conservation and mounting on "sunk mounts" of a standard Royal size (559 × 406 mm), with gilded edges; on their return, they were stored in 30 solander boxes. The album numbers were retained and printed on the new mounts. It is possible that the prints' arrangement on the new mounts imitated their appearance on the album pages, but we cannot be sure.

Of the albums that were dismembered at this time, the binding and album pages of the one devoted to Rembrandt are still intact. Lord Fitzwilliam's collection of 490 Rembrandt prints was considered second only to Clayton Mordaunt Cracherode's collection at the British Museum (Dibdin 1817, 329). Looking through the now-blank pages is curiously enthralling; it reveals information that cannot be gleaned from the separately mounted prints and allows the arrangement to be re-created digitally. In the example shown in figure 9, with the impressions of *The Entombment* (ca. 1654), we know that additions to the left-hand page were added after binding in 1804.

Mezzotints

In the first decade of the 20th century, the mezzotints from four of Fitzwilliam's 12 oversized albums were removed, probably to prevent further damage the album format was causing to their delicate surfaces. The album pages were cut out, the inventory numbers were noted next to the prints, and the sheets were overmounted. Puzzlingly, the corresponding numbers were erased from library reference material, meaning that it was no longer evident from which album a particular print had been taken or its position within the binding. Recent work to free the prints from the acidic mounts has revealed some original album numbers, but in many instances the pages were trimmed extensively and the



Fig. 8. Marco Dente after Raphael, *Venus Wounded by a Rose's Thorn*, 1515, engraving, 267 × 174 mm, P5364-R & P5365-R.

numbers are lost. We do not know the numbers of around 60 of the 370 mezzotints.

The Hogarth Album

Fitzwilliam's album devoted to William Hogarth (1697–1764) contained 114 prints mostly by Hogarth, plus a small number of copies. The prints were removed from the binding at an unknown date, possibly for exhibition in 1964. The binding was discarded, but instead of lifting the prints, the album pages were folded to fit inside the new mounts, so the order of the prints is visible. The album pages feature rare annotations in Fitzwilliam's hand where he identified some of the figures.

The Elsheimer Album

In 1963, the album of engravings after Adam Elsheimer (1578–1610) was dismembered to display the contents in frames. The prints were cut out and mounted, and the binding and the remnants of the album pages were retained, except for a rather crucial section featuring instructions to the binder (Ling 2010).

With these exceptions, the albums are essentially intact. Between 1940 and 1984, individual prints were temporarily removed from bindings for display in the Fitzwilliam Museum's rolling program of exhibitions. Album pages were cut just outside the print margin and the sheet subsequently secured back in place using gummed paper



Fig. 9. *Engravings by Rembrandt Harmensz. van Rijn*. Album binding with digital reconstruction showing 23.K.5-143-148. © The Fitzwilliam Museum, Cambridge.

tape. Some prints show evidence of repeated campaigns of removal and replacement. This work was done in a rather slap-dash manner, often with poor alignment of the cut edges. The tape adhesive can fail, and poor-quality tape has abraded and discolored areas of the facing page.

Recent repairs use two layers of long-fiber Japanese paper. Cut edges can be realigned accurately using stable materials. These repairs are more effective at restoring the structural integrity of the pages. The current guiding principle at the museum is that once the pages have been repaired in this way, prints will no longer be removed from the albums.

In 1933, the generosity of John Charrington (1856–1939), Honorary Keeper Prints, enabled the museum to build a print gallery that, crucially, since 2014, contains cases deep enough to display many of the albums. Charrington also funded an adjacent office, which is where the majority of the albums have been stored vertically ever since. Additional vertical wooden dividers and bookshoe supports were introduced in 1984. The storage is not ideal, but alterations to this now-historic interior would create several challenges.

The impulse to lift and mount the prints is understandable. Stable archival materials could be used, handling and display would be simplified, and the risk of mechanical damage would be reduced. The versos could be examined, progressive states could be compared much more readily, and the appearance of many objects could be improved in the process. But as this article hopes to have demonstrated, the album format of this collection contains vital evidence, which is easily lost.

ACKNOWLEDGMENTS

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NOTES

1. *An alphabetical catalogue of the Prints of the Right Hon.ble Richard, late Viscount Fitzwilliam, copied from the Catalogue in his Lordship's Hand Writing January 1819.* Fitzwilliam Museum archives. This fuller list names 425 items. Three of the four portfolios in Woodburn's inventory would have been destined to become bound volumes; the fourth was a group of prints after Fitzwilliam's portrait, which he would probably have had to give to friends.

2. Sale of the Sykes Collection was held at Sotheby's throughout 1824, and Italian prints on May 24 and 12 following days. On July 5, 1824, the Syndics reported a total spend of £712: "[The Syndics] ... recommend that the Volumes of Marc Antonio and of the Ghisi be broken

up, and that a fresh arrangement of the works of those Masters be made by Mr. Sam. Woodburn, who has expressed his readiness to undertake the task." Fitzwilliam Museum archives.

3. Some duplicates among the new acquisitions were sold at Sotheby's on April 2 and 3, 1878, to raise funds to purchase important omissions: *Important and historical collection of the etchings of Rembrandt, comprising three hundred lots... being duplicates from the Cambridge University Collections... together with Aldegraver, Aldorfer, Lucas van Leyden and Martin Schongauer.*

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Nineteenth-Century Japanese Tourist Albums at the Art Institute of Chicago: Complex Interpretation and Material Deterioration

INTRODUCTION

This article will cover the binding structure, materials, and conservation issues of two 19th-century Japanese tourist albums in the photography and media department at the Art Institute of Chicago.

Albums in a photography collection create an opportunity for unique cross-disciplinary collaboration between the fields of book conservation and photograph conservation. It is important for album structures to be correctly integrated into a collection database, as binding-specific information contributes to a fuller understanding of not only object condition but also provenance.

Japanese tourist or souvenir albums were, as the name suggests, a tourist commodity acquired by travelers in the 19th century on their world travels. Photography was introduced to Japan roughly in the middle of the 19th century after the country was forced to open its doors to more foreign trade. Japan, with the exception of controlled trading posts, had been closed to foreign trade and travel by a strict seclusion policy. To the outside world, Japan was a mysterious nation, especially to the United States and Europe.

Tourist photographs were printed in bulk for sale to not only those visiting Japan but also for world export to be sold closer to home. The market for images from Japan rose and expanded at an exponential rate, and the demand for hand-colored albumen prints was at its peak during the 1880s and 1890s. Felice Beato was considered the father of commercial souvenir photography, followed by Raimond von Stilfried, Adolfo Farsari, and simultaneously Japanese photographers like Kusakabe Kimbei, Tamamura Kosoburo, and many more. These photographers and their unknown contemporaries in the trade created a body of photographic stock that was, throughout the subsequent decades, lost, copied, sold, and traded among their respective studios. This practice understandably makes it

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difficult to identify the origin of an image. To a certain extent, this body of work could be considered homogeneous, as studios created similar images and subject matter; in the quest to appeal to foreign buyers, studios were not afraid to copy one another, creating similar sets and costumes. Even the same actors posing for different images can be easily identified.

Scholars have dedicated ample research to the interpretation of these images and their impact on societal interpretations of Japan. There has, however, been less attention dedicated to their material components and what their materiality tells us about these objects. Even less attention has been given to the albums and their bindings.

A TALE OF TWO ALBUMS

Both albums are bound in accordion style (synonym: orihon or concertina binding). This means that the leaves are attached to each other in a “zig-zag” formation: one edge is attached to the previous page and the other edge to the next.



Fig. 1. Unknown artist, Japanese souvenir album, 19th century, accordion binding with lacquered boards, 20 × 15 × 5.5 cm, Photography and Media collection, Obj. 259348. Courtesy of the Art Institute of Chicago.



Fig. 2. Unknown artist, Japanese souvenir album, 19th century, accordion binding with lacquered boards, 20 × 15 × 5.5 cm, Photography and Media collection, Obj. 259348. Courtesy of the Art Institute of Chicago.

The first album (figs. 1, 2) has two black lacquered boards. The front board has a white inlay, possibly ivory, carved in the shape of cranes and a maki-e painted background. The back board is decorated with small insect paintings. There are 24 leaves made of a thin pasteboard core with a cream wove paper laminate that is the same for the front and the back of the leaves. The album contains 22 hand-colored albumen photographs that are approximately 14 × 9 cm (5.5 × 3.5 in.) each and 22 Chinese paintings on pith paper. The album itself is approximately 20 × 15 × 5.5 cm (7.9 × 5.9 × 2.2 in.).

The second album (figs. 3, 4) has two red lacquered boards, both decorated with a cherry blossom design and



Fig. 3. Unknown artist, Japanese souvenir album, 19th century, accordion binding with lacquered boards, 20 × 15 × 6.5 cm, Photography and Media collection, Obj. 259349. Courtesy of the Art Institute of Chicago.



Fig. 4. Unknown artist, Japanese souvenir album, 19th century, accordion binding with lacquered boards, 20 × 15 × 6.5 cm, Photography and Media collection, Obj. 259349. Courtesy of the Art Institute of Chicago.

maki-e paintings. There are 25 leaves, also made of tin pasteboard core with a cream wove paper laminate that is the same for the front and the back. The album contains 50 hand-colored albumen prints, which are about 14 × 9 cm (5.5 × 3.5 in.) each. The album itself is approximately 20 × 15 × 6.5 cm (7.9 × 5.9 × 2.5 in.). There are also tipped-in interleaves made of a stiff, thin, laid paper.

BINDING STRUCTURES

As figures 5 and 6 show, there are subtle differences between the albums. The first album uses a single hinge that is slit in between a cut made in the edge of the card material. The second album has two hinges, one that wraps around the outside of the leaves and one on the inside. Paper is used for the hinging material in both albums.

It is noteworthy to observe the differences between the two bindings and the effect each binding has on reading the albums. Books with text have an obvious order as the text guides the reader from page to page. Available literature on Japanese tourist photography suggests that these albums are ordered according to certain themes. Some examples of



Fig. 5. Diagram of obj. 259348 (black lacquer album).

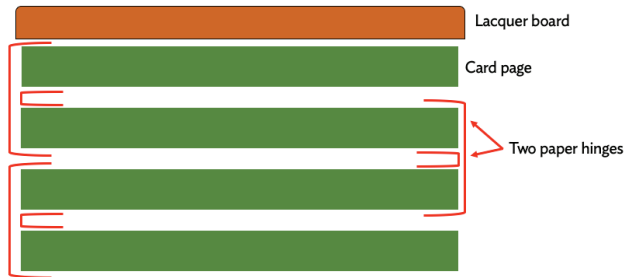


Fig. 6. Diagram of obj. 259349 (red lacquer album).

themes include “sites and locations,” “types and people,” and “craft and occupations.” These albums differ from traditional accordion bindings, where text is presented on one side of a long sheet, which is folded accordion style. The albums in question, rather, have information on both sides.

The way of opening and, in consequence, the order in which the images are viewed can vary. In other words, the way of opening determines the order in which the images are viewed. However, there is more than one way to open the albums. Handling a photographic album could be interpreted as a social event in the 19th century. They were part of a time when carte-de-visite albums and scrapbooks were parlor central objects to be shown off to visitors. Therefore, the handling of the album becomes part of the storytelling.

First, the album can be spread out in one line, facilitating continuous reading (fig. 7). Viewing the images side by side in a continuous reading motion, everything is spread out at once. The albums would first be viewed left to right, then turned so the reader could view the other side or other story. This could be done by spreading the album out on a table, or two readers would hold opposite ends of the album while viewing the images spread out between the people.

Second, the album could be held by one person and flipped through in a one-sided motion (fig. 8), first flipping the pages left to right until the end of the album is reached, then turning the album and flipping the pages from left to right until the reader is back at the front board. This way, only one side of the album is viewed at a time. The image sequence in this reading style is equal to the image sequence in the continuous reading style.

Last, again, the album could be held by one person and flipped through in a zig-zag motion (fig. 9), flipping the first page from left to right and then flipping from right to left. This way, both sides are viewed in the same reading sequence in contrast to the previous reading motions.

It is difficult to ascertain how these albums were intended to be viewed and read, if there was even a certain intended method. Between colleagues in the same conservation studio, what was considered the natural way of handling the albums was different to each person. The three handling options listed previously are undoubtedly not the only options. As resources are scarce and the individual is restricted by personal frame of reference, it is possible that there are overlooked factors.

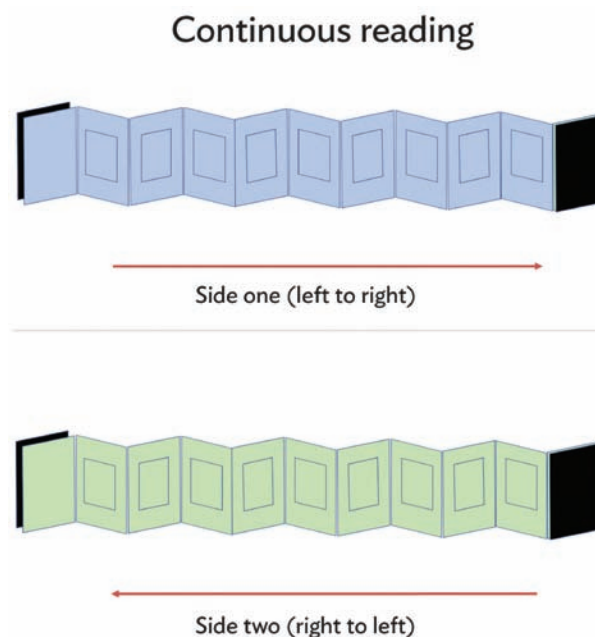


Fig. 7. Diagram illustrating a continuous reading motion facilitated by spreading the album out fully at once.

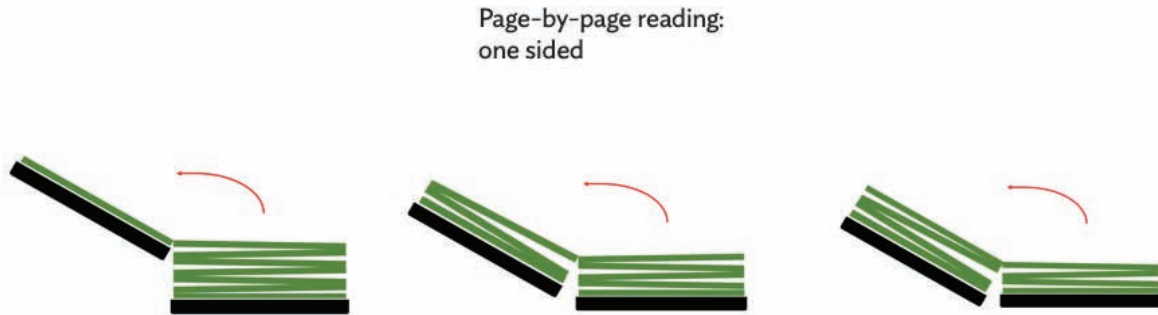


Fig. 8. Diagram illustrating a page-by-page reading motion facilitated by turning the pages consistently from one side to the other.

MATERIAL COMPONENTS AND CONSERVATION ISSUES

Lacquer Boards

The glossy coating over the albums' covers has been investigated by Fourier transform infrared spectroscopy (FTIR) and pyrolysis gas chromatography mass spectrometry (Py-GCMS) to inform conservation decisions and to help understand provenance. The FTIR spectra of samples from the coating showed a resemblance to reference data for various natural resin materials, including Asian lacquer. Py-GCMS analysis showed pyrolysis products that are characteristic of lacquer. In particular, the detection of pentadecylcatechol suggests the lacquer to be obtained from *Rhus verniciflua* (also called *urushi*) and originating primarily from Japan, China, and Korea. Additional compounds were also detected and indicated the presence of a drying oil and of a Pinaceae resin. Oils and natural resins are mentioned in the literature as additives used to improve lacquer performance. This might have been a deliberate decision to reduce lacquer preparation time and costs, thus supporting the context of the albums as tourist commodities, made for mass production and fast sale.

The lacquer boards show cracking around the outer edges, which resulted in losses. There is a loss of gloss and

fingerprints spread around the surfaces of both albums, more so on the front boards than the back boards. Urushi lacquer is susceptible to fingerprint etching, so handling the objects with nitrile gloves is imperative. Asian lacquers are also more susceptible to fluctuation of relative humidity and temperature, making it necessary for the storage environment to be as stable as possible. Urushi lacquer is also reactive to UV light, making it reactive and susceptible to UV degradation; UV sources should be eliminated to the extent possible.

Binding Structures

The albums have been mended in the past with the use of sticky tapes (fig. 10). The tapes on the album with the red lacquered board are partially failing, whereas the tapes on the black lacquered album are fully intact with the exception of the attachment between the back board and the last leaf. There is also the addition of plastic protective layers held in place by the sticky tape that cover the Chinese paintings in the black lacquered album (fig. 11).

The loose leaves of the red lacquer album pose a large issue concerning image sequence. As mentioned earlier, according to the research done by historic scholars, the image sequence is particular to the album structure and tells the story of the traveler. However, the warping of the pages is inconstant, as is the application of interleaves. There are gaps between the leaves caused by adverse warping (fig. 12). These bundles

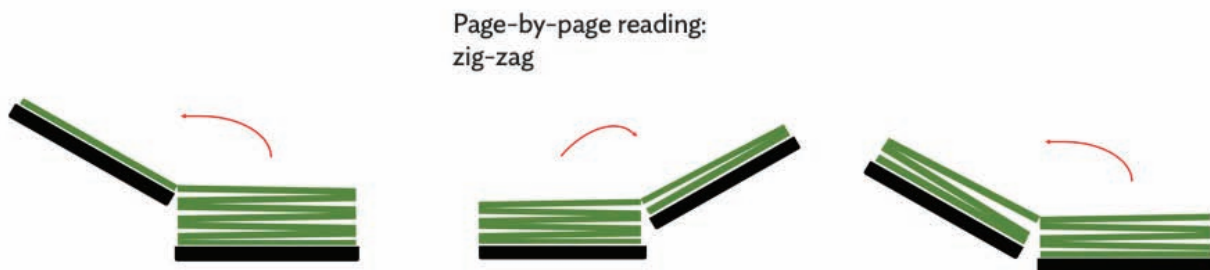


Fig. 9. Diagram illustrating a page-by-page zig-zag reading motion facilitated by turning the pages from one side to the other, each time switching on which edge the page is turned.



Fig. 10. Detail of obj. 259349 (red lacquer album) illustrating the tape application. Unknown artist, Japanese souvenir album, 19th century, accordion binding with lacquered boards, $20 \times 15 \times 6.5$ cm, Photography and Media collection, Obj. 25934. Courtesy of the Art Institute of Chicago.



Fig. 11. Detail of obj. 259348 (black lacquer album) illustrating the plastic protective layer. Unknown artist, Japanese souvenir album, 19th century, accordion binding with lacquered boards, $20 \times 15 \times 5.5$ cm, Photography and Media collection, Obj. 259348. Courtesy of the Art Institute of Chicago.

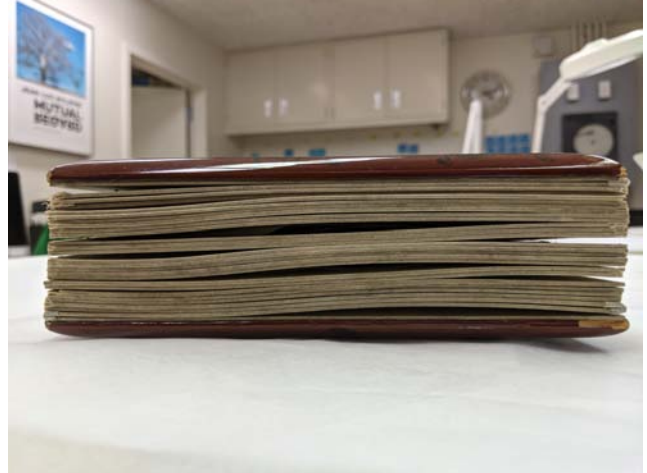


Fig. 12. Detail of obj. 259349 (red lacquer album) illustrating the warping of the leaves. Unknown artist, Japanese souvenir album, 19th century, accordion binding with lacquered boards, $20 \times 15 \times 6.5$ cm, Photography and Media collection, Obj. 259349. Courtesy of the Art Institute of Chicago.

of counter warped leaves can be turned to fit perfectly, consequently changing the order of images. In addition, the interleaving is not consistent throughout the album. Between certain pages there is no interleaving, between others there is interleaving tipped in (sometimes on the outer edge, sometimes on the inner edge), and at other times there are two interleaves. This, together with the inconsistent warping, indicates a loss of the original page order, which considerably complicates conservation treatment planning. Rebinding seems impossible when there is uncertainty about the order of pages, but at the same time, the legibility of the album also depends on the order of the images that is defined by the binding.

Albumen Prints

All photographs throughout the two albums have the same measurements (14×9 cm or 5.5×3.5 in.). They all exhibit the standard aging patterns of albumen prints: surface grime accumulation, microcracking, fading, and yellowing. There has been no particular pattern observed in the microcracking or any other of the degradation.

It is interesting to note that throughout the albums, the same actors are observed posing in different scenes in other albums. For example, figure 13 is from one of the Art Institute's albums; figure 14 is from the Imperial Edition Volume 3 of Francis Brinkley's publication on Japan; and figure 15 is from the Imperial Edition Volume 1, in which the actors are the same but the scene is different. Other examples of the same images in different publications can be seen in figures 16, 17, and 18. Figure 16 is from the Art Institute's album, whereas the other two images are from other albums



Fig. 13. Unknown artist, Japanese souvenir album, 19th century, accordion binding with lacquered boards, 20 × 15 × 6.5 cm, Photography and Media collection, Obj. 259349. Courtesy of the Art Institute of Chicago.



Fig. 14. Photographer unknown, Francis Brinkley (1887–1888), Japan: Described and Illustrated by the Japanese, Boston: J.B. Millet Company. p. 91. Imperial Edition. Vol. 3. Fine Arts Library, Harvard University. <http://nrs.harvard.edu/urn-3:FHCL:8519091?n=250>.



Fig. 15. Photographer unknown, Francis Brinkley (1887–1888), Japan: Described and Illustrated by the Japanese, Boston: J.B. Millet Company. p. 16. Imperial Edition. Vol. 1. Fine Arts Library, Harvard University. <http://nrs.harvard.edu/urn-3:FHCL:8519091?n=61>.



Fig. 16. Unknown artist, Japanese souvenir album, 19th century, accordion binding with lacquered boards, 20 × 15 × 6.5 cm, Photography and Media collection, Obj. 259349. Courtesy of the Art Institute of Chicago.



Fig. 17. Tamamura Kozaburo (Attr.), *Photographs of Japan* (p. 41), ca. 1880s. Special Collections EGS25.41. Harvard Fine Arts Library. <http://id.lib.harvard.edu/images/olworks577010/catalog>.



Fig. 18. Tamamura Kozaburo (attr.) ca. 1870–1883, p. 42. Special Collections K5 416 (EGS26). Harvard Fine Arts Library. <http://nrs.harvard.edu/urn-3:FHCL:5142487>.

in other collections. The images are not completely the same, but they stem from the same original. Because measurement information is missing from most online databases, it is difficult to compare the images and identify them as copies of the same negatives that were cut smaller, or if different negatives were used.

The hand coloring throughout the albums was first visually assessed using an optical microscope. Ten different colors were identified visually (yellow, orange, light blue, dark blue, light green, dark green, red, light red, pink, and purple/violet). Cracking and flaking of the colorants are sporadic and only happened where the colorant was applied thickly.

CONCLUSION

These two albums are perfect examples of the complexity of Japanese tourist albums in their material aspects, as well as in their interpretation. The literature has been particularly focused on the content of the image not considering the material implications of the accordion-style binding.

This article's purpose is to report on the observations made as part of a larger ongoing multidisciplinary research project. The albums at first sight appear to be the same, but after closer assessment they clearly have different binding structures. Understanding the complexity and varied binding styles is important for rebinding considerations, as well as for provenance studies. The analysis of the lacquer indicates that the boards are likely urushi, which informs handling and storage. It also supports the context of these albums as being tourist commodities, as the possible detection of drying oil additions shows the mass production of these objects for commercial sale. Further analysis into the colorants used for the hand coloring and treatment of the objects is ongoing, and further information will hopefully be uncovered, leading to our further understanding of these and similar photographic albums.

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Revisiting and Reconsidering Disbound Photograph Albums

THE ALBUMS

At the end of 2003, The United States Holocaust Memorial Museum (USHMM, or “the museum”) received a donation of four photograph albums that had been removed from the private residence of Heinrich Himmler, the leader of the *Schutzstaffel* (better known as the SS) and the second most powerful man in the Third Reich. Himmler was a very capable administrator who consolidated all police forces in Germany into a state entity with himself at the head. He centralized and expanded the concentration camp system, and led the development of the state apparatus for mass killing of Jews, Roma and Sinti, and Slavs, as well as political enemies and the disabled.

The albums had been in the Himmler family residence in Gmund am Tegernsee, in Bavaria, located about 40 mi. (67 km) from Munich, and about 17 mi. (27.5 km) from the border with Austria. Many documents and personal effects were taken from the residence by U.S. Army Intelligence in the spring of 1945, while Himmler was in the war and after Himmler’s wife and daughter had fled the family home and gone into hiding in Austria. These four albums were not registered officially as evidence with the other materials taken from the home, so a U.S. Army Intelligence officer was able to keep them as souvenirs and bring them home with him to the United States. Upon the death of the Army officer, the albums were bequeathed to his friend, who sold them to a collector, who wanted to sell them to a museum but was unsuccessful in finding a buyer. The collector eventually sold them to his lawyer, James Blevins, who donated the albums to USHMM and to whom the gift is credited. USHMM’s counsel, however, did extensive legal research before accepting the albums to ensure that the donor was a rightful owner who could make such a donation, and that no other government entity or person, such as a surviving family member, had a superior claim to them.

Papers presented during the Joint Book and Paper + Photographic Materials Session, AIC’s 49th Virtual Annual Meeting, May 10-June 25, 2021 have been jointly published in volume 40 of the *Book and Paper Group Annual* and volume 19 of *Topics in Photographic Preservation*.

The albums contain photographs spanning the years 1911 to 1945, which are both personal family snapshots and photographs taken by professional photographers following Himmler. All of the photographs in all of the albums are black and white. Two of the albums are attributed to Gudrun Himmler, Heinrich Himmler’s daughter (b. 1929) and cover the years 1937 to 1945, approximately ages 8 to 15 for Gudrun. The two albums have covers that would likely have been chosen by or for a little girl, one with a wooden applique of a shepherdess and the other with voids in the shape of small dogs, possibly schnauzers, indicating that there may have been appliques there that have since been lost. These two albums were tied with cords. Most of the photographs are attached with corners and have captions in Kurrent-style script, a type of handwriting taught in German schools at the time of Gudrun’s childhood. Photographs that show her in them have “i.” or “m.” (for “ich” or “mich/mir”) in the captions.

A third album, with a blue cover, also bound with a cord, contains press and other professional photographs, and only a few possibly personal photographs. There are no captions, making it difficult to attribute, although one of the album’s intermediate custodians attributed it to Himmler himself, even writing an inscription to that effect (in English) on the interleaving of the first page. The handwriting on the backs of some of the photographs could possibly be that of Himmler. The fourth album has a sewn binding and is attributed to Margarete Himmler, Heinrich’s wife and Gudrun’s mother.

There was great excitement about the albums when they arrived at USHMM. Photographs in the albums placed Himmler in various locations around the Eastern Front of the war at the time of major actions, corroborative evidence previously unavailable to Holocaust scholars. The images in the albums, along with photographers’ credit stamps and notations on the versos of the photographs, correspond with dates and places in wartime appointment diaries belonging to Himmler that had recently been made public by the Moscow Special Archive, as well as other documentary sources, and in many cases show people named in the diaries. Of particular interest were images showing Himmler interacting with command staff at Hegewald bei Zhitomir, the headquarters compound of the SS for the Eastern Front, located in

Ukraine, in the years 1941 to 1942. From here Himmler gave the orders to liquidate ghettos in Poland and Ukraine and began the implementation of *Lebensraum*, a massive program to eject the indigenous Slavic peoples of the region and to repopulate it with ethnic Germans, as well as a mass kidnapping scheme to take Slavic children of “Nordic” appearance from their families and “Germanize” them. The photographs show that Himmler and other high-level officials were nearby during recorded massacres and not simply supervising from Berlin (note 1).

Not only did the albums show Himmler “at work” at various locations during the Nazi rise to power and the war but also they also gave a view into the personal life of a well-known perpetrator and his family members. By design, very little of USHMM’s collection reflects the experience of perpetrators, and the museum generally refuses offers of mass-produced Nazi paraphernalia. USHMM has in a few instances accepted materials relating to the experience of individuals who may have been sympathetic to or even joined the Nazi cause, to further understanding of how individuals may have been attracted to Nazi messaging, and to contrast their experiences with those of victims and survivors. This collection, showing a perpetrator in action and at home, is highly unusual among USHMM’s holdings.

The two albums attributed to Gudrun Himmler contain mostly family photographs, showing herself and various family members, her aunt, mother, and cousins, and the family home in Gmund. Most of the photographs in the album with the schnauzers on the cover are personal photographs, whereas the majority of the photos in the album with the shepherdess cover are by professional photographers, including some attached to units of the SS, whose stamps are on the backs of the photographs.

It appears that extra copies of professional photographs that included Gudrun or her father were given to Gudrun for her albums, sometimes with notes on the back from her father addressed to “Püppi,” her childhood nickname that translates roughly to “Dolly,” and often signed “Pappi,” her name for him. Almost from the time of Gudrun’s birth until the time of his death, Himmler spent most of his time away from home, either in Berlin or traveling around the country, and becoming an increasingly well-known public figure. He became estranged from Gudrun’s mother but frequently telephoned Gudrun and many times sent for her to visit him. They were close, but it appears that a good deal of their time together was observed by the photographers following him. Gudrun frequently copied from these verso notations for her captions on the pages of the albums.

IMAGING

The museum was very eager to make the images available to researchers and the public. USHMM’s historians and

photograph archivists made initial selections of images to copy and release as soon as possible, choosing the images they determined would be of immediate interest to Holocaust scholars. Plans were made to then image the albums comprehensively, page by page and image by image, and, whenever possible, to capture the versos of photographs. Individual images were to be photographed with medium format 120 black-and-white film, as well as making a 4 × 5 in. color photographic transparency of each album page and each photograph, and the back of each loose photograph, and then the negatives or transparencies would be digitized. These digital images could be made individually searchable and would be readily available for research or reproduction. There was also an outline for web pages that would show each album as if the viewer were able to turn the pages, seeing pages side by side like an opening of a volume, and allowing the user to click on individual photographs to see enlargements and the verso. Although commonplace now, in 2004, implementing these features in a website would have been a complex and time-consuming undertaking.

To do this kind of photography, it was argued that the pages needed to be perfectly flat against the deck of the copy stand, with the camera lens facing straight down, and that the best way to facilitate this would be to take apart the three albums that were bound with cord. This is not an unusual approach to imaging photograph albums, since having the individual pages lying flat on the copy stand minimizes glare from the glossy surfaces of the photographs, and facilitates further flattening with glass or Plexiglas if the photos are not in plane. Disbinding for photography is still the norm at some institutions, and it is also often done with scrapbooks with heavy or bulky attachments, or brittle pages, that make turning pages risky. Photographing disbound individual pages eliminates problems of distortion from the curve of the page coming out from the gutter, and of having to repeatedly adjust the camera height and angle, or the volume, while progressing through the text block.

It was also argued that the images would become more accessible for exhibit if the albums were disbound, since individual pages could be exhibited, or loaned for exhibit, without putting an entire album at risk, or making the rest of an album unavailable by showing only one opening.

If these albums were being considered for initial digitization today, with contemporary equipment, and with the familiarity with digitized collections expected of researchers now, we might not see a need to disbind them. In 2004, copyshooting to film was the best way to make a photographic print when a negative was unavailable, or to produce a new film copy negative, because film still gave better resolution than the image sensors of digital cameras of the time. Digital camera sensor resolution has, in many respects, caught up to film, or even exceeds it, so the image capture today would be direct to digital. As one of USHMM’s imaging experts

explains: “The old method of making color transparencies and then digitizing them adds extra steps where color information might actually be lost, and introduces noise from the film’s grain, leading to a less accurate digital version. Today we not only have better equipment and measuring tools for capturing and displaying colors accurately, we also have Federal Agencies Digital Guidelines Initiative (FADGI),” which is a nationally recognized set of best practices for achieving the best possible digital image quality for cultural heritage materials (note 2). With today’s equipment, the camera height and angle can be adjusted while previewing the image on a monitor rather than by looking through the camera viewfinder, giving the imager a better impression of what the final image will look like on screen. The imager may choose to progress through a volume capturing recto sides of pages first, followed by the verso sides, and then integrating the images in viewing order, which is more challenging to do with roll film than with digital files.

Viewers of photograph albums and scrapbooks online do not necessarily need to see pages side by side, presented like the opening of a volume, to understand the sequence—although this presentation, if not the actual opening showing both pages, is often desired. If a bound album is too large for a full opening to fit in the frame, a left-side page image can be shown followed by a right-side page image. With single-page captures, the means of restraint is on the side not pictured, which might be a weight or a special mount or even the imager’s hand, if the album is bound tight, or has a cord that cannot be manipulated to open fully. The interleaving is moved from side to side, so it is not seen except along the gutter edge of each page image. In this type of presentation, however, an album that is still bound can look very much like a disbound album.

TREATMENT

It was decided that, to facilitate film photography, the three albums bound with cord would be disbound, with the cover and cord of each one stored in a box with its pages. Each album was documented by Conservation as a bound volume, with both written and photographic documentation. Color slides (35 mm) were taken of the front and back of each album with detail shots of the tying and the head or tail. The disbinding was considered a minor enough treatment that checklist treatment proposal and report forms—on paper—were used.

Many of the photographs were loose, having been mounted into the albums with photo corners most often constructed of white paper and clear plastic, or of black paper with slits, which had failed due to age, or possibly due to removing and replacing photographs in them over the years. Photographs that were loose were removed, and the openings in which they were found were recorded. The locations of photographs that were still attached to the pages, having at least one

corner of the photograph in a photo corner or having been adhered directly to the page, were recorded. One help in this process was that the pages had been numbered in each album, likely by one of the intermediate owners rather than by one of the family, since the ink appears to be that of a blue ballpoint pen. It was agreed that the numbering most likely did reflect the original page order, although it did give pause to reflect that the albums likely had been disbound and retied before, and that the numbering was a sign of that intent.

After removing the cords from the albums, several images were copied from each of the albums and from among the loose photographs that accompanied them, 100 in all, using medium format 120 black-and-white film. The albums were then returned to Conservation for treatment, and the images were soon made available on the museum’s collections website.

In addition to the disbinding, conservation treatment also included light surface cleaning of each page with a soft brush, removal of stray marks and grime with a white vinyl eraser, and a few minor mends around the edges of pages, as well as reattaching loose photographs to album pages in preparation for comprehensive imaging. The treating conservator worked with two of the museum’s historians to determine the proper locations for the loose photographs, matching people and places to captions or to other images showing the same locations, or taken near the same date as other images, as well as matching the size and shape of loose photos to broken and empty photo corners. There were also many somewhat arbitrary placements of loose photos, based on where an image fit intellectually in a sequence where there was a gap rather than on physical evidence like corners on the page matching up in size to the photograph. All of the placements were recorded, although as the number of photos on each page rather than the images—a temporary measure, since the pages were to be photographed with the photographs in place in the next phase.

There were no pages that showed damage indicating that an adhered photograph had been torn out, in any of the three disbound albums. Many of the photographs, both loose and associated with broken corners, had black paper remnants on the verso where they had been torn from other pages, or had tabs from a tab-and-slot attachment system, although there were only a few slots on the pages. There were also instances where a page had clearly been reused, with corners arranged for photos of a different size in addition to those for the photographs currently attached. The conservator and historians concluded that probably each compiler had changed his or her mind a few times when composing the albums, taking some photos out of albums and putting them in others, possibly rearranging without immediately securing all four corners. There are also gummed linen reinforcing circles around the string holes of several pages, which indicates that the albums received heavy use at some point. These may have

been placed by one of the family, or by one of the subsequent owners, but the album would have to have been unstrung to place them.

It was decided that the method of attachment for the photographs would be Japanese tissue T-hinges adhered with wheat starch paste. This method was chosen so that the backs of the photos would remain easily accessible but, unlike paper corners, would not be visible on the front of the photos. The hinges could also easily be removed if a single photograph were to be selected for exhibit or loan. Two T-hinges were used for each loose photograph, and for each photograph that was held in by only one corner, the photo was taken out of the corner and secured with two T-hinges. Each page was housed individually in a clear polyester sleeve sealed along only one side to accommodate easy removal, if needed, since glassine interleaving was still attached to many of the pages, and each sleeved page was placed inside an acid-free lignin-free 10-point folder. Each reformatted album was housed in a drop-sided album box, with folders containing the covers and cords following the series of foldered pages. Loose photographs for which a location could not be determined were grouped together by theme by the historians, and these were stored with the album that was designated last in the series, which was the album with the dog shapes on the cover (the so-called “puppy-dog” album).

REEVALUATION

These albums are now in line for digital imaging as part of the USHMM’s program for digitizing archival collections. They can certainly be imaged in their disbound state, just as it was planned in the mid-2000s, but the COVID-19 pandemic provided an opportunity to consider these albums again and to investigate the possibility of reassembling them, particularly since imaging intact albums is now routine in the USHMM’s imaging program. It had become clear that there was little interest in the photographs or the albums for exhibition, and in fact, the disbound albums were passed over for a 2013 exhibit. The exhibit was on the role of collaborators and bystanders, including family members, in abetting the perpetrators of the Holocaust, and the exhibit’s curator was interested in Gudrun’s portrayal of her own life and her depiction of her father through her albums. The curator saw photograph albums as signifiers of domestic life that exhibit viewers could recognize from their own lives, and needed an artifact that visually registered as an album to support that vision. The album with the sewn binding that was still in volume format (the album attributed to Margarete Himmler) was chosen instead. With the selection of individual photographs available online, the albums were requested only a couple of times for research in the intervening years. For many reasons, the full plan for comprehensive imaging and online presentation of the albums outlined in 2004—which

disbinding the albums was ostensibly meant to facilitate—was not realized.

The treatment in the 2000s took place in two phases: first the disbinding and the placement of the loose photographs, and then the sleeving and foldering of the individual pages after their return from imaging. The first phase was documented with paper and slides that were stored onsite in the lab and were inaccessible while the museum’s buildings were closed to staff in 2020–2021. Only the narrative treatment documentation for the second phase was available remotely in electronic format. Neither the condition of the string holes of the pages nor the covers was noted in the documentation of the second phase, giving the impression that they must be in good condition. Based on this limited information and the memory of the treating conservator, an investigation into the possibility of reconstructing the albums was proposed.

The conservator reached out to longtime colleagues over e-mail to ask them about their recollections of these albums and how they came to USHMM, and the original imaging project. Over the course of a couple of brief, half-day visits to the lab over the winter, the conservator was able to revisit these albums, to read and copy the treatment documentation, including slides, and take some new photographs. In the course of researching the history of the albums for this article, a vague association often spoken of among USHMM staff about these albums over the intervening years—something not mentioned in the readily available collection documentation and thought to be a misinterpretation of the custodial history—was confirmed: the albums had once been stored in the Alfred P. Murrah Federal Building in Oklahoma City. A curator brought forth from her own files regarding the acquisition of the albums a colleague’s contemporaneous memo describing an interview with the collector who was the second-to-last private owner of the albums. He was a federal employee based in Oklahoma City, and he kept the albums in a fireproof cabinet in his office in the Murrah Building. The albums were in the building on April 19, 1995, the day that domestic terrorists carried out a bombing that destroyed the building and killed 168 people. The bombing happened in the morning while the collector was still on his way to work. The cabinet, and the albums, were recovered some time later from the remains of the building. The collector and his lawyer, by then a co-owner of the albums, moved the albums to a safe deposit box at a bank and the collector redoubled his efforts to find an appropriate buyer for the collection (note 3).

The documentation from the 2000s barely discussed the covers of the albums, since they were seen as far less important than the photographs, and because, once dissociated, they became almost extraneous, no longer needed to be viewed or handled to see the photographs. The covers received only minimal treatment, surface cleaning and consolidation of lifting paper around the edges. The more recent review of

the album covers showed them to be in much worse condition than remembered or that could be interpreted from the available documentation. The covers of the three cord-bound albums showed water damage as well, having abraded and split cloth on the spines and scratches and gouges on the cover boards. The collector who had the albums in the Murrah Building referred to damage to the spines and loosened photographs, and implied that those effects were due to the building collapse and recovery effort.

The album with the dog shapes has a significant loss to the covering paper on the front, although the cover itself, a single sheet of thick paperboard curved around the text block, is largely intact. The loss is about 10 × 15 cm and exposes the padding material inside, which is loose sheets of soft tissue, like a rough facial tissue. The loss does not have any impact structurally, but it is not purely a cosmetic issue either because the tissue is not adhered to the board and flops around where it is exposed, and could easily get torn in handling. The loss would need to be filled if the cover were to go back into service as a functioning book cover at any level of use. The abraded cloth and the tide lines are essentially cosmetic damage, but if this damage were to be deemed significant to the history of the album as an artifact of the Oklahoma City bombing, it would impact our decision making on whether and how we would treat it.

The other two album covers—the blue and the shepherdess albums—have cloth spines, and these have splits in the cloth and the inside paper lining along the joints. The boards of the album with the shepherdess on the cover are constructed of two thin boards joined by a strip of folded cloth tape along the spine side. The cover paper, a thin paper printed with a plain weave textile pattern, holds the two boards together. The cover paper is split all the way around, and the boards move freely, with the cloth tape acting like a hinge. It also has extensive tide line staining, as well as dye staining from the cord and rust stains from the eyelets. The boards and the spine would need to be repaired to make this cover structurally sound and functional as a cover. In all three cases, it is difficult to attribute specific damage to the covers to particular events, such as the removal from the family home, or the building collapse, as opposed to repeated transit and poor storage and handling across decades.

The cords of all three albums are frayed and would likely need to be replaced rather than reused if rebinding were considered. The tassels of the cord from the shepherdess album are matted with material that appears to have come from the exposed stuffing of the padded front cover of the puppy-dog album. Each original cord shows the memory of its tying pattern, which can be replicated with replacement cord. Several of the patterned glassine interleaving sheets are missing as well and could be replaced with new glassine or other interleaving material.

In addition to the issues with the cords, interleaving, and covers, and the amount of new material required, the previous

treatment of pages gives pause to question the practicality of rebinding. The T-hinges make the photographs easy to flip over to read the backs, but they would make turning the pages difficult to do safely if they were gathered in a volume, even with glassine interleaving. Retaining ready access to the backs of any photos reattached in the 2004 treatment would likely be a requirement of any future treatment. Suggestions for keeping photographs from swinging when turning pages include adding either a folded retaining tab or new folding corners to the bottom edge of each photograph, or replacing all the hinges with four corners on each photo. Both options would be problematic, however, because they would be visible on the fronts of the photographs, and new corners would have to be applied on top of old corners.

Another option that was suggested is tab-and-slot mounts, where a paper tab is adhered to the back of the photo that slots into a strip of paper mounted on the page. Although tabs were found on the backs of some photos, and a few slots elsewhere, none were found in use in the albums. Paper tabs and slots are heavier than tissue, and would be less easily reversible, but would make temporary removal of individual photographs for imaging or exhibition easier. This option was rejected due to the extensive notations found on the versos of the photographs that might be obscured by adhering a new tab.

Changing or even just adjusting the attachment method across three albums would be a large undertaking, and the previous treatment may simply have gone too far in the reformatting direction for it to be practical to reverse. However, even if it is impractical, and difficult to justify, it would not be impossible to re-format the pages, repair the covers, replace the cords, and rebind any of these three albums if it were decided sometime in the future that there were compelling and approved reasons mandating their reassembly.

It is interesting to note that a review of the treatment documentation from the 2000s indicates that there was no intention then of rebinding the albums. An option for rebinding was given on each album's treatment proposal, but reformatting as single leaves in folders was chosen. It could simply have been the condition of the covers that drove that decision, or it could have been a calculation that the albums had passed through too many hands and there were too many loose photographs to truly know what the original order of the pages and photographs had been, and a decision not to further fix possible errors in place by rebinding.

CONCLUSION

What is expected to happen now is that imaging of the albums will proceed, with the three disbound albums remaining in their current format. New treatment at this time would only address replacing cut, torn, or failed T-hinges found in the recent predigitization review of the albums. Discussion of whether to reassemble the albums can wait for further

examination, and can even wait for further advances in technology and technique in both imaging and conservation treatment. Digitization of the albums under USHMM's current archival digitization program guidelines will be comprehensive and analogous to the present format, capturing each page of each album in order, along with individual captures of each photograph and the caption below it, and when accessible, the back of each photograph, similar to what was originally planned in 2004.

With comprehensive imaging, researchers will finally be able to see all of the photographs in the collection and consider them individually along with their verso information, but the story told in the arrangement and descriptions of the photographs the family placed in their albums does not need the covers attached to read it. Images of the cover can be placed at the beginning and end of each album's sequence of page images in one of the online viewing options. The pages will appear in order as they are numbered, and the photographs are, for the most part and to the best of our knowledge, in their intended places. The conservator, historians, and photo archivists worked to preserve the order as it was perceived at the time, but perhaps the ability to isolate images and reorder them digitally will show where mistakes were made that could then be corrected. The initial digitization effort brought one story to the forefront, that of Heinrich Himmler, the perpetrator, but overshadowed Margarete and Gudrun Himmler's authorship of their own stories of their lives and their relationship with him as husband, father, and public figure, as told through their albums. Allowing viewers to see the albums in their entirety, digitally, brings each album back into focus as the narrative of a single creator, despite the many sources used in its creation, but the digital format allows us to deconstruct the albums intellectually and examine each source individually.

Roughly 20 years ago, around the time of the albums' donation, research and exhibition focusing on the perpetrators and the bystanders of the Holocaust was in its infancy. The decision to focus only on images of Himmler for the website and not to present the full context of the family albums stems from both the curatorial history of the USHMM and the historiography of Holocaust research. Interest and research into the actions and motivations of perpetrators later expanded into exploration of the roles of bystanders and supporters, including families, such that the exhibit curator who reviewed the albums a few years after the reformatting was less interested in the perpetrator than in his family who supported him, validating, although not reinvigorating, the plan to image the albums in their entirety.

By concentrating initial digitization and access efforts on images of Himmler during the years of the Nazi regime and the war, and de-emphasizing the personal and familial, the argument could be made that scholarly interest in specific images from the albums outweighed any personal property rights, and that USHMM was the proper custodian of the

albums and their images. Gudrun Himmler was still living when the albums were acquired by USHMM, and there was concern that she would make a claim for them. Although she had not been old enough to have joined the Nazi party herself as a voter—she was 15 at the war's end—she was fully indoctrinated in Nazi beliefs and remained sympathetic to the Nazi cause for the rest of her life. She was associated with *Stille Hilfe*, or "Silent Help," an organization that supported former Nazis by helping them emigrate, or restart their careers, or caring for them in old age. Although she kept a low profile, she was known to have spoken to sympathizer groups, and to have spoken about wanting to do research in the United States, to find the records that, as she said, would clear her father's name, and to write a biography that would rehabilitate his image. No challenge was made to USHMM's ownership, and Gudrun Himmler Burwitz died in 2018, at the age of 89, without ever visiting the United States.

Physical reconstruction of the albums attributed to Gudrun and the third album runs the risk of rebuilding a shrine to a perpetrator. Gudrun may have simply been documenting her childhood, at a time while she was arguably herself an innocent, but her idolization of her father and her privilege as the daughter of a high-ranking Nazi is evident throughout. Although the juxtaposition of Gudrun's sheltered naivety with her father's calculated cruelty is intriguing, it could be difficult to justify the time and resources for the treatment of this collection when we have so many other compelling stories to tell.

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NOTES

1. Wendy Lower, email message to Sharon Muller et al., August 22, 2003, forwarded to Judith Cohen, and forwarded by Judith Cohen to the author, May 19, 2021.
2. Justin Donaldson, review comment to the author, May 5, 2021.
3. Sharon Muller, *Report on Meeting with Dale Edwards Re: Acquisition of Himmler Photo Albums*, internal memorandum, September 2, 2003.

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FURTHER READING

Reverso Context (<https://context.reverso.net/translation/german-english/>): Online German-English contextual dictionary.

Cross-Disciplinary Care for the Preservation of Photograph Albums

INTRODUCTION

Photographs are held throughout museum, library, and archive collections in numerous formats, from early cased objects to loose photographic prints, to matted artworks, to those in bound volumes. Photograph *albums* have distinct preservation needs, and their care must be approached cross-disciplinarily, often by both a photograph conservator and a book conservator, and always with the goal of minimal treatment intervention (fig. 1). Caring for bound photographic collections requires a holistic preservation approach that balances research, communication, and *sometimes* conservation treatment. This article highlights the hybrid nature of albums and the ways that their preservation issues may be exacerbated by their materials and construction. A basic overview of the variety of structures of photograph albums is provided, followed by a discussion of the aspects of albums that may fall outside of the traditional condition issues addressed by book and photograph conservators. These include handling and environmental considerations of photographs for book conservators, and a review of the structural and material aspects of bound volumes that may complicate photograph conservation practice. The article also includes a brief review of storage, mounting, and exhibition recommendations for these complex objects.

PHOTOGRAPH ALBUMS AS HYBRID OBJECTS

Cultural institutions may employ book conservators and/or photograph conservators, although these professionals rarely work in the same conservation lab, and many smaller institutions and libraries employ neither. In recent decades, there has been a rise in the curatorial and art historical interest in photograph albums, helping to flesh out our collective understanding of the private and more intimate

settings in our shared cultural pasts than are commonly seen in museum exhibitions. Constructed to house some combination of images, manuscript notations, and printed text, albums serve as protective enclosures, as mechanisms to keep photographs flat, as carrying cases, curatorial stories, and display devices. As more attention is paid to photograph albums, the preservation needs of these complicated objects are coming into further focus as well. Research undertaken to address these needs is not new. The postprints from the 1999 AIC Annual Conference (AIC 2000), as well as a number of articles covering Victorian album structures, collection surveys, and individual treatment case studies are invaluable resources. With this article, the author aims to continue these collaborative conversations.

All codex format volumes rely on numerous areas of movement to function. Understandably, at the time of manufacture, the structure and the materials employed in a book's construction work as one and the volume opens well, with the movement of inner and outer joints, the paper, and the sewing or other spine structure allowing access to the contents. Critical, of course, is the continued mechanical endurance of these materials. Yet over time, the leather, adhesives, threads, and papers may inherently degrade on their own and suffer from external conditions—each component deteriorating at a different rate. These structural breakdowns inhibit the function of the object, sometimes completely. And photographs, although historically made using very high-quality materials and developed on strong paper supports, remain variously sensitive to light and to the chemistry of their immediate environments. Their surfaces are easily marked and must remain protected from any direct contact. In comparing the handling concerns of these two art disciplines, their needs seem in opposition with one another: the volume only functions well while its movement is uncompromised, with the pages manipulatable by hand; the photograph is safest when kept still and stable, untouched. Likewise, the book conservator must keep the bound object moving, whereas the photograph conservator must keep the photographic object still. The *photograph album*, of course, combines the two art forms.

Papers presented during the Joint Book and Paper + Photographic Materials Session, AIC's 49th Virtual Annual Meeting, May 10–June 25, 2021 have been jointly published in volume 40 of the *Book and Paper Group Annual* and volume 19 of *Topics in Photographic Preservation*.



Fig. 1. Owen Angel, *Follett Family Album of Children Costumed for a Fancy Dress Ball*, ca. 1880. Cabinet card photograph album, 28.6 × 22.9 × 4.4 cm. The Metropolitan Museum of Art, Purchase, Joseph M. Cohen, William Talbot Hillman Foundation, Robert and Joyce Menschel Family Foundation, Robert D. and Virginia R. Joffe, Paula and Ira M. Resnick, and Maureen and Noel Testa Gifts, 2007 (2007.284). Courtesy of Aleya Lehmann.

These hybrid characteristics influence the long-term preservation of albums as well. Industrialization of production methods across all sectors during the 19th century changed the way businesses produced goods, and the shift toward mechanizing paper manufacture in particular revolutionized print and publication runs, from newspapers to novels to art. As demand for all printed matter increased, wood pulp was sourced as the main ingredient in paper slurries, replacing the less available linen, cotton, and flax, and bleaching was introduced to brighten papers, offsetting the darker tone of wood pulp-based products. Photograph album structures across the 19th and 20th centuries were designed by innovative bookbinders to accommodate the various and changing processes that were being developed by photographers, but despite the creative solutions devised to pair the photograph with the book, industrially produced binding materials resulted in the reduced long-term quality of many products, including the adhesives, cloths, threads, and leathers used in production bookbinding, as well as the papers chosen for the text blocks. Proper preservation care of these comparatively delicate objects can be built on

cross-disciplinary communication and understanding the mechanics and the materials of this subset of bound volumes, including how the development of album structures followed the growth of the photographic industry, from the first photographs up through the present.

ALBUM STRUCTURES

Photographs on paper were introduced to the world in 1839, and almost immediately artists mounted them into books and albums. Across the decades, bookbinders devised countless album structures to accommodate photographic images, but very broadly they can be differentiated between sewn structures, guarded leaf structures, and albums with exclusively mechanical leaf joins.

Albums with sections sewn through the folds or with side-sewn single sheets are commonly found across collections. The traditionally bound *Emma Charlotte Dillwyn Llewelyn's Album* from the 1850s (figs. 2, 3), with its text block of wove paper made into sections and sewn through the folds, is covered in half red leather with marbled paper sides. It contains

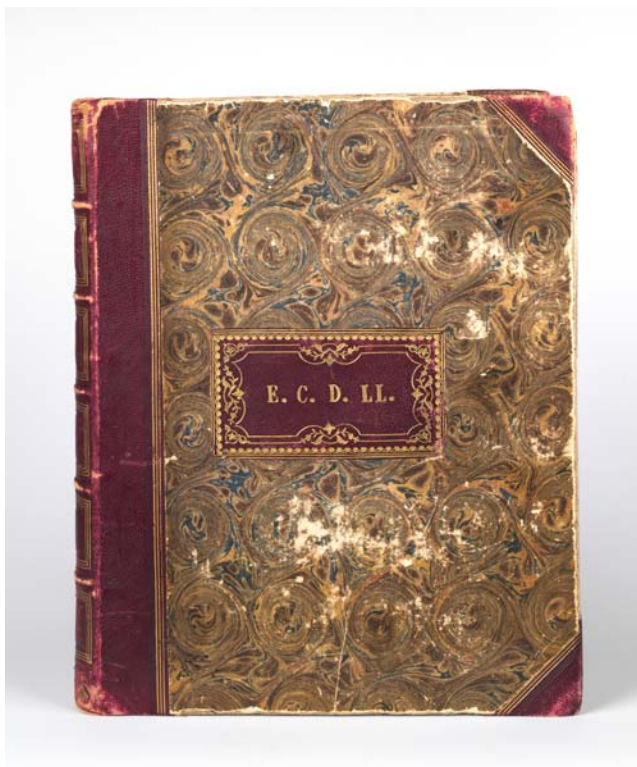


Fig. 2. John Dillwyn Llewelyn, *Emma Charlotte Dillwyn Llewelyn's Album*, 1853–1856. Album with salted paper and albumen silver prints, 28.8 × 22.3 × 3 cm. The Metropolitan Museum of Art, Gilman Collection, Gift of the Howard Gilman Foundation, 2005 (2005.100.382 (1-85)).

128 salted paper prints and albumen silver prints made from paper and glass negatives, and the majority of the very thin photographs are attached to the album pages with adhesive around just their four edges. The opening action of this bound volume, with its sewing structure and flexible leaves, is typical for the style of binding, and its continued use relies upon the sewing threads, the linings of the spine, and the drape of the paper that makes up the text block. As move the leaves, so follow the delicate photographs, and in this example, the actions that allow the book to function smoothly may themselves pose a risk to the thin edge-mounted artworks, both causing their planar deformation and increased risk of tearing when the pages are turned, and placing strain on the adhesives that hold the photographs in place.

Side-sewn albums that join together loose single sheets rely on the fiber strength of the text block material and the continued fold endurance of the paper and the cloth spine covering, the materials responsible for supporting the opening action. The leaves of the *Album from the Archive of the French Medium Henri Matthouillot*, 1920–1938 (figs. 4, 5) are bound with a cord laced through two holes that extend through the cover and the text block. The album contains gelatin silver prints mounted overall onto recto and verso throughout, adjacent to lengthy manuscript ink notations written on slips



Fig. 3. John Dillwyn Llewelyn, *Emma Charlotte Dillwyn Llewelyn's Album*. Image of "Theresa," edge discoloration from attachment adhesive around the edges of the print (2005.100.382 (32)).

of paper. The photographs in the album are quite stable, but they are mounted side by side with their descriptions, and when the volume is closed, the adhesives and the inks rest in contact with the conjugate photographs' surfaces. Loosely side sewn, the structure offers limited planar stability for the album, and the user must be careful to avoid allowing the delicate and glossy surfaces of the photographs to rub against one another or the mounted annotations. With prints adhered almost to the fore edges of each opening verso, the user risks touching the faces of the photographs in turning the leaves unless aware of the layout before handling, which makes this album a good example of one for which to include handling instructions on the label of the protective enclosure.

Binders accommodated the addition of photographs into the pages of sewn volumes in various ways and at times altered the structures to account for the thickness of the new contents in manners similar to those utilized to bind volumes with intaglio or woodblock prints. For example, leaves were removed



Fig. 4. Unknown, *Album from the Archive of the French Medium Henri Mathouillot, 1920–1938*. Side-sewn album with gelatin silver prints and manuscript descriptions, 11 × 7.9 × 1.5 cm. The Metropolitan Museum of Art, Gilman Collection, Gift of the Howard Gilman Foundation, 2005 (2005.100.383.2).



Fig. 5. Unknown, *Album from the Archive of the French Medium Henri Mathouillot*. Detail of mounted photograph adjacent to manuscript ink inscription (2005.100.383.2).



Fig. 6. Traditionally sewn album with leaves removed to accommodate the addition of photographs to text block.

(fig. 6), folios were back hooked for sewing, or sections were sewn with compensation paper guards, the guards approximating the thickness of the anticipated additional materials.

From the very outset of photography, practitioners advanced their methods, and by the mid- to late 1850s the albumen silver print was the most widely used photographic process. Made using very thin paper, these photographs tended to curl dramatically if left unrestrained, and in an effort to counter this effect, they were mounted onto secondary supports, either into the leaves of an album or, with growing popularity, onto individual rigid cardboard supports, as with the *carte de visite* (100 × 64 mm), and later the larger *cabinet card* (165 × 108 mm). Stiff, individually mounted albumen images could not successfully be mounted into flexible-leaved bindings, which led to the development of stiff-board guarded leaf albums to house and display the CdVs as well as tintypes and cabinet cards. Rather than being sewn, the text block leaves were guarded together, and the cartes de visite or cabinet cards were inserted into the board-weight rigid leaves instead of being pasted into the pages of a traditionally or side-sewn album. Consisting of an albumen silver print adhered overall to a thick paper card, the *carte de visite* was introduced and patented in Paris in 1854 by André Adolphe Eugène Disdéri. The introduction of these cartes, smaller in format and more affordable to produce and purchase, helped democratize photography by allowing a broader demographic to have their images taken, to own their own cartes and albums, and to curate them for private enjoyment. *Carte de visite* albums and, beginning in the 1860s, the larger-format cabinet card albums are found in great numbers across both institution and personal collections.

Although there are numerous variations in their structural details, the primary hinge album and the secondary hinge album with board stubs are two of the most commonly seen

formats of the guarded leaf album. Comprising the text block, the leaves of guarded leaf albums each consist of a board from which has been excised a recess just larger than the object to be inserted. Facing papers are adhered to both sides of the board, each of which serves as a device to frame the image beneath and as an overmat to keep the *carte de visite* or cabinet card in position. Photographs on their rigid supports are eased into position in the board-weight leaves either from the tail or through a slit in the page front, sliding underneath a section of unadhered facing paper, to sit back to back in the recess cut from the board, each object's recto then matted for the viewer. In albums with primary hinges, the leaves are joined one to the next with cloth or paper guards, adhered underneath the facing papers of the conjugate pages at each opening (fig. 7). In albums with secondary hinges, the board or folded cloth stubs are sewn or adhered together at the spine edge, with the board leaf then guarded to the stub (fig. 8). The guarded leaf structure of the *Carte-de-Visite Album of Central Park Views* from the 1860s was formed with folded compensation stubs made from cloth over paper, with the extensions of cloth serving to attach the stiff leaves of the book block at the secondary hinges (fig. 9). In both primary and secondary hinge guarded leaf albums, the opening action relies on the continued fold endurance of the guards that hold the text block together rather than on the thread, spine liners, paper drape, adhesives, or other traditional methods of opening support utilized by bookbinders over the centuries.

Numerous preservation challenges lurk in the pages of guarded leaf albums. The aforementioned concerns about later 19th-century papers, leathers, and adhesives must be considered, as the degradation patterns of these materials put handling and the binding function at risk. The design of these albums allows for relatively straightforward insertion



Fig. 7. Primary hinge guarded leaf structure, from tail. Osborn's Gallery, Charleston, SC, *The Evacuation of Fort Sumter*, 1861, 12.6 × 9.4 × 2.5 cm. The Metropolitan Museum of Art, Gilman Collection, Museum Purchase, 2005 (2005.100.1174.1–.16).



Fig. 8. Secondary hinge guarded leaf structure, from tail. Ambrose Jackson, Stacy's Photographic Carte de Visite, Publisher, *Carte-de-Visite Album of Central Park Views*, 1860s, 15.4 × 13.4 × 3.9 cm. The Metropolitan Museum of Art, Bequest of Herbert Mitchell, 2008 (2015.400.199).

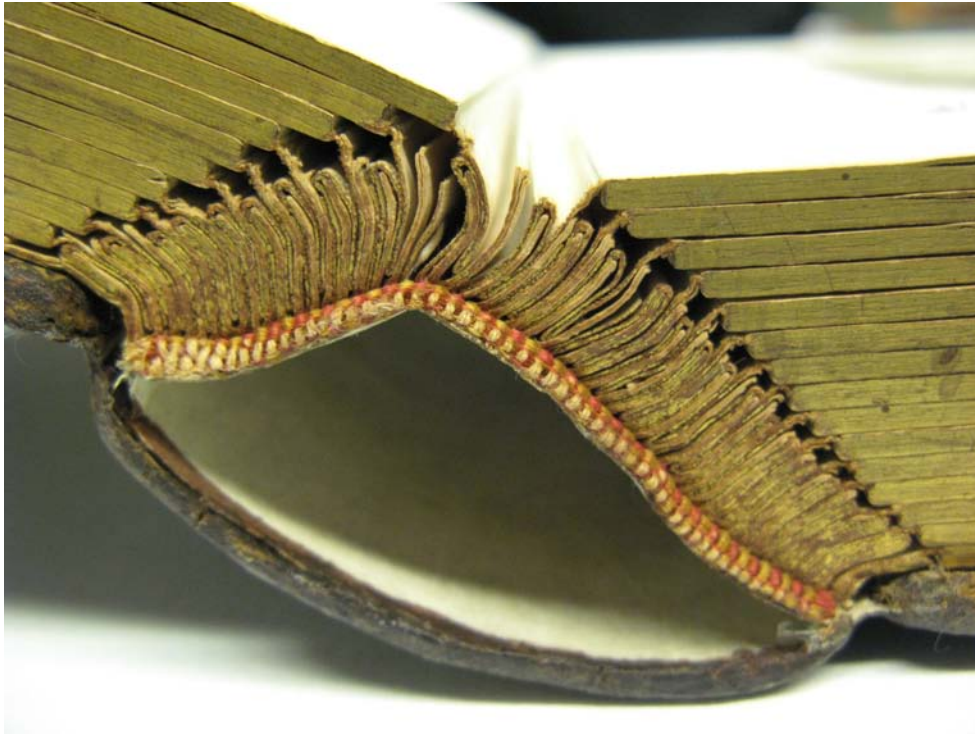


Fig. 9. Detail of compensation stub in secondary hinge guarded leaf album. Ambrose Jackson, Stacy's Photographic Carte de Visite, Publisher, *Carte-de-Visite Album of Central Park Views* (2015.400.199).

of a photograph, but they are not conducive to changing the order of prints by removing and reinserting the cartes, which often results in damage to both the delicate images as they are slid in and out, and to the facing papers. Cloth guards and facing papers can lift away from the boards as adhesives fail (fig. 10). The text blocks, made of matboard, adhesives, paper, cloth guards, and photographs, are heavy for their size, and larger albums, when stored vertically, can succumb to gravity, pulling their own text blocks forward out of their squares, as they often lack the rounding and backing at the spine to help support themselves on the bookshelf.

MECHANICAL JOINS AND LATER STRUCTURES

Albums with purely mechanical leaf joins are less common, but the examples here include an accordion structure held with metal pins that fits a series of miniature albumen prints into a tiny locket album (fig. 11), a metal cabinet hinge album with leaves that swing nonadhesively on opposing tabs over metal rods (fig. 12), and a dramatic metal secondary hinge in the patented Metal Back Album (fig. 13). These mechanical joins continue to function well despite the deterioration of some of the surrounding binding materials.

Numerous later structures were employed throughout the 20th century by not only the photographic industry but also

for business administration, including post bindings, ring binders, and spiral and plastic comb bindings. Although not covered in depth here, these too suffer various similar preservation issues based on the quality of the materials used in their construction. The proprietary ingredients in their material production make their degradation patterns difficult to address, and this category of later album structures warrants further study to determine the most effective long-term preservation strategies.

These many examples provide just a glimpse into the variety of album styles, and each discussed here presents its own set of challenges. The inclusion of the physically and chemically sensitive photographs adds a nuanced layer to their preservation. When adhered just around their edges, thin and potentially light sensitive salted paper and albumen prints are put at risk by the action of turning the pages, as well as by their proximity to 19th-century papers and adhesives. Side-sewn albums without spine support may not provide the planar stability necessary to prevent conjugately mounted photographs from rubbing against one another. The removal and reinsertion of cartes de visite into aging albums increases the risk of handling damage to both the photographs and the album pages. Developing an understanding of photochemistry and the basics of these bound structures provides book and photograph conservators, respectively, more tools with



Fig. 10. Lifting facing paper, in carte de visite album. The Metropolitan Museum of Art, Department of Photograph Conservation Study Collection, N.A.



Fig. 11. Mathew Brady, *Miniature Wedding Album of General Tom Thumb and Lavinia Warren*, 1863, 2.7 × 2.0 × 1.0 cm. The Metropolitan Museum of Art, Joyce F. Menschel Photography Library Fund, 1999 (1999.89).



Fig. 12. Cabinet hinge album. The Metropolitan Museum of Art, Department of Photograph Conservation Study Collection, N.A.

which to address album care, and the author recommends a photograph identification course for book and archive conservators and a basic bookbinding course for photograph conservators to further interdisciplinary communication.

HANDLING AND PHOTOGRAPH ATTACHMENTS

As with any bound volume that is regularly accessed in a study room or selected for exhibition, the dynamic nature of a photograph album leaves it vulnerable, as necessarily it is manipulated at each use. Balancing an album's condition with what is being expected of it is of particular importance. If, for example, an album that has not been seen or studied for decades is proposed for exhibition, at first glance it may appear quite robust in its box in the vault. Yet, in the process of shepherding the album through the exhibition process, from selecting an image through treatment and catalog

photography, cradling, conditioning checking, and mounting at one or more institutions, by the time the album has returned safely to storage, it has been opened and closed upward of 30 times. Therefore, understanding what is being expected of these hybrid objects before permitting exhibition plays an essential part in their preservation planning. Even without being slated for exhibition, the photographs mounted in albums, subject to movement, handling, and the environment, have much more expected of them physically than those that are safely matted and behind glazing.

Together with understanding the quality of the materials used at manufacture and that which is being asked of an album in its function as an artwork, the conservator must be mindful of the method of attachment of the photographs within the text block. Each image is held in its location in a particular way: adhered overall, dabbed at the corners, hinged in with Japanese paper, slid into a preprepared recess in the leaf, edge mounted, corners tucked through one or two slits in the support, held by paper or plastic photo corners, tipped in with a line of adhesive, guarded into place, even left intentionally loose and inserted into the text block. Some newer album structures were designed with lines of slightly tacky adhesive and liftable plastic overlays, transparent plastic sleeves, or photo corners ready to receive images. All of these methods of attachment may inadvertently cause harm to the photographs or supports, or may fail as materials deteriorate and adhesives desiccate, and the handling or treatment of the object as a whole must be undertaken with the photographic attachment method in mind.

CONSERVATION AND PRESERVATION

Conserving photograph albums involves making decisions about how best to keep these dynamic objects functioning while bearing in mind the particular preservation concerns discussed earlier. Maintaining the various moving parts of an album may require stabilizing the existing material or replacing an original aspect of an album, and, invariably, ethical questions arise in each treatment plan. Should a leather outer joint be replaced with new leather that will, based on its inherently acidic nature, break down over time? Is it appropriate to introduce a different material to the structure, despite being a departure from the original design? If the sewing threads are broken in one part of a volume, should the entire book be re sewn even though the treatment is more invasive? If photographs have detached from the pages, should the conservator use a different, but more reliable, method of reattachment? How can manuscript captioning below a photograph be preserved if the paper on which it is written is inherently so weak that the photograph is separating from the page? How does the conservator wrestle with the pervasive issue of photographs made with stable materials that are kept in proximity to poorer-quality papers and adhesives while striving to retain



Fig. 13. Patented Metal Back Album. The Metropolitan Museum of Art, Department of Photograph Conservation Study Collection, N.A.

the integrity of the album as a singular object? These are among the various ethical considerations that enter into the treatment plans for albums.

In weighing possible treatment options, one must consider the most vulnerable aspect of the album, whether it be the covering materials, the adhesives used for attachment, the photographic process, or the light sensitivity of the mounted images. With in situ treatment of the photographs in a particularly delicate structure, book and photograph conservators work together to cradle the volume in a supported manner to allow for safe conservation treatment. Determining whether to retain, remove, or replace interleaving papers and the decisions about treatment adhesives and housing materials are taken with the delicacy of the photographic material in mind. Cross-disciplinary communication encourages both book and photograph conservators to consider artwork sensitivities outside of their main disciplines, and, invariably, more communication up front results in better longer-term preservation of the objects.

Examining albums from a book conservator's vantage point involves recognizing numerous photograph-specific considerations. Identifying the photographic process or

processes in the volume, noting what the surface of a photograph is in contact with on the conjugate page, and being mindful of the potential physical wear to which the action of the book may be subjecting the photographs are essential first steps. Conversely, for photograph conservators, the complicated structural elements of bound volumes and the sometimes disconcerting condition of the binding materials may be daunting. Learning to handle albums, to set up cradling structures that allow safe in situ treatments, and building a baseline understanding of the mechanics of the book will help allay some of these fears. Treatments to ensure that the images are well attached at their locations will help mitigate physical damage, as lifting or loose photographs are at risk of damage or being dissociated from the object. When possible, the author strives to keep the albums together as integral units, both for historical and archival reasons and because most of these objects have been designated as single artworks. It can be difficult to determine how best to preserve photograph albums while recognizing their inherent vices, and at times the most appropriate decision is to be certain that the exhibition or storage environment, the housing materials, and the handling practices are of the highest quality rather

than to introduce a deeply interventive conservation treatment. These are just some of the many hybrid considerations that both book and photograph conservators need to keep front of mind as they find themselves responsible for these composite art objects.

Cumulative light damage is of great concern across the PMG and BPG specialty groups, and the better one's understanding of a photographic process and album materials (or the ability to determine them), the more confidently one is able to recommend storage and exhibition parameters. For example, a mounted albumen silver print may well be more light sensitive than its text block secondary support, and thus an open album will be kept at 4 footcandles (40 lux) during exhibition. Yet, although a gelatin silver photograph can be safely exhibited for a short exhibition at 8 footcandles (80 lux), the author would recommend only 5 footcandles (50 lux) for the object while on display in concern for the text block paper.

Providing protective enclosures made from Heritage (fig. 14) or other similarly tested board rather than housing albums in cloth-covered drop spine boxes, ensuring that storage and exhibition materials have passed the Oddy and Photographic Activity Tests, and maintaining a stable environment during storage, research, and display will result in

the most effective long-term preservation of photograph-based artworks.

Preservation efforts may be enhanced through well-placed education and advocacy, including hosting handling sessions for new staff and fellows, advocating for cold storage facilities, and reaching out to registrars and curatorial teams to review preservation protocols. Welcoming visitors to the lab, whether students or potential donors, regularly results in excitement about what the field entails and the practices involved in the long-term care of art collections. Following is a list of housing and storage recommendations, handling guidelines, and the names of a small number of materials and vendors that supply them, with the hope that these will be useful in furthering the collaborative work undertaken by the book and photograph conservation communities.

Housing and Storage Recommendations

Most photographs should be stored at cooler or colder temperatures.

Most albums are stored at 60°F/40%RH.

Photographs and bookbinding materials are light-sensitive.

Environmental conditions in galleries are 70°F/50%RH.

Housing materials should pass the Oddy Test (test each new batch).



Fig. 14. Heritage board protective enclosures for volumes containing photographs.

Housing materials should pass the Photographic Activity Test (P.A.T.).

Use enclosures of Heritage board or other conservation-quality material.

Micro-climate housings will slow down temperature and RH fluctuations.

House and store heavy or unstable albums flat on folio shelving.

Label housings with any handling instructions and/or warnings.

Include maximum safe opening angle instructions on housings.

Provide handling instructions for more complicated housing designs.

Handling Guidelines

Handle albums with gloves until familiar with the object.

If a volume is housed vertically on a shelf, do not remove it by pulling the headcap.

Be mindful of the condition of covering materials.

Lift an album, do not slide it, and place it in a new location.

Open the album slowly to avoid drawing and lifting the endpapers.

Use book supports or angled cradles to support open albums. Adjust the cradling support and opening angle to accommodate various openings.

Avoid flexing photographs with the movement of the album pages.

Handle only the outer margins of the text block leaves.

Be aware of interleaving and any loose or detaching photographs.

Allow no photos or interleaving to slip into the gutter or become creased.

Mounting Recommendations

Examine the album with photograph and book conservators. Albums may appear robust even when in poor condition.

Build a cradle specific to the opening page spread and support the squares during exhibition.

Mounting and case materials should pass the Oddy Test (test each new batch).

Mounting and case materials should pass the Photographic Activity Test (P.A.T.).

Strap leaves gently with polyethylene to keep them open during exhibition.

Consider exhibiting facsimiles if albums absolutely may not be exhibited.

Before permitting exhibition, understand an album's limitations.

Housing Materials

Heritage Archival Corrugated Board

Mylar polyester

Polyethylene strap

Four flap enclosures

Photo-Tex paper

Tyvek

Suppliers

Talas

Archival Products

University Products

Creation Baumann

MasterPak

Benchmark

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Abstracts presented during the Book and Paper Group Session

An Investigation into the Stability of Thermal Copying Records in the U.S. National Archives Produced from the 1950s to the 1970s

Henry Duan, Lisa Isbell, and Jennifer Herrman, The U.S. National Archives and Records Administration

This work addresses outstanding questions related to the preservation and conservation of records made from thermal recording media from the 1950s to the 1970s. Although there is available literature about the developmental trajectory of thermal recording media, there is little published research about safe approaches to conservation treatment of the different generations of technologies. Conservation practice would benefit from information about the residual heat sensitivities, solvent sensitivities, and acidity of the media.

Thermofax and associated thermal recording technology were invented during the early 1950s, and were developed and commercialized as an office copying method and process later in the decade. Across the 1960s, newer generations of the technology arose, leading to the commercialization of more stable thermal recording media. The use of thermal recording technology for office copying lasted well into the mid-1970s and was gradually replaced by toner-based electrostatic photocopying.

Federal agencies were among the earliest to adopt the thermal copying technology. As such, many federal government records from the late 1950s to the 1970s were produced using thermal copying media of different technological generations, and were ultimately accessioned into the National Archives. Problems with the stability of these records from early generations, such as Thermofax, were noted in the 1980s. They yellowed and even turned dark brown, so there was diminished tonal contrast between the text and its background. In addition, for some of these records, the tensile strength of their support paper decreased and the sheet became brittle. Concerns arose about the prospect of irretrievable losses, especially from records made with earlier generations of media. However, reports of in-depth research about these materials are rare. Specifically, there is a lack of understanding why some media grow dark and brittle, resulting in image

degradation, whereas others are aging in line with nonthermal recording media of the same era. Due to these variations in stability across different generations of technologies, it is highly uncertain during conservation treatments if heat or solvents may be used, for example, to remove adhesive tape, or to clean a contaminated record.

This presentation will provide an overview of the developmental path of thermal printing technology from the 1950s through the 1960s, discuss the image-forming chemistry based on research of historical patents, and compare it with results from instrumental analysis. We will also report on experimental results that identify which types of thermal copying media remain heat sensitive and which are sensitive to a range of organic solvents in a simulated conservation treatment. In addition, we will report on the acidity of these media, which may help predict future storage stability and mitigate risks for museum display and conservation treatment.

Based on these findings, we will provide a risk assessment for potential losses of information on printed thermal recording media during long-term storage, their vulnerability during conservation treatments, and propose a risk-mitigation strategy for institutions holding these records.

Beyond the Manila Folder: Sharing Heritage Data

Andrew Forsberg and Fenella France, Library of Congress

This work is on developing a web-based data analysis platform to support scientific researchers' work with heterogeneous data types, and to assist scientists and cultural heritage partners engaging with the results. We began work on the platform to manage diverse records for the Mellon Foundation funded project, Assessing the Physical Condition of the National Collection (ANC: <https://nationalbookcollection.org/>). This project was outlined at AIC in August 2020, and involves comparing the physical, chemical, and optical characteristics of 500-plus "identical" books, published between 1840 and 1940, from five large research libraries in distinct regions of the United States. We selected a representative stratified random sample of titles from their shared holdings to better identify "at-risk" time periods and paper types for the project, and undertook visual assessments and a range of objective paper testing analyses.

This data platform already allows us to import analyses from various instruments (FORS, FTIR, SEC, Tensile

Papers presented during the Book Abstracts presented during the Book and Paper Group Session, AIC's 49th Virtual Annual Meeting, May 10-June 25, 2021

testing, XRF), and researcher compiled spreadsheets for pH and spot tests (aluminum, lignin, protein, rosin, starch). The analyses are minimally processed into data structures for storage in CouchDB (a JSON document store), along with sampling and nonscientific data for each book. The analytical data is stored as close to “raw” as is practical. Given some of the challenges with algorithm bias, our intention was to leave our options open—to be able to closely compare the “same” book across institutions; optionally filter and then plot all the samples’ data for arbitrary axes (e.g., pH, Mw, Publication Date on x , y , z axes); test combinations of multiple transformations on the data; and, in short, acknowledge from the beginning that we do not know what we do not know just yet.

This “store raw, transform on demand” approach has been working very well for us, servicing many different data visualization, comparison, reporting, sharing, and exporting tools. Most importantly, we can quickly scaffold and then refine services for new research avenues as they present themselves, without having to locate and retrieve (or worse, attempt to reconstruct) the original data.

This platform has led to a focus on the need for active data that meets the FAIR principles (Findable, Accessible, Interoperable, Reusable), and the events of the past months have shown the dire need for this approach to data. An expanded project includes a much larger array of analytical procedures and scientific instrumentation, our stores of research on sample databases (see CLASS-D: <https://www.loc.gov/preservation/scientists/projects/class.html>), and incorporates a more thorough integration of events and the temporal dimension within the platform, including the first implementation of our Linked Open Data model for sharing scientific cultural heritage data. Our intent is to share the platform (sans data) as a community resource on GitHub prior to AIC 2021. This presentation will discuss the approaches and directions assessed, issues, and challenges.

Tango with Cows: Balancing Access and Preservation in a Research Collection

Melissa Huddleston and Rachel Rivenc, Getty Research Institute

Tango with Cows (1914) is widely considered a seminal example of Russian avant-garde book art. The book consists of 12 poems written and designed by Russian futurist Vasily Kamensky in collaboration with brothers David and Vladimir Burliuk. They were part of a group of artists and poets who reimagined the book as a new art form during the years leading up to the Russian revolution. The group developed their own descriptive terminology. For example, Kamensky referred to several of the poems in *Tango With Cows* as “ferroconcrete,” meaning “reinforced concrete,” describing design layouts that related his poetry to modern Moscow’s urban infrastructure.

Tango with Cows exists in multiple copies. It was printed on pages cut out of cheap wallpaper, every opening revealing a

poem opposite the colorful printed floral pattern of the wallpaper. The words and letters are arranged pictorially using several different typesets and design compositions. The copy that was acquired by the Getty Research Institute came to the collection unbound in a stack of single sheets. The book was originally bound with a stapled stab binding.

Currently, *Tango with Cows* is housed in a portfolio. The pages are individually encased in transparent Mylar sleeves intended to provide access with minimal contact. Consequently, the visual and tactile quality of the book is diminished when viewed this way. Readers often request to remove the fragile pages from the sleeves and hold them side by side, emulating the book as if it were bound. Efforts to protect the book have inadvertently introduced excessive handling, making it even more vulnerable to damage.

In discussion with Getty Research Institute curators, scholars of the period, and conservators from other institutions who hold copies of the book in their collections, a range of solutions were explored. Mock-ups were created to visually aid discussions on the aesthetic, practical, and conceptual implications of potential decisions including several binding alternatives and a variety of creative housing solutions. On the one hand, binding the book would allow it to function as originally intended while also ensuring that the pages stay together in the proper order. It would also prevent the pages from shifting out of alignment, which could cause edge bends and tears. On the other hand, rebinding is an intrusive intervention that could introduce stress to the fragile paper and erase aspects of its history.

This predicament aptly illustrates the challenging balancing act of providing access while preserving the materiality, history, and function of an object.

From Prints to Paintings: The Transformation of Maria Sibylla Merian’s Counterproofs

Catherine Stephens, The Conservation Center at the Institute of Fine Arts, New York University

Maria Sibylla Merian (1647–1717) is famous today as a painter, a printmaker, and an early pioneer in the fields of entomology and scientific illustration. For the latter part of her life, Merian supported herself by selling her illustrated books about insect metamorphosis and her opaque watercolor paintings on parchment, which elegantly portray specimens of South American insects and plants. In 1705, Merian published her widely acclaimed folio of 60 etchings, *Metamorphosis of the Insects of Suriname*, and, at about the same time, she produced three sets of watercolor paintings that bore striking similarities to her *Metamorphosis* etchings. For three centuries, these 137+ artworks were believed to be typical opaque watercolor paintings with hand-drawn underdrawings; in

fact, they are hybrids created through an extraordinary combination of printmaking and painting. Rather than laboriously copying 137 underdrawings by hand, Merian made counterproofs of her *Metamorphosis* etchings onto sheets of fine white parchment. (A counterproof is made by transferring the ink from a fresh print to another surface.) Merian was quite adept at reproducing designs by hand, but a counterproof requires far less time and effort than a typical underdrawing, and traces of printmaking ink are just as readily obscured with layers of opaque watercolor. A straightforward counterproof will mirror its “parent” print exactly, yet Merian developed a technique for rearranging the imagery of her counterproofed “underdrawings” so that each composition was unique. Through my reconstructions in a printmaking studio, I have found that Merian’s counterproofing method is deceptively simple, so much so that it begs the question as to whether she was the only artist employing this labor-saving technique at the time. Although Merian’s ingenious methods allowed her to speed up the production of her sought-after watercolor

paintings, they also may have constituted art fraud, by modern definitions. In 1706, Sir Hans Sloane paid 200 Guineas to Merian for her *Metamorphosis* “originals,” the hand-drawn and painted models (*modelli*) upon which her etchings were based. Instead of honoring their agreement to the letter, Merian sent him one modello and 59 overpainted counterproofs on parchment. Sloane apparently never discovered (or admitted to) the substitution, perhaps because Merian’s technique produced multiple sets of unique paintings that cleverly belied their mechanical origins. Today, microscopic examination and imaging software allow for the identification of such transformed prints. A casual observer, however, may not immediately see the difference between a painting with an authentic underdrawing and one based on a counterproof. In this presentation, I will discuss previous scholars’ research on this topic and my reenactment of Merian’s workshop practices in a printmaking studio. I will also describe two noninvasive methods, one of which can be performed remotely, for the identification of overpainted counterproofs.

Library and Archives Conservation Discussion Group 2021

Library and Archives Conservation: Priorities of the Past, Present, and Future

INTRODUCTION

The Library and Archives Conservation Discussion Group (LACDG), newly formed with the vote of the Book and Paper Group (BPG) membership to merge the Library Collections Conservation Discussion Group (LCCDG) and the Archives Conservation Discussion Group (ACDG), held their first annual meeting presentation and discussion session. Randy Silverman and Hilary Kaplan, two early co-chairs of LCCDG and ACDG, respectively, were invited to share memories and reflections on the creation of the individual discussion groups officially established by AIC in the early 1990s. The session shifted from honoring the past to focusing on the future priorities for libraries and archives with four different and informative presentations. The presentations included reconsidering microfilm collections, creating training videos for library student workers during the pandemic, returning exhibition loans during the COVID-19 pandemic, and initiating anti-racist approaches to library and archives conservation. The session concluded with ideas for future LACDG panel discussions.

SUMMARY OF PRESENTATIONS

Randy Silverman (LCCDG Co-Chair 1990–1998) and Hilary Kaplan (ACDG Chair 1995–1998) joined the panel to answer questions regarding the LCCDG and ACDG. Their responses have been paraphrased.

LACDG Co-Chair: Please tell us about the early discussion group days and why it was important to create the discussion groups.

This open discussion took place *virtually* on May 21, 2021, during AIC's 49th 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.

Silverman: Back in the 1980s, the BPG didn't have room for discussions about library book repair. Book repair units were often governed by conservators, so at some meetings there were informal discussions. I remember one specific meeting in a hotel cul-de-sac that ran until 10:30 or 11:00 at night with 20 people in attendance. Jim Stroud passionately said that if AIC requires documentation, we just have to do it. The counter to that was that the Association for Research Libraries (ARL) was asking for statistics on book repairs that included things like 0 to 15-minute repairs. What kind of documentation could be created for 15-minute repairs? In fact, what were our standards of practice? Maria Grandinette and I co-chaired the LCCDG from 1991 to 1998 with this burning question: How do we establish professionalism in operations that have been going on for years, sometimes 100 years? We had to have context for that discussion because some labs were very small, maybe one person or two with technicians up to very large labs that were made up of student repair technicians. So the question of how you could train a technician to do a respectable cloth rebacking was key. Equally important was what materials warranted a split board binding versus a case binding, and why were we lining the spine of general collections books with polyvinyl acetate (PVA) when we knew that was going to cause a long-term problem for collections care? At the 1992 meeting in Buffalo, we staged the first-ever smorgasbord of ideas. People from 25 different libraries brought examples of the repairs that they were doing in their book repair sections and people set them out. We circulated and talked about the different techniques, and it was an eye-opener because there had never been an opportunity to see that much repair work in one place. It was kind of staggering. For the first time, we got to see what we were doing in the flesh, and we repeated the process the next year in Denver. By 1993, we had a beginning idea of what we were doing nationally.

Kaplan: In the early 1990s, the Society of American Archivists (SAA) received a grant from the National Endowment for the Humanities (NEH) for archives preservation training. It was known as the Preservation

Management Training Program. A group of conservators, mostly from government agencies, were very much involved in this program. We had state representatives Maria Holden in New York and Kathy Ludwig at the Minnesota Historical Society, and at the time, I was at the Georgia Department of Archives and History. There was also a whole crew of folks from the National Archives and Records Administration (NARA), including Mary Lynn Ritzenthaler, Karen Garlick, Diana Alper, and Jane Klinger. Apologies if I have omitted anyone, but I don't think I have. Evelyn Frangakis led this project for SAA. This group of conservators working on this program never had a chance to talk about conservation treatment. We were always talking about preservation. So, a group of archives conservators decided it would be a great idea if we could get together and talk at AIC about conservation. We wanted to discuss issues specific to work in government archives. And there are challenges, not unlike those in libraries, such as handling issues. Materials get used. They don't sit behind glass untouched. We were operating within a parent organization, so there were politics and organizational operations to be considered. The big issue was that we were dealing with large groups of related records. When we called for this meeting in 1992, it was inclusive and everyone was invited. The focus, of course, was on paper, a natural expectation of the parent Book and Paper Group (BPG). The scope was a little hard to iron out at first. It was easy to say what our discussion would not include. Even though we have books at the archives, we weren't going to talk about books. Even though we have beautiful drawings and posters, we weren't going to talk about art on paper. We have presidential libraries with some manuscript collections, but we weren't going to talk about manuscript collections either. The ultimate focus of the group was going to be on practical batch treatments rather than individual item treatments. This is a general focus of archives. Some of the topics we explored reflected that focus: humidification, flattening, surface cleaning, several years on mold, hazardous holdings, how to document environmental monitoring, and mending. We talked about factors driving conservation treatment and how they revealed vulnerability such as when items are requested by a researcher for use, or when items for exhibition may need stabilization. We never want to put anything on exhibit that is not stable because exhibitions make records vulnerable. We always want to show the public that we do our very best to make sure the records displayed are in good condition. If something is going on exhibition, it might need conservation treatment to both stabilize and convey the sense it is being well cared for. Another major driver of conservation intervention is reformatting. In the early days, that was microfilming; today, it is more likely to be digitization.

LACDG Co-Chair: What were the most memorable moments for the groups, and what were the groups' greatest contributions?

Silverman: Once we had the smorgasbord of ideas, we could talk intelligently about what is possible to train staff to do. It was clear we had to know how the books were being used by scholars who were using them as physical objects. So we invited Sue Allen to address publishers' cloth bindings at the 1994 Nashville meeting. The following year, we invited Thomas Tanselle to address the Modern Language Association (MLA) statement on the significance of primary records in St. Paul in 1995. This was key because the MLA scholars were using books as physical objects in their scholarship, but they were collectively saying libraries were mindlessly destroying the evidence they needed for their research. Out of those two meetings, we crafted a document called the *Checklist of Primary Bibliographical Evidence Contained in 19th and Early 20th-century Publishers' Book Bindings*. This document proved useful in December 2004 when the University of Michigan began participating in the first Google book search library project. The library wanted to cut the spines off the general collections books to speed up the digitization process. Shannon Zachery called me desperately seeking guidelines for physical evidence that would allow her to transfer books from the general collection to special collections in order to physically protect them from the guillotine.

Kaplan: The nature of archives is important, and we strived to distinguish archives from elements such as manuscript collections. Archives document the mission and purpose of its parent. Government archives focus on records that provide evidence of the organization's functions, policies, decisions, procedures, and operations. It also includes any other activities that will enable citizens to exercise their rights and responsibilities. The Federal Records Act came into being in 1950 under President Harry Truman. There were amendments added in 2014, which extended the Federal Records Act to specifically include Presidential Records. Tied in with the nature of government archives is an element called *records management*. Within records management, longevity is dictated by a document called a *records schedule*, which focuses on enduring historical or informational value. According to record schedules, many government agency records are destroyed. In fact, most records are destroyed. The ones that are kept are the permanent records retained for the life of the Republic. These are the records deemed worthy of preservation because they have enduring historical or informational value. I've been at NARA for almost 20 years. I used to work in preservation, but now I conduct training and records management. Only 2% to 5% of records are saved as permanent records. Temporary records are likely to be destroyed, though in some rare cases, they might be donated to an

academic institution. Decisions on whether or not to keep records are never based on politics or condition. The records schedule determines whether records are kept permanently or destroyed. It also determines how long certain records are kept. Regarding condition, I used to complete numerous preservation assessments, and I recall encountering one institution that had a rusty film canister. It did not meet their collection criteria but was accepted as a political decision. They had no equipment to play the item, and even if they did, its condition was unsalvageable. Even though its condition was unstable, they decided to keep it. In a private institution, holdings can be deaccessioned. If it doesn't fit collection policies and isn't playable to access information, there's no reason for it to take up valuable space. We cannot do that in government archives because the records retention schedule dictates what we can do with the records.

LACDG Co-Chair: Is there any other information you think our participants today might be interested in hearing about?

Kaplan: The idea of government archives may sound boring, but we have more than paper-based records. We have three-dimensional objects as well. For example, Alan Johnson at NARA constructed a creative housing for a bicycle petition that had resulted in legislation related to paving roads. The petition looks like a bicycle. We have the most unusual and amazing documents at NARA. The first item I treated when I arrived was rolled and brittle. I had no idea what it was. When I could get a peek inside, it looked like a very sketchy pencil drawing. I humidified and flattened it so it could be safely opened. This item turned out to be the original drawing for the pulley designed to haul stones to build the Washington Monument. You might think, what is this old drawing and why is this important for us to have? It has significance because it shows us how a prominent architectural structure, which everyone who comes to the DC area sees, was built. This is just the tip of the iceberg of the gems in government archives.

Silverman: We frequently think of the origins of modern book conservation as rising out of lessons learned from the Florence Flood. Today, however, we're collectively experiencing a different formative event shrinking budgets and downsizing preservation staff. The golden era during the 1970s when preservation was first being adopted into research libraries, largely funded by collection development monies, has been displaced by digitization that is now diminishing many budgets, certainly mine. So today, rather than worrying about which techniques are most appropriate for the general collection books, my library deaccessions most damaged books because it's cheaper to simply replace them than to repair them. That policy has focused my department work back almost exclusively on the Special Collections. Libraries need

to remain relevant, and, accordingly, the smaller research libraries' conservation labs need to remain focused on the changing environment. But this change of emphasis, which is largely hinging on the idea that if it's digital why are we going to need the original materials at all, is going to put the weight of maintaining the largest research libraries' general collections back on those libraries themselves. The smaller institutions are no longer going to be able to participate in the burden of repairing books for general use through interlibrary loan. I'm concerned that the use of physical materials will be necessary for certain types of scholarship. And yet, the departments that are scattered around the country doing the bulk of that work are going to evaporate, leaving the work with the huge libraries. I fear their budgets aren't going to be able to keep up, which will place interlibrary loans at risk, which is a change I'm not sure anybody's talking about at this point.

Kaplan: One of the comments I neglected to state emphatically in my presentation is that all archives records are unique. Randy talking about replacement reminded me that we can't replace archives records. Recently, I believe in 2019, there was a directive passed by the federal government stating that all records generated by the federal government must be digital by December 2022. By this date, the archives will no longer take in paper-based records. So a lot of agencies are busy digitizing records. This creates all sorts of issues, particularly issues that personally concern me. There will be obstacles to potential access by people with disabilities because you can't scan everything and anticipate access for all. Blind people using screen readers may not be able to make sense of the scanned document without extra steps to make it accessible. This is something that is addressed by the Rehabilitation Act section 508, and the government is required by law to meet its requirements. Does everyone do that? No. But it is the law for those in the federal government. A lot of very interesting actions are probably going to be forthcoming as this change is made from paper to electronic recordkeeping.

Hilary Kaplan, Training Specialist, National Archives and Records Administration, College Park, MD

Randy Silverman, Head of Preservation, Marriott Library, University of Utah

FLETCHER DURANT
ANALOG TO DIGITAL TO WHAT? RECONSIDERING
THE ROLE OF MICROFILM COLLECTIONS IN THE
21ST-CENTURY LIBRARY

From 1982 to 2007, American research libraries committed to a massive series of preservation projects to microfilm printed cultural heritage. During that period, more than 60 million pages of historic newspapers were microfilmed through the

U.S. Newspaper Program, more than 1 million books through the Brittle Books Program, and 12,000 titles in the Center for Research Libraries' Foreign Newspaper Library Partnership. Today, microfilm collections take up shelving space in libraries, little used by researchers, but now serve as the basis for large-scale digitization projects such as the National Digital Newspaper Project. Preservation copy microfilms reside in cool or cold storage and are promised to last more than 500 years. If the past of microfilm was the preservation of brittle paper, and the present is digitization, what might the future of this much-maligned format be?

The University of Florida Library (UF) is responsible for 17,453 reels of unique preservation microfilm of newspapers, 40,407 monograph titles, and 4613 reels of serials, archives, and "other" collections. With each reel holding somewhere between 600 and 1600 pages, this represents a lot of history worthy of being preserved. Over the past 25 years, the UF has been committed to digitizing microfilmed newspapers, and today the digital collections hold almost 3 million pages of Florida newspapers and more than 1.6 million pages of Caribbean newspapers. Although UF has not digitized much of their monograph, microform, and government document collections, they recently became a Google Books partner and will soon send out unique holdings to be digitized.

In newspaper digitization, libraries remain the major players. Selecting for recent Council on Library and Information Resources (CLIR), United States National Digital Newspaper Project (NDNP), and the Library Services and Technology

Act (LSTA) grants allowed a closer look at the digital availability of titles for which UF is the repository of record. For Florida newspaper titles published pre-1923, 96% (1422 out of 1486 reels) will have been digitized by UF by July 2021.

For international newspaper collections, the digitization picture is more complex, as until the generous support of CLIR, UF has had limited grant support for conversion. However, the international nature of the 10,000 reels means that there is a much larger pool of stakeholders involved in the preservation of these newspaper titles. Taking advantage of a socially distanced work arrangement during the COVID-19 pandemic, the speaker conducted a review of what newspaper content had been digitized at UF. The survey revealed that 70% of pre-1924 global titles and 12% of post-1924 global titles had been digitized (fig.1). Additionally, it was discovered that 50% of all French Caribbean newspapers and 43% of all Dutch Caribbean newspapers had their microfilm preservation copy holdings digitized through efforts of the French National Archives, the Bibliothèque Nationale de France (BNF), and Delpher in the Netherlands. Only 15% of UF's English Caribbean Newspapers have been digitized, with almost all of those done by UF and Digital Library of the Caribbean (dLOC) partners.

When we think about mass digitization in the library world, we tend to think of Google Books, which is a program that is not interested in newspapers or microfilm. Google Books is about books, monographs, bound serials, and pamphlets. So, if 18% of UF's newspaper preservation copy microfilm have a digital surrogate freely available, and 81% are out of copyright

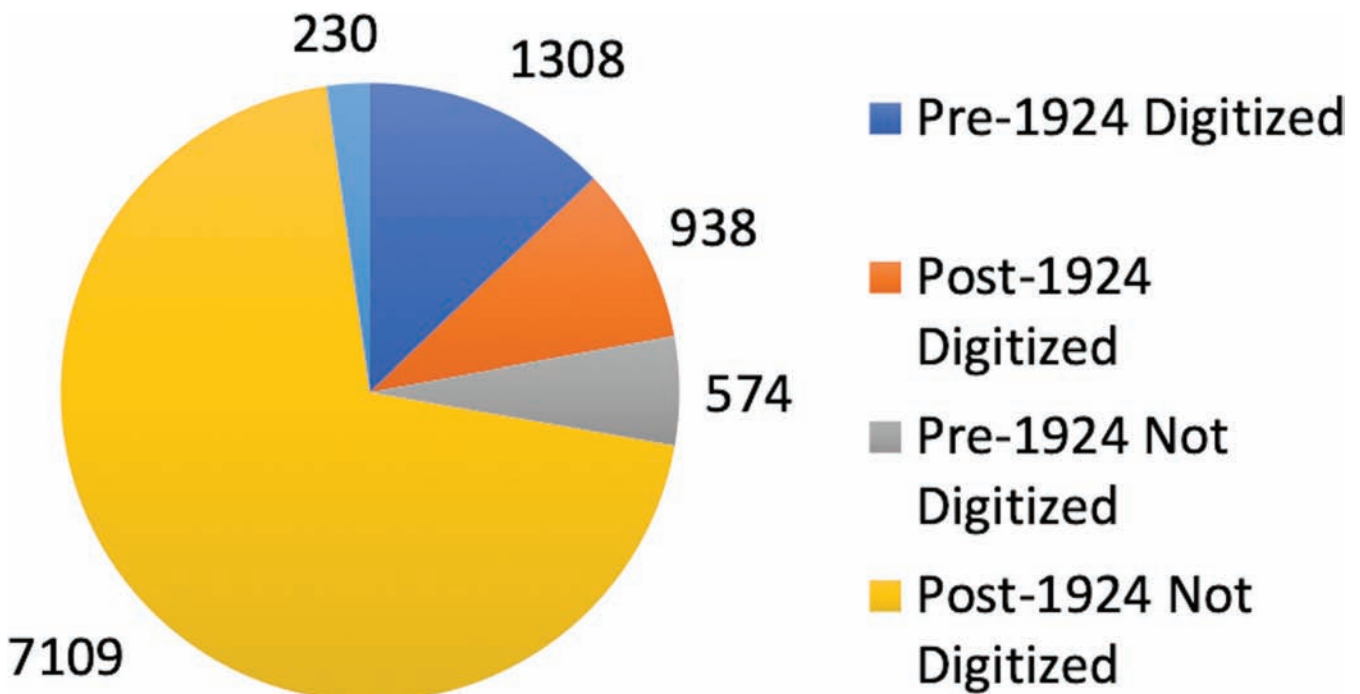


Fig. 1. Digitization of UF international newspaper microfilm reels.

reels, what about UF's 40,407 brittle book titles? The beauty of newspaper titles is that a single search can provide information on 5, 10, 100 reels of newspapers.

For the filmed monographs titles, a survey was devised and a random sample of 522 titles was selected for 95% confidence. The UF catalog was first searched to locate the title, taking note of the existence of a print version, a microfilm version, or a digital version. The inclusion of HathiTrust titles for controlled digital lending helped facilitate this search. If no digital version was listed in the catalog, subsequent searches were performed in HathiTrust, Google Books, WorldCat, and then Google to determine if a digital version was available.

The survey revealed that 72.61% of the monograph titles, although not always an exact edition match, had a digital or digitized version readily available online. Of the 51.9% of titles in the catalog that had a linked digital version, 13.28% were UF's digital collections. Another 60.89% were HathiTrust, 72.32% were Google Books, and 16.24% were "other" subscription databases. Of the versions with nothing linked in the UF catalog, 20% were in HathiTrust and 35% were in Google Books. Additionally, the survey also revealed that only 78.9% of the monograph titles surveyed still had a print version in the catalog and that these titles without print versions were predominantly from UF's Latin American and Caribbean Collection. Only 93.68% of the titles, which UF microfilmed and listed in their inventory of preservation copy film, have microfilm versions listed in the catalog, and 1% of the titles had no entries of any kind in the UF catalog.

These are preservation copy microfilm. The preservation back-ups for our at-risk cultural heritage. UF contracts with two vendors to store film in cool storage but has seen their storage prices rise in recent years. In recent years, one vendor contract rolled off of a grandfathered pricing agreement and costs rose 310%. Good storage is worth any price, but in the past two years, several large duplication orders were placed to only discover that the vendors didn't have the necessary supplies and that the orders could take up to six months to complete. It is costing UF an average of \$0.48 to store a physical reel with a vendor but only \$0.12 to store digital packages of TIFF, JP2, PDF, and XML files for that same reel, with no access charges.

Ultimately, this is a question of priorities and values. If the content is digitized and stored in a repository, what are we saving this film for? Are we preserving the film because we don't trust our digital repositories? If we don't trust our repositories, what does that say about how we are valuing all of our born-digital content, for which we have no analog back-ups? Setting aside thoughts of deaccessioning the film, what if we just stored this film in our high-density storage facility for \$0.25 per reel per year? Perhaps the lifespan for the polyester film base falls from 500 years to 200 years? What disaster are we planning to befall us over a 500-year horizon that necessitates preserving 60 million pages of regional

newspapers that we didn't need to worry about for the first 200 years of storage? Could the \$20,000 a year in storage costs be better used? Would our collections be better served by taking that money and hiring another conservation technician or funding audiovisual collections conversion?

Newspaper and brittle books microfilming projects once drove the growth of research library preservation programs and offered a solution to the storage of growing collections of newspapers and access to the information stored in 19th and early 20th-century books that could no longer be safely handled. We are at a point where we need to start a discussion on what the impact of 15 years of mass digitization may mean for library microfilm collections and explore what is needed to feel confident moving from one preservation paradigm fully into the next.

Fletcher Durant, Director of Conservation and Preservation, University of Florida

KIM HOFFMAN

HANDS-ON, VIRTUALLY: SHIFTING TO STUDENT TRAINING VIDEOS DURING A PANDEMIC

During the COVID-19 pandemic, the preservation and conservation department at the Miami University Libraries faced the two-fold challenge of figuring out how to virtually train student employees in a new socially distanced work environment with limited supervision and finding meaningful work for these students to complete while working from home. The answer was a creative shift to student training videos.

The preservation and conservation department at the Miami University Libraries falls under the special collections department, which relies heavily on the help of student assistants, most of whom are undergraduates. In preservation, they are allowed to hire three or four student employees but are sometimes required to share them with the rest of the special collections department. Student assistants support preservation efforts for both special collections and circulating materials. For special collections, students mostly make boxes and for circulating materials they can perform a variety of repairs, such as tip-ins, paper repairs, pamphlet binding, pockets, and spine repairs.

On March 17, 2020, the Miami University campus closed due to the COVID-19 pandemic. Student workers were let go for the remainder of the semester, and the only student trained in conservation graduated. When the preservation and conservation department returned to campus in August 2020, staffing was limited to an alternate week rotation, with one cohort working remotely while a second cohort worked from campus. The department was approved to hire new student assistants but was faced with the problem of needing to hire all new students who had no prior conservation training. How can one observe social distancing while conducting the

kind of one-on-one training relied on in the past? In addition, what remote work projects could the students work on during their scheduled work-from-home weeks?

Transitioning to filmed training videos was identified as the best solution. The benefit was that videos could be watched alone, at home, or in the office, and could be repeated as necessary and serve as a learning aid for the students. Videos could also reduce, although probably not eliminate, the need for face-to-face training, and might facilitate solo problem solving to further support independent work. In addition, the videos could be edited, and maybe even shot, at home to create a remote work project for the students to contribute to.

The first attempt was a toolbox introduction video, with the idea that walking through the common tools used in conservation work would be both an easy video to film and would help new students become comfortable with the project. Working on this video helped to identify some initial issues with the process and allowed for adjustments to be made to the process. A YouTube account was identified as the easiest place to host the videos and to aid filming at home. The toolboxes became reserve items so that the students could check them out from the library to take home. Although the primary audience for the videos was internal to the university, the library decided to make the videos public to allow more flexibility for their future use. Miami University branding was added to all the videos (Miami University Preservation, n.d.). During the session, snippets from some of the videos were played to give the audience a sense of their approach to the project. All the videos are fully captioned to improve accessibility.

After the toolbox introduction video, students worked on a pamphlet binding video, which was their first true procedural training. This video presented some new challenges to work through. For one thing, it became clear that if students were going to be filming at home, they needed better lighting. A ring light was ordered and made available as another reserve item for students to check out and take home. The ring light included a phone mount, which also made it easier to film overhead shots. The pamphlet binding video required a little more planning than the toolbox video since it needed to be scripted in advance, but this conveniently provided another task that could be completed remotely. Portions of the video that required special equipment, such as a board shear, were filmed on campus.

After the success of the pamphlet binding video, students shifted to creating a series of videos on box making (fig.2). Since the box-making process was a little more complex and time consuming, they opted to break it up into multiple shorter videos instead of one long video. Over time, one student became more involved in the filming and took increasing ownership of this video. The box-making videos gave this student the chance to apply all the skills learned during the semester. It also provided the student with the opportunity to work independently, do some creative problem solving, and figure out how to make the videos work.

Overall, the training videos ended up being an excellent student project. They helped the department successfully train students in various tasks and increase their comfort level with treatment procedures. The project also provided student assistants with the opportunity to develop

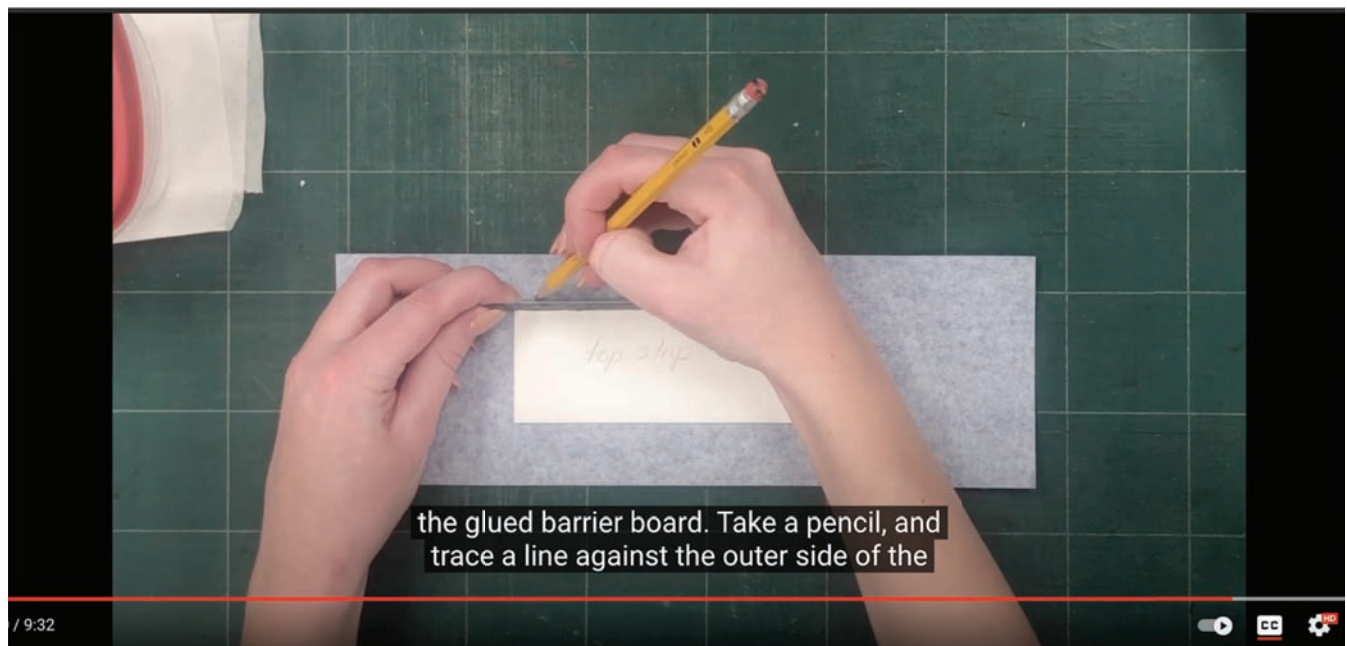


Fig. 2. Still image from the box making a video on Miami University Preservation's YouTube channel.

marketable skills in video creation and editing to add to their resumes. The department now has a library of fully captioned training videos that can be used as training aids with future students and content for social media campaigns. Additional videos are being planned for future filming to add to the series.

Kim Hoffman, Preservation Librarian, Miami University

JENNIFER K. HERRMANN AND DONG EUN KIM
RETURNING LOANS SAFELY DURING THE COVID-19
PANDEMIC

Due to the COVID-19 pandemic, canceled courier trips over the past year have made virtual condition reports and virtual deinstallations necessary to retrieve loans. New guidelines have been developed for quarantine periods and the disinfection of materials and surfaces. NARA and the Victoria and Albert Museum (V&A) worked together virtually to safely return an important map to the United States from England. That experience and research then guided the safe return of the Treaty of Point Elliott at the Hilbulb Cultural Center (HCC) in Tulalip, Washington.

The map, "United States Systems of Highways 1933," has annotations by Franklin Roosevelt and was loaned to the V&A in London in November 2019 for the exhibition *Cars: Accelerating the Modern World*. The map has significant historic value requiring specific conservation, preservation, security, and transfer measures including a courier for installation and deinstallation. NARA exhibits conservator Dong Eun Kim accompanied the shipment to the V&A, where she unpacked the document and installed the map with assistance from a V&A colleague. The exhibition, *The Power of Words: A New Chapter in Tulalip History*, displayed the Treaty of Point Elliott at the HCC in Tulalip, Washington. Herrmann and Kim acknowledge the Duwamish, Suquamish, and other indigenous people's past, present, and future of Washington State affected by the treaty, which returned to its original signing location after 160 years. The treaty was only shown from January 2020 until the center's closure in mid-March due to the pandemic. Improved safety procedures allowed the exhibition to reopen safely in August until a scheduled return in October 2020.

During the closure, the exhibits were protected from light exposure with security and environmental systems fully operational. However, concern about pandemic viral transmission and travel restrictions had changed daily routines and deinstallation plans. When the decision regarding handling the returned loan needed to be made, there was little information about how the virus spread or how infectious or deadly the virus might be, so the risk from surface contamination was considered high to protect the staff. Masks were required for combating airborne transmission, and viral attenuation research of different common materials was used

to guide best practices for keeping staff safe in shared spaces and helped inform loan practices. NARA partnered with other cultural heritage organizations, universities, the Institute for Museum and Library Services (IMLS), the Online Computer Library Center (OCLC), and Battelle Research Labs to develop and share science-based information and best practices to reduce transmission in the Reopening Libraries, Archives, and Museums (REALM) Project.

REALM published surveys of scientific literature related to airborne and surface transmission, and several rounds of research were conducted on material surfaces important to daily functions at cultural heritage institutions and libraries. Cells were monitored after coming in contact with different surfaces infected with the virus. Based on the REALM data, NARA conservation scientist Jennifer Herrmann made plots for NARA to show how the virus naturally attenuates or disappears off of surfaces that multiple staff was going to need to touch during the return of the loans. For packing, the acrylic sandwiches contained the encapsulated documents that were wrapped in Tyvek, a high-density polyethylene fabric, and then placed in a polyethylene foam enclosure within a composite wood-based crate lined with polyester urethane foam. The crate also contained the original paper report. Monitoring the decrease in the number of cells on the specific surfaces that staff would touch, including paper, polyester film, Plexiglas, and Ethafoam meant NARA could understand how long a quarantine period might be needed to keep staff safe. The use of disinfectant was not recommended so close to cultural heritage materials. Disposal of all the packing material to reduce the potential of surface transmission was unacceptable from a sustainability standpoint, so quarantine seemed the best option to mitigate surface transmission risk. REALM had created easy-to-use visual aids to summarize information for libraries, archives, and museums, as well as the general public, including plots similar to those created by NARA. More detailed and nuanced information can be determined from the actual plots. NARA determined that one week of quarantine would be acceptable before staff should open the crates and unpack the returned items. As it turned out, with building occupancy protocols, the crates sat for longer than a week. The REALM website has useful tools about different surface materials tested as well as the literature reviews, the last of which includes information on the importance of the vaccine and social distancing to end the pandemic.

With the pandemic restrictions making courier travel impossible, NARA needed to attempt virtual deinstallation. Given the obstacle of working in different countries, time zones, and daily schedules, the virtual deinstallation plan had to be discussed numerous times before confirmation. Effective visualization of the object during deinstallation was difficult due to a less than optimal computer camera system and the requirement that no awkward objects, such as laptop computers, could be held above the document. However, whenever the NARA

team asked a question to check something during the virtual deinstallation, V&A staff immediately complied, working together as if in person. Working with the highly professional and trusted team at V&A allowed a smooth deinstallation with only slight technology issues with no conservation concerns and no negative impact on working relationships. Subsequent deinstallations with smaller institutions such as the HCC were informed and aided by the experience with the V&A. That experience allowed NARA to spell out a specific methodology for borrowing institutions to follow and hold practice sessions before the deinstallation takes place. A practice run with HCC was carried out in July, and the actual virtual deinstallation occurred in October. NARA supervised all movement including loading the crate into the truck (fig. 3). Thanks to careful planning, the practice run, and cooperation, this deinstallation also went smoothly and successfully.

This ongoing global crisis has created a need for new protocols and possibilities, establishing the ability to respond and maintain effective procedures in emergency circumstances. Stakeholders can use these developments toward cooperative decision making about exhibition-related activities. Future considerations include:

- Reconsideration with all stakeholders of courier activities requiring physical proximity/incorporation of “virtual courier” duties to lessen travel requirements—tracking devices and software could compensate if couriers are not required to travel;
- Development of new software programs and/or dedicated apps designed for remote monitoring of exhibition-related activities, possibly dedicated secure virtual live monitoring while maintaining the security locations being filmed;
- Condition reports conducted remotely, with supporting technical resources—upgraded networks, improved Wi-Fi, and audiovisual equipment;

- Improved encryption for digital file sharing (loan, condition, courier, and facilities reports);
- More development in digitization technology with a rise in virtual exhibitions.

New software developments, upgraded networks and encryption, and improved digitization technologies can all contribute to the field beyond the current crisis. Progress has already been seen in these categories. As difficult as this past year has been, it has also been a time of potential for collecting institutions and for the field of conservation.

The pandemic has changed how work is accomplished, and more continues to be learned about COVID-19 and its transmission. Scientific research of viral attenuation on surfaces helped inform cultural heritage decisions and staff safety. Procedures were influenced by the need for quarantine times to allow the virus to naturally attenuate before surfaces were used by different staff or contractors, especially early in the pandemic prior to new research determining that the virus spread mainly through airborne transmission pathways. REALM continues to update its toolkit and research summaries as new information is learned about keeping people safe during the pandemic. Travel restrictions and complications from the pandemic required more virtual work and therefore put even greater emphasis on good communication with all stakeholders, maintaining positive working relationships, trust, and collaborative practices. But together there is an ability to protect each other and cultural heritage during the crisis and hopefully influence more sustainable practices for the future.

Jennifer K. Herrmann, Conservation Scientist, National Archives and Records Administration, College Park, MD

Dong Eun Kim, Exhibits Conservator, National Archives and Records Administration, College Park, MD

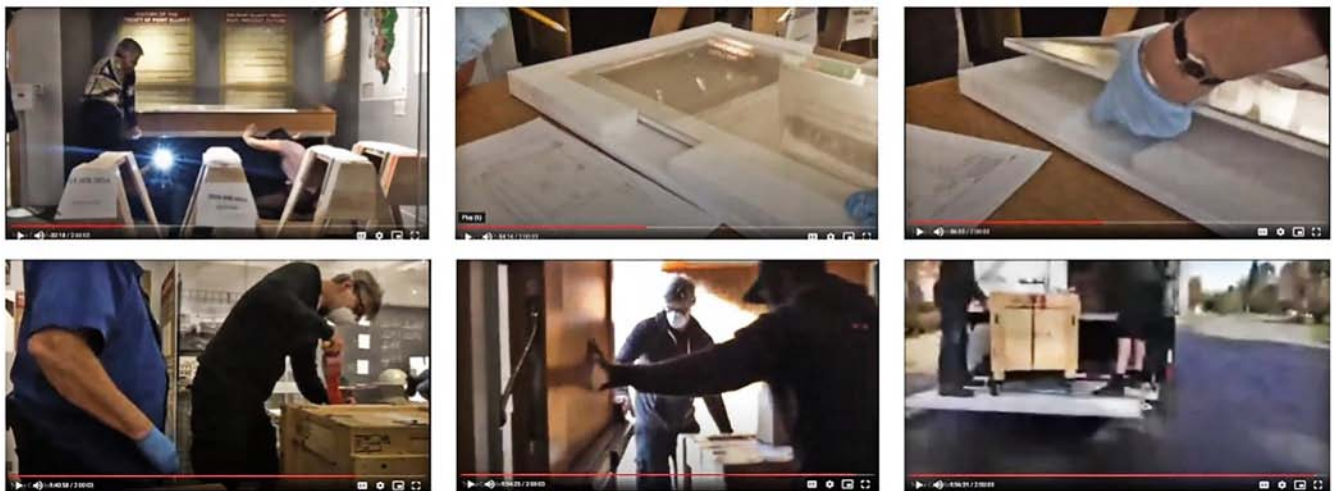


Fig. 3. Deinstallation at the Hibulb Cultural Center.

CONSUELA (CHELA) METZGER AND MICHELLE
C. SMITH
WORKING TOWARD ANTI-RACIST APPROACHES IN
LIBRARY AND ARCHIVES CONSERVATION

In the wake of a nationwide reckoning with racism and racial violence, the Preservation & Conservation Department at the University of California at Los Angeles (UCLA) Library initiated a dialogue between their department and colleagues in the library to expose and understand how systemic racism may operate within their workplace and the field of library and archives conservation. These conversations revealed the need for the department to (1) develop new policies for handling racist materials, (2) identify and correct preservation prioritization practices that perpetuate racism, and (3) incorporate anti-racist approaches into their in-lab training and education.

In discussing the development of new policies, Metzger and Smith first shared some context around the department's conversations around anti-racism. The UCLA Library is an encyclopedic research library based in a public university, and its Preservation & Conservation Department is small. Staff come from different ethnicities, age groups, and backgrounds. Like many universities, UCLA has its own history as a site of social struggle, and there have been groups engaged in ongoing anti-racist work at UCLA for decades.

When the UCLA Library announced an anti-racism initiative, the Preservation & Conservation Department began thinking about how they as a department wanted to change the way they did things. In weekly and monthly reports, the department head encouraged everyone to include a section for anti-racism-related activities and emphasized that reading articles and attending webinars on these topics was an important part of work as conservation professionals. It was also decided that the departmental blog would focus on anti-racist approaches in preservation for at least a year. The department head published the first blog post about anti-racism on July 31, 2020, entitled "Inner Meditations and Outer Resources for Understanding Library Conservation and Preservation as Racist or Anti-Racist" with feedback from colleagues. This first post included the following list of actions viewed necessary to build an anti-racist initiative within the department:

Here at UCLA Library, we are in the process of building an anti-racism initiative. This initiative must become a program, and the program must not have an end date. Within the Preservation & Conservation Department, our first actions are:

1. We support a union environment with union action to ensure a living wage and benefits for pre-program, post-graduate, and other preservation and conservation colleagues. We cannot accept unpaid interns.
2. We assess all new job descriptions in the department to be as inclusive as possible, with the goal of removing unneeded barriers to applicants.
3. Within the department, on-boarding and orientations include safe, responsive reporting options for racist incidents and aggressions.
4. We will not ask job candidates to complete Equity, Diversity, and Inclusion Statements unless we first do the work of completing our own statements. (Metzger 2020)

Developing new anti-racist policies for the department involved a lot of watching and listening. While working at home during the pandemic, the department used Slack to interact daily. They found that they shared a lot of common ground with their colleagues in the department during conversations about anti-racism over the past year, especially during local and national uprisings last summer that followed the murders of George Floyd and so many other Black people by police—horrific tragedies that brought renewed attention to very old problems. As a department, they read the many statements on anti-Black racism released by UCLA and others, and they especially noted the statements and open letters by Black colleagues within the field of conservation. The Black Art Conservators' statement released in July 2020 was particularly impactful (Black Art Conservators 2020).

In a September 2020 blog post (Smith 2020) about conserving racist materials, a draft "standard operating procedure" was included to outline procedures for how to handle racist materials when they enter the lab. This procedure, which was based on discussions within the department, included identifying racist content when discovered, documenting it, discussing it with the curator, determining the priority level for the material, and ensuring that all preservation staff has the option to recuse themselves from treating racist materials. Since they were already in the middle of creating a JIRA ticketing system for incoming conservation work, they decided to add a category for sensitive content. It is expected that procedures will evolve as they encounter new projects and have more conversations.

Beyond thinking about the treatment of racist materials, they are also thinking about how racism is perpetuated in their work by inequitable prioritization practices. What defines "research value" in our institutions? How does that definition impact what items "need" conservation? In a *Book and Paper Group Annual* article on the politics and of use and value in research libraries, Jan Paris (2000) notes, "The cultural biases that influence decisions about which artifacts will receive conservation treatment are often invisible. Both conservation training and the culture common in many of the institutions that employ conservators reinforce this invisibility. Materials that libraries and archives have historically undervalued are often the most valuable resources for the study of non-traditional subjects and overlooked groups." What do we value? How is "value" determined?

Inequitable prioritization practices take place in our organizations, and it is the responsibility of conservation professionals to speak up. Quoting from a statement by Black Art Conservators (2020) released last July: “Conservators help shape what our society values by making decisions on what to preserve, whom to include in our work, and therefore whose stories we remember. We, conservators, must hold ourselves, our field, and our institutions accountable for the long-term, systemic failure to uplift Black voices and document the Black experience truthfully.”

There is a need to ask more questions about our work practices. What kinds of materials are being prioritized for treatment in our institutions? Who sets the priorities? How can we work with our curatorial colleagues to establish anti-racist prioritization practices together? Are there Black, indigenous, and people of color (BIPOC) cultural heritage collections in our institutions that are currently underutilized because of preservation needs? Are there curators or subject-area specialists in our organizations who are not familiar with our department and the services we offer? If they knew that we wanted to prioritize the treatment of collections from underrepresented communities, would they be interested in working with us? How can we expand our services?

The talk ended with a discussion of education and training in the lab, which they think will need to shift along with our treatment priorities. How can we address gaps in our knowledge that may be preventing access to collections? If, for example, your organization has a large collection of Islamicate manuscripts in need of treatment but no one in your lab has experience in this area, perhaps you can hire an instructor to teach a workshop.

How can we incorporate anti-racist principles into pre-program training? What kind of projects do we assign to preprogram interns? We might have an idea of “standard treatments” that everyone needs to have in their portfolio—how might this notion need updating? There is a need to create space for conversations, decentralize early modern European library materials, and give a well-rounded vision of what this work can look like to those entering the field. At the UCLA Library, it is expected that there will be increased use of their East Asian, Islamicate, Armenian, and Ethiopic bound materials in the future. What kinds of book models do we tend to make, and what kinds do we expect to see in the portfolios of potential interns and fellows? How can we all prepare ourselves and our colleagues for a different future?

Openly acknowledging that this talk was “long on questions, short on answers,” Metzger and Smith expressed a hope to open a broader discussion on these issues with colleagues in the library and archives conservation field. They encouraged the audience to use their voices within their organizations to raise concerns about racist practices, even if there is not yet a clear avenue for doing so, and to collaborate with others outside of conservation who are doing anti-racist

work. Topics not covered in this talk and important for future discussion include facilitating repatriations of materials and exploring the opportunities presented by community archives and noncustodial collecting.

Consuela (Chela) Metzger, Head of Preservation and Conservation, University of California at Los Angeles
Michelle C. Smith, 2019–2021 Kress Assistant Conservator, University of California at Los Angeles

QUESTIONS FOR SPEAKERS

After the presentations, the co-chairs took questions and comments from the Q&A and chatbox. They were read to the panelists. The answers to the questions have been paraphrased.

Question for Kaplan and Silverman: Do you think there is enough common ground between libraries and archives to establish meaningful discussion group content that will benefit all LACDG members?

Kaplan: I don’t know. Archives and libraries are very different. They’re probably more similar from a policy standpoint if the focus is on electronic material.

Silverman: It’s a difficult question. The LCCDG was created out of a need. There was a lack of opportunity for people to get together for some specific types of discussions. I think that the driving force should precede the question of whether or not the two groups together can address meaningful content to benefit all. I’m not sure we know what the focus should be, and maybe we need to go in a different direction altogether that hasn’t been invented yet. There was a proposal by Seth Irwin for the last AIC meeting to do a hands-on workshop dealing with varnished wall maps. It’s a complex topic, and the workshop would have involved experienced people in the field. Wall maps exist in small historical societies that don’t have a budget for repair and in the largest libraries that collect them and can perform a variety of treatments on them. As Hilary noted, the idea of stabilization for items that people really can’t afford to treat is a national problem. We don’t see it because we’re not focused on it unless we see this particular type of object come to our lab. It’s not really a crisis, although the maps are probably rare and kept in a back room disintegrating. We don’t know how obscure some of these pieces are. The idea is to get together with conservators, perform hands-on treatment, experiment with techniques, and actively talk about what they’re doing to come up with conclusions. This might lead to a panacea of treatment options that would be very useful. That’s an interesting model to have participants working through a problem, solving it, and publishing it in some way. We could look at these kinds of issues and the ideas Chela and Michelle raised today. Our concerns could

be addressed in some ways that we haven't thought of yet. We need partners in some of this discussion.

Kaplan: A long time ago, NEH was reluctant to fund any type of treatment-specific object project if that item was going to be returned to an unstable environment. We want to keep in mind what the ultimate goal is. Is it individual item treatment only to be placed back into a vulnerable circumstance, or do we want to work toward the betterment of the whole?

Question for Durant: Are you planning on deaccessioning your microfilm?

Durant: No, it's easier to do nothing. The money to pay for our storage vendors doesn't come out of a budget that I see directly. If I said that I can save us \$20,000 a year, I don't know if that money would come back to me in a way where it could be spent in a meaningful way. Because of the survey and this project, it's more likely we will take a closer look at the space we have on campus for our microfilm access copies. The preservation copies are held off-site. We have newspapers and other micro-films that we acquired mixed in. Half of our Humanities and Social Sciences Library floor is taken up with microfilm collections. I've asked questions about how much of that microfilm is used. There are always a few reels of microfilm waiting to be reshelfed. How much of that content has been digitized and is accessible through online databases? It's going to be a pressing issue for on-site space the next time they decide that they need to add more study areas for students. Maybe the answer is that the microfilm access copies can go into storage instead of printed books and our limited selection of print journals can remain on-site. I don't think it's unreasonable to think we may have another economic downturn as we saw in 2009 and 2010 with shrinking library binding budgets. The historic budgets show we were spending \$100,000 a year on library binding in 2008. We're spending \$1000 a year on library binding currently. If my unit had to make big cuts again, there's nowhere else to cut. Potentially, we could stop paying vendors \$20,000 a year. We own our high-density storage facility, and if we transfer the microfilm into this storage, we're saving. We wouldn't see this cost for high-density storage until we had to build an extension. The short answer to the question is no, but I'm open to it.

Comment and Question for Hoffman: The videos should be considered for embedding in the BPG wiki. Did your library allow your students to take home library materials to treat offsite, and if so, did you have to coordinate with others for liability purposes? How did you manage that?

Hoffman: The students only took home circulating materials, and those materials would be checked out to the students directly. The tools were also made a reserve item able to be checked out. The only thing they were taking home that

wasn't being tracked directly was barrier board and book cloth. When they needed to work on boxes related to a special collections item, they would take home pre-cut pieces of board and book cloth. Because of that, we didn't worry much about the liability. I cleared it with my department head in advance and made sure we were on the same page. The system worked well.

Question for Herrmann and Kim: How would you relate your experiences and your findings to the AIC position statement on virtual courier oversight?

Kim: I agree with the AIC position statement that these measures were a necessary compromise in a crisis, but they don't constitute best practice for the safety and preservation of collection items. There are many stakeholders and considerations in executing virtual courier activities. The newly gained confidence that this is possible in emergency situations is what is important. This gives us the opportunity and the ability to move forward in a future crisis.

Question for Metzger and Smith: Could you say a little more about flagging sensitive content in your ticketing system? Is this something that curators or others requesting a treatment flag, or something that conservation staff flag, or both?

Metzger: It's a very new JIRA ticketing system. The way it is set up is that the curators, collections managers, or processing archivists will be the ones initiating the JIRA ticket. If they know of sensitive content issues, there are boxes that they can check. We also have boxes that indicate why it is being prioritized. We just need to find out more about the context, and because we haven't been using JIRA that long, I can't give you an actual use instance. If we notice something during documentation, we have lines in our forms for this as well and then we can add it to the JIRA ticket. Right now, we're not doing a JIRA for our circulating collections.

Smith: We expect that there will be times that we see things that a curator would not have seen. The preservation department at UCLA includes audiovisual preservation, and they're often digitizing films and things that no one has seen. It might just be one line describing what might be on it. They may see something that a curator didn't know was there, so we expect it to be a dialogue where we are letting them know things that we see as well.

Question for Hoffman: Did you consider using camera equipment other than a phone, and can you talk a little bit about editing the videos?

Hoffman: We did consider using other equipment besides phones, and the department had purchased a GoPro for filming projects. When we realized that we were going to be doing

the filming work remotely, we looked into checking out the GoPro, but due to liability concerns, the department wasn't comfortable with that. The other thing that I didn't anticipate was that the student was already comfortable using her phone to make videos, and she was not interested in learning how to use the GoPro. We were getting great results, so we decided to not add another layer of complication. But I do think that's something I would consider again in the future, particularly as we have ended our remote work for students, so anything we do with this will be in the lab. For editing, I didn't have a great idea going into this of what we would end up wanting to do. That was something else that was driven by what the students were comfortable with. The student who was doing the editing was already comfortable with iMovie, which is the standard editing tool that comes with Apple products. Because that was working really well, we just kept using it. I have used iMovie many times on a laptop, but she was editing directly on her phone, which was foreign to me. I can't believe she was sitting there editing the videos on her phone, but her process worked great, so we went with it.

Question for Metzger and Smith: Could you talk more about your experience at UCLA talking with your curatorial colleagues and library administrators about establishing anti-racist treatment prioritization practices? What advice do you have for colleagues who may be embarking on similar conversations?

Metzger: A lot of our conversations were initiated by our Black colleagues within conservation and other fields. Our procedural work was fostered by the anti-racist initiatives that the UCLA Library is embarking on. These initiatives have many committees with representatives from all over the library, including things like changing cataloging terms for groups and topics, hiring practices, retention practices, and digitization prioritization. So, there was a framework already there that was helpful for us. I didn't feel like I had to initiate these conversations. With Special Collections, they were already developing a matrix for prioritization to deal with backlog issues and acquisitions. These issues were part of their matrix already so, to be in alignment with Special Collections, it made sense for us to begin these conversations. I think there's going to be more conversations, because we've just started with the JIRA system, and more use is going to confirm if it gets used the way we hope. It will bring these conversations to the forefront.

Smith: A slide we ended up cutting was about familiarizing yourself with any EDI (Equality, Diversity, Inclusion) statements and mission statements within your organization at all the different levels. If you're expecting pushback or receiving pushback, these statements can be introduced when you raise concerns. It's a compliance issue. They've made these statements naming these priorities, and these are actions you need to take to go along with what they've stated they want to do.

Question for Herrmann and Kim: Do you envision a change to the established requirements of borrowing institutions if virtual deinstallations persist? For example, might a lender have to meet the minimum technology criteria needed in the event of a virtual installation or deinstallation?

Kim: The answer is complex. I don't think we know yet. Currently, we are relying on our good working relationships with colleagues at other institutions to make virtual loans work effectively, but we will also consider each loan on a case-by-case basis. I hope that in the end, it's people and trust in relationships that get us through difficult moments.

DISCUSSION

The session concluded with a discussion of where the newly formed LACDG should head next and what topics are important to explore going forward. Past BPG discussion group sessions were highlighted as having provided an important space for library and archives professionals to connect and learn from one another. It was suggested that there should be an effort to collaborate more with allied organizations, such as SAA and the American Library Association (ALA) since they are often addressing similar concerns within the field.

Many participants in the discussion referenced the impact of recent changes in commercial library binding practices on their work in libraries. These changes have been precipitated by declining binding budgets, a shift to collecting more electronic materials, and a new replacement for F-grade buckram book cloth. Other suggestions for future topics included reimagining exhibitions of entirely digitized physical archives, exploring ways the field of conservation could engage in more environmentally sustainable practices, and focusing on increasing inclusivity and diversity in our conversations.

There was a hope that future sessions could continue to bridge the gap between the more specialized special collections treatments often presented in other BPG sessions with the more day-to-day work typically done in archives and library collections. The audience indicated a desire to move away from presentations in future sessions to allow more time for discussion. Being able to talk with and learn from colleagues is important. Some missed past sessions where there was an opportunity to discuss specific treatment techniques or batching treatment procedures and looking at examples of work.

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Conservator and Stakeholder: Experiences with the Salvage of a Confederate Time Capsule

This article issues from a presentation given from Charlottesville, Virginia, on the ancestral land and waters of the Monacan Nation. The author extends her respect and gratitude to the Monacan Nation elders and hopes the reader will have a chance to look at their website (<https://www.monacannation.com>) to understand more about their culture and community. In addition, the author works on the Grounds of the University of Virginia (UVA) which was built upon and thrived off of the labor of enslaved workers. Please consult <https://slavery.virginia.edu/> to read more about the history of slavery and enslaved workers at UVA. Black and indigenous lives and the lives of people of color matter, and it is the author's hope that this presentation contributes to that.

INTRODUCTION

On September 12, 2020, the Confederate statue in front of the Albemarle County Courthouse was removed. Albemarle County is located in Central Virginia, east of the Blue Ridge Mountains, where the city of Charlottesville and the University of Virginia (UVA) are located. Charlottesville was the site of the deadly Unite the Right rallies in 2017 when white supremacists rallied against the city's proposal to remove statues of Robert E. Lee and Stonewall Jackson from public parks. They marched with lit tiki torches through the UVA UNESCO heritage site, assaulted students and counter protesters, and ultimately murdered an activist named Heather Heyer. Three years later, the nation was reeling from the onset of the COVID-19 pandemic and the horrifying murder of George Floyd in May 2020 that incited protests against racial violence worldwide. It was in this climate and with this history that the Albemarle County statue was removed.

Albemarle County's Confederate statue was located in front of the county courthouse, which is located on county land in downtown Charlottesville. The statue was dedicated in 1909 as the "Johnny Rebel" or *At Ready* statue, paid for

by the county with some contributions from the United Daughters of the Confederacy and citizens of the county. The county Board of Supervisors voted in August 2020 to remove the statue, becoming the first locality in the area to remove its Confederate statue. A time capsule was buried underneath the bottom pedestal of the statue, and the director of Equity and Inclusion for the county first reached out to UVA Library to understand what condition the time capsule could be in and then later asked if the library would be interested in acquiring the time capsule.

TIME CAPSULES: MATERIALS AND IMPACT

Historically, time capsules often have an outer structure made of a sturdy material (e.g., metal or stone) that is buried underground, such as that underneath the Robert E. Lee monument in Raleigh, North Carolina, which was unearthed in July 2020. They can also be enclosed in a component of a building or monument, such as the time capsule within a granite sphere on the Salt Lake City Mormon Temple or within a marble cornerstone under Charleston's John C. Calhoun monument. Time capsules commemorate a specific event, such as the erection of a building or monument, or the turn of the century, or of a specific person. Their contents are selected by specific communities or organizations responsible for the special event, monument, or building.

Time capsules can often be found underneath Confederate monuments erected in the 1910s and 1920s as part of the southern "Lost Cause" campaign because the burial of a time capsule was used as a fundraising event for the statue itself (note 1). The burial of the *At Ready* time capsule was well attended and well documented, complete with an article in the local paper about the contents that were put inside it. This curated collection of documents and artifacts celebrated veterans of the Confederate cause and the Confederacy. Those who originally buried it under tons of concrete never intended for it to see the light of day again: they placed the last pedestal over the hole with the time capsule, where they said it would stay until "time shall be no more" (Revelation 10:6, as quoted in *The*

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Daily Progress, March 15, 1909) (note 2). In this way, the people who erected the statue entombed and sought to protect their view of history to the detriment of voices of color in Albemarle County and the surrounding area.

Time capsules can be quite problematic, especially ones that are buried underneath monuments. The weight of monuments can crush time capsules, allowing water to infiltrate and devastate the contents. Images published online after opening Raleigh's time capsule showed a wooden box that had been salvaged with only a mass of sludge that had once been paper visible in the background. Only small pieces of text could be identified amidst the debris. Unfortunately, this image was foreshadowing for the condition of the *At Ready* time capsule. At the same time, giving the author hope, a time capsule had been unearthed from Arlington National Cemetery in May 2020 with its contents intact, although the Arlington time capsule with its double-walled copper enclosure did not have much in common with the *At Ready* time capsule.

In a list printed in the local newspaper *The Daily Progress* in 1909, the *At Ready* time capsule contents were primarily paper-based documents such as membership rosters and histories of UVA, Charlottesville, and the area. One silk ribbon and one zinc commemorative badge were listed as well. With the knowledge that any water infiltration could lead to mold growth and result in severe damage to the paper within, it was important to Albemarle County to have someone to whom they could bring the time capsule after removal to assess damage and stabilize if necessary. Removing the time capsule safely and having a place for it to be assessed were important steps to facilitate the removal of the *At Ready*/"Johnny Reb" statue.

Work at the UVA Library conservation lab has included stabilizing items from the Unite the Right rallies in 2017 and creating a housing for a burned cross from the 1960s, so dealing with materials with harmful histories was lamentably familiar. Yet accepting to assess and stabilize the *At Ready* time capsule represented the opportunity to act as a stakeholder in the community while contributing expertise as a conservator. Facilitating the removal of a racist statue would help reduce the everyday trauma that Black citizens feel in Charlottesville. And in so doing, the evidence of that harmful history would be preserved, safeguarding it so that it would not be repeated or denied.

SALVAGE OF THE *AT READY* TIME CAPSULE

On the day of the statue's removal, thousands of pounds of granite stacked in layers were lifted away carefully until only the cement of the foundation remained. As indicated in the 1909 *Daily Progress* article, the time capsule was indeed located underneath the bottom pedestal, but it was in a condition no one could have anticipated. A hole roughly 12 in. square had been carved out or molded in the cement to fit the

dimensions of the time capsule, and it was completely inundated with water. Adding to the horror, when the last pedestal was removed, large bugs that looked like cockroaches scurried out from the hole. Members of the Albemarle County crew bailed water out of the hole with a disposable coffee cup, all they had on hand, to try to locate the time capsule.

It seemed that the concrete had expanded over time, pressing in on the sides of the thin copper box, causing the lead solder to fail and the box lid to pop off. This meant that the time capsule had most likely been soaking in groundwater since slightly after the box was interred in 1909. As the water level rose, the contents of the time capsule became bathed in what the Virginia State Archaeological Conservator described as an "acidic soup." Because of the type of cement and the amount of expansion, it required more than an hour of careful jackhammering to free the time capsule from the hole.

When the box had been removed and taken to the UVA Library conservation lab, it was clear that the contents had been submerged in water for a long time. The acidic water had stripped the outer layers of metal, leaving the sides of the box orange and shiny, whereas areas above the water line were a dull greenish-brown (fig. 1). Similarly, when the commemorative badges were excavated, the metal was shiny and bright, not at all what would be expected from metal obtained from an archaeological context. Upon exposure to air for the first time in more than a century, however, the brilliance of the metal quickly tarnished (fig. 2).

The textiles within the time capsule were also intact, although the small flag (unlisted in the contents) that was at the bottom of the box was heavily stained, and only the faintest colors were discernible. This and a silk ribbon were in relatively stable condition, with the copper of the box and the lack of oxygen in the time capsule perhaps having contributed to their preservation.

In contrast to the metal objects and the textiles, the paper-based items did not fare as well. The 20th-century wood pulp paper simply did not have the structural integrity to withstand more than a century of immersion in dirty, acidic water. There was extensive damage to the edges of the stacks of paper, and once-distinct books or pamphlets were practically fused together (fig. 3). Everything felt soft to the touch—like the bottom of a lake. Microspatulas and dental tools had to be inserted into a pile of degraded paper without the tactile information generally available when performing a wet treatment on paper. Strips of nonwoven polyester and the capillary action of the wet pages could be used, however, to peel sections apart and reveal the less-damaged text in the middle of the piles. This allowed the curator present to identify the work based on the list of contents from the local newspaper (fig. 4).

In addition to the need to separate pages, there was the pressure of triaging the more at-risk objects within the time



Fig. 1. The *At Ready* time capsule upon its arrival at the conservation lab. Courtesy of Nicole Royal.

capsule. After being in a wet, acidic, and anoxic microclimate for 111 years, a patina formed on the metal of the artifacts in a relatively short amount of time. And the image of the University chapel in the postcard photograph turned cloudy and dull upon drying. This meant that it was important to focus on what needed to be pulled apart while still wet and pliable, in addition to trying to match pages to a contents list (fig. 5).

Soon after salvage began, it was clear that working on this Confederate time capsule was a lot like salvaging items from a disaster. It smelled horrendous, go-to techniques in a normal lab setting were not feasible, expertise of conservation staff was stretched thin, everyone wanted to know what was inside, and there was the strain of the content and context of the material being salvaged. Other conservators working on time capsules from Confederate monuments have spoken of having to work on an extremely short timeline because of the sensitivity around removing monuments. Although there was no secrecy around the removal of the *At Ready* statue, UVA Library's involvement was announced during the livestream of the removal, and the history of the riots in Charlottesville and racial tensions added another strain to the process.



Fig. 2. Image of a copper medal as it was revealed inside the time capsule. The metal is bright, in contrast to the surrounding gray pulp of the paper.

Factors in the Decision to Stop Salvage

When everything had been removed from the copper box and the extent of the damage was fully revealed, it became clear that the majority of the paper-based objects were unsalvageable. Together with the director of Equity and Inclusion from the county and the UVA Library curator of 20th-century materials, conservation staff decided to separate pages to allow for identification of the book it was from, photodocument the revealed page or spread, and then stop. A staff member who is a freelance photographer came into the lab to help with this documentation.

With the extremely poor condition of the paper, individual sheets could not be separated without extreme focus and a lot of time. Considering that the author is the only book and paper conservator at UVA Library, there were simply not enough staff members or resources to peel apart thousands of pieces of paper that no longer had any structure. Furthermore, being print materials in an area that UVA actively collects, copies of most of the works already existed in the Special Collections, so peeling apart pages would not have provided new insight. The physical condition of the items in the time capsule was the insight that the curator found the most important, and that was being documented.



Fig. 3. The paper-based items in the time capsule had been soaking in acidic water. Although they retained vestiges of their original shape, the paper was soft and mushy, having lost all structure. Courtesy of Nicole Royal.



Fig. 4. Some pages that were thicker, or of a better quality, could be peeled away in sections. Courtesy of Eze Amos.



Fig. 5. A picture postcard of the UVA chapel. On the left, immediately after the postcard had been removed from the time capsule. On the right, after the postcard had dried. Courtesy of Eze Amos.

The health of all involved in the salvage was also a factor in limiting the intervention time on the paper-based items. Because this was happening during the COVID-19 pandemic, everyone in the lab that day was wearing cloth masks. At first the masks were effective in blocking the smell, but it became so overpowering that despite the fume extractor running, both conservation staff members had to put on respirators halfway through the day. After hours leaning over a table of muck, the smell was nauseating.

Finally, the Albert and Shirley Small Special Collections Library has made a commitment to dismantling white supremacy in the archives and uplifting marginalized voices, and in 2020 the conservator added reparative conservation as one of the highest priorities for treatment. This was another important reason to restructure the salvage approach to one of documentation.

In the midst of these very real and powerful reasons to stop, there was also a paradoxical push to keep going. This was likely due in part to conservation training, as well as to self-doubt experienced by the conservator and the fear of judgment from the profession or from the community for doing too much or too little (fig. 6).

AFTER THE SALVAGE

All things considered, the number of items recovered from the metal box was surprising, given the conditions in the hole. The metal and textile items are currently being kept in housing that aims to achieve appropriate humidity conditions until they can be transferred to Special Collections, and the copper box will receive treatment from a partner agency. The photodocumentation taken during the salvage will become part of the record for the time capsule, and recent 3D scanning of the bullets and badges will also provide important



Fig. 6. The contents of the time capsule, laid out in the artifact sink. Courtesy of Nicole Royal.

data. Paper that was peeled off into thin sections was laid to dry on the drying rack in the lab, and a few thicker sections were sent to be frozen in the department's freezer.

The goal for these items is that they will be accessible for community members to research and observe. The Nau Center for Civil War History at UVA teaches such classes as “Civil War in Myth and Memory,” for which the time capsule would be an excellent artifact to consider in terms of how citizens in the area constructed the Lost Cause narrative. Furthermore, discussions around why citizens did not want the time capsule opened, and what it means that it was brought to light, would engage students in productive discussions about myth, memory, and harmful histories.

Removing the statue and time capsule but preserving the harmful history serves not only as evidence of the past in the hopes of not repeating its atrocities but also lays down the framework to rebuild, metaphorically and literally. Once the cement had been removed and the earth leveled, a layer of straw and grass was laid down. This marked a meaningful step forward, as people can now walk into their courthouse

without passing by a monumental intimidation tactic. But work must continue (fig. 7).

Community

From the beginning of the author’s involvement with the time capsule, there was an incredible amount of anxiety over how the community would respond and over the lack of engagement from administration about the impact of the time capsule. Additionally, there was an embargo on communication since Albemarle County retained official ownership of the time capsule until a Board of Supervisors meeting held in November 2020. Upon lifting the embargo after the board meeting, articles and photos in local coverage gave the impression that salvage was ongoing, two months after it had actually stopped. The inconsistency was addressed at a library collections meeting to assure colleagues that salvage efforts had only taken one day, but Black committee members voiced



Fig. 7. The Albemarle County Courthouse after the statue was removed. Straw and grass were laid down, symbolizing healing and renewal. Courtesy of Kristin Jensen.

their dismay at how it had been presented in the media, and they reported sentiments of betrayal and continued distrust of UVA in the local community.

To counter the discrepancy and to describe the actions that Special Collections, the Preservation Department, and the Nau Center for Civil War History were taking and why it is important to preserve objects that evoke harmful histories, members of these three entities, with Albemarle County's approval and encouragement, gave a virtual presentation to the community in January 2021. When outlining the approach for the January 2021 presentation to administration, the author was told she had a "unique way of complicating things." Although this is no doubt true, explaining one's position and anticipating questions or concerns seems like an overcomplication that is worth committing to. And since one's level of engagement will not always be the same as the administration's, the author recognized with this experience the need to be vocal about the anticipated physical and emotional impact on colleagues, community, and conservation staff, as well as about the duration of a treatment on an item with a harmful history. Preserving the time capsule helps tell the whole dirty, complicated story of Charlottesville and Albemarle County, but it was also important to preserve the author's time to work on items that amplify Black voices and experiences, such as the Jessie Fuller scrapbook (note 3). One of the most poignant lessons learned during this was how necessary it is to share decisions, in as timely a manner as possible, when it comes to items with harmful histories.

Thirty-five people attended the presentation live on Zoom, and the video had been viewed 125 times as of late April 2021. Although the COVID-19 pandemic reduced opportunities to actively engage with community members, the ability to record such presentations does help with access, and there is hope that the people interested in knowing about the time capsule can still find out about the library's preservation efforts through this recording.

CONSERVATOR AND STAKEHOLDER

Conservators treat and observe the physical qualities of objects in their care, but they are also keenly aware of objects' stories. In his talk "Conservation Is Not Neutral," Fletcher Durant states, "It is our job as conservators, in consultation with curators and owners and stakeholders, to decide which stories we want our objects to tell. Some stories are simpler than others" (Durant 2020, p. 5). The *At Ready* time capsule salvage experience illustrates the nuance of feelings a conservator might feel in such situations. The author/conservator felt deeply connected, in at points surprising ways, to the salvage, and it felt increasingly critical to speak about the salvage approach to curators, administration, and the community, especially in light of the internal and external pressures that were present. These pressures may be familiar to conservators

who have responded to disasters but were unanticipated for this circumstance. It was the desire to help others who may find themselves in the position of salvaging Confederate time capsules in the future that motivated the author to share and reflect on these experiences and hopefully encourage dialogue about the impact of preserving harmful histories and the role conservators can have in prioritizing conservation treatments.

Preserving the time capsule and its contents serves as evidence of some of humanity's darkest moments, as do the artifacts in museums dedicated to memorializing lives lost to genocide and other tragedies. People already deny the message behind the statues commemorating the Lost Cause, but this copper box of Confederate items is undeniable, and that is why preserving it is essential. After all, cultural heritage collections are filled with the worst and the best of humanity, and conservators are sometimes asked to treat both.

It is not enough to simply do the preserving, however. It is vital to recognize what preserving can mean to a community and to acknowledge the inherent complexities of local history. The trajectory of the *At Ready* statue is harmful and ugly, representing immensely painful rhetoric, beliefs, injustices, and deaths. Nevertheless, the same community that erected the *At Ready* statue voted to take it down 111 years later, so the time capsule's physical presence above ground also reflects the power of communities and the power of change. Adding to that complication, UVA struggles with the weight of 200 years of prejudice and racism, and the optics of the author, a white woman, preserving a Confederate time capsule as a University employee is understandably difficult to accept as any form of progress. But the time capsule's removal from that foundation allowed a place tainted with hatred and oppression to be returned to a site of justice, and while putting a Confederate time capsule in the archives might not look like progress right now, the fact that it saw light of day at all is momentum in the right direction.

Providing appropriate context to items with harmful histories can help continue this momentum. Museums and libraries can protect and be aware of the importance of preserving items with harmful histories without endorsing what the items represent, but this has to be specific and intentional. UVA Library can preserve the time capsule as evidence *and* focus on reparative work in the archives and reparative conservation in the lab. These are not contradictory actions but different parts of the same effort to preserve history and evidence for the future. Similarly, the traits and training of good conservators also makes them good advocates and can help their colleagues and communities make important decisions. The author's privilege of being a white woman employed at a university and specifically in a library that is trying to dismantle white supremacy carries a responsibility to continue complicating things in her unique way, and to be an active advocate for reparative work. Thus, in talking about and prioritizing reparative work, it is possible to fill the roles of both conservator and stakeholder, despite the professional pull to stay "neutral."

UPDATE

Following a change in state law in July 2020 and a Virginia Supreme Court ruling in April 2021, the Charlottesville City Council finally voted in June 2021 to remove the statues of Robert E. Lee and Stonewall Jackson. What started as a petition by Zyahna Bryant, then a teenager in high school, came to fruition on July 10 and 11, 2021, when these two Confederate statues, along with two other statues depicting violence against indigenous people in the city were removed, including a statue on UVA Grounds. Countless people in Charlottesville and all over the world woke up on July 12, one month before the four-year anniversary of the death of Heather Heyer, with more hope that movement on the path to progress and dismantling white supremacy will continue.

ACKNOWLEDGMENTS

The author would like to thank the conservators who have shared their experiences working with Confederate materials but who asked to remain anonymous. The author would also like to thank the members of SERCA who provided a safe and encouraging space for the first iteration of this presentation, and the Small Special Collections Library staff and the Albemarle County team who were so professional and helpful. Thank you, Zyahna. Thank you, Heather.

NOTES

1. After a phone conversation with Dr. Sarah Beetham, an expert on Civil War monuments and memorials.
2. Curator Christina Keyser Vida of the Valentine Museum in Richmond and State Archaeological Conservator Kate Ridgway of the Virginia Department of Historic Resources observed in December 2021 that boxes placed under Confederate monuments would be better described as “cornerstone boxes” since they predate the notion of time capsules and had no anticipated date of opening.
3. “The Jessie Fuller Scrapbook: Balancing Access and Context in the Treatment of an Important Black Sorority Scrapbook from 1949 with a Unique but Damaging Structure.” Presented with Krystal Appiah at the 2021 AIC Annual Meeting, June 15, 2021.

REFERENCE

Durant, Fletcher. 2020. “Conservation Is Not Neutral.” *Icon* 2020. <https://ufdc.ufl.edu/IR00010800/00001>.

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Leather Selection and Use: A Panel Discussion on the Impact of Conservators' Choices

INTRODUCTION

The Leather Discussion Group (LDG) was initially formed in 2016 by the four authors of this article, all book conservators, who seek to acquire a better understanding of leather and leather dyes used in conservation. Today, the LDG is working with experts in fields such as zooarchaeology, tanning, and scientific analysis. Ongoing conversations with these experts, conservation colleagues across disciplines, and other leather users continue to provide valuable feedback to move the research forward.

PROJECT BACKGROUND

The LDG goal is to identify factors that contribute to good quality leather and to evaluate currently available conservation leathers. Over time, there have been many changes to leather production and use. Some known problems have been remedied through advances in the production process. Are there still contributing factors that would reduce leather's longevity that conservators are not aware of?

The group has surveyed conservators and tanners regarding their observations on leather. According to the survey results, leather use in modern conservation appears to be declining. Why? And is the decline in use likely to reverse itself? Perhaps it is due to a lack of trust in the material, a shift in conservation philosophy, a lack of training in working with leather, or even due to personal ethics.

The group is in regular communication with several of the primary producers of leather for conservation. From their

experience, the tanners are interested in working with conservators to achieve a quality product that is suitable for our needs.

To make research results accessible, the LDG is working with information technology experts at the National Library of Medicine (NLM) to combine historic and modern data into an online, geospatial resource to demonstrate trends in leather production that link use, availability, and quality over the centuries.

Many leather research projects have preceded this one, and the group is summarizing them on the AIC wiki. There are many avenues to consider when assessing leather's longevity, and this warranted research into changes in animal husbandry to determine the effects the mechanization and chemical changes in the tanning and finishing industries may have had on leather quality. Additionally, the group has a collection of discarded leather covered book boards that span several centuries and has partnered with the Smithsonian Museum Conservation Institute (MCI) to conduct a series of tests on them.

The group's current focus is on evaluating the relationship between the tanning process and leather's microbiome. Mr. Jesse Meyer, of Pergamena Parchments & Leathers Incorporated, is collaborating with the LDG to tan several locally sourced hides with known diets using both modern drum and traditional pit tanning methods. At every stage in the process, he is taking samples for analysis. Dr. Laura Weyrich, at the Pennsylvania State University Ancient DNA Laboratory, will then evaluate the microbial characteristics of the samples at different stages in the tanning process. Other Penn State labs will be analyzing the isotopes present to help with diet characterization of unknown leathers.

THE 2021 AIC PRE-SESSION PANEL DISCUSSION

The LDG hosted this panel discussion during the pre-conference session of the virtual 2021 AIC annual meeting. The panelists consisted of conservators across disciplines, other leather users, tanners, and scientists who focus on leather

This panel discussion took place *virtually* on May 5, 2021, during AIC's 49th annual meeting. The panel discussion organizers planned and led the discussion and recorded notes. Readers are reminded that the panel discussion organizers 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.

research. Katharine Wagner moderated the overall panel, and Kristi Wright moderated the discussion portions.

The panelists were grouped into three sections: leather users, tanners, and researchers. Each panelist gave a short presentation, and each section had a dedicated discussion portion for those panelists. At the end of the three sections, an overall discussion took place between the panelists.

SUMMARY OF PANEL 1: LEATHER USERS

The panel started with short presentations from a range of leather users in multiple disciplines. Many panelists currently use leather for projects that require its aesthetic and mechanical properties. These panelists prefer to use leather because of the way it can be molded over irregular surfaces, and because it is a traditional material. Some panelists discussed the use of alternate materials such as spunbond polyester or synthetic textured fills. One panelist prefers alternate materials over leather. There was discussion about the need for additional training and a lack of demand for leather use from curators or clients. All panelists agreed that there are some situations where leather is the only suitable material. Attendees surveyed throughout the panel corroborated the panelists' experiences, stating that more leather training, assurances of leather quality, and greater demand for leather use in treatment is needed to ensure the future use of leather in conservation.

WILLIAM MINTER

LDG member and book conservator William "Bill" Minter was the first panelist in this section. Mr. Minter started his book conservation practice in 1978 after a formal apprenticeship and has been using leather for many years. He is currently the senior book conservator at Pennsylvania State University Libraries. He emphasized how book and paper conservators have examined paper and all its nuances, but have not done the same with leather. Rather, conservators examine it and choose it for its aesthetic properties and perhaps thickness, leaving quality to the reputation of the tanner. Conservators rely on tanners for quality assurances but can see that this was not the case 100 years ago. How and what do conservators know about today's leather? More than 100 years ago, T.J. Cobden-Sanderson tasted his leather to test it for acidity, and this seemed to have satisfactory results. What can conservators take away from the taste test?

Some earlier binders tested leather in a door hinge to determine its longevity, and Mr. Minter once replicated that earlier experiment (fig. 1). He also discussed the PIRA test and its rejection in the 1970s, stating that conservators need to know if today's leather will last as long as the leather from earlier centuries, and need a reliable test for today's leather.

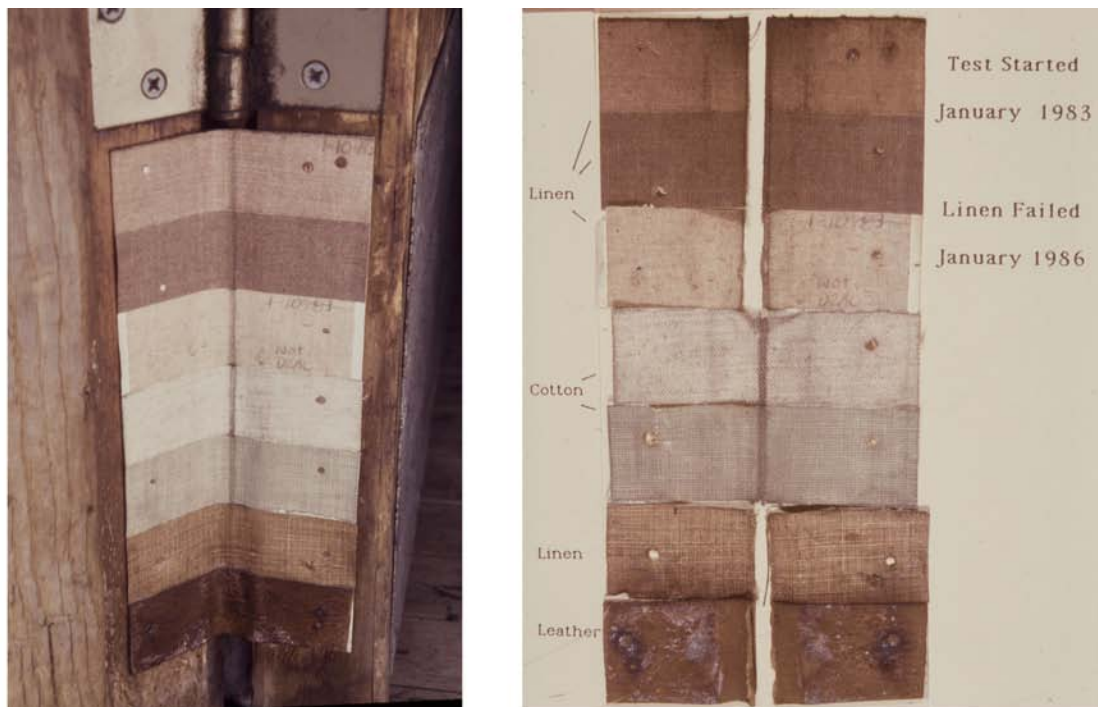


Fig. 1. Bill Minter, an example of testing leather in a door hinge.

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PATRICIA ENGEL
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CONSERVATION-RESTORATION RESEARCH IDEAS

Patricia Engel is a senior researcher at Donau University in Krems, Austria, and currently heads the European Research Centre for Book and Paper Conservation-Restoration. Dr. Engel gave an overview of the European Research Centre (ERC) and discussed two leather research ideas. She also provided a wealth of resources to help conservators interested in accessing the most recent research.

The ERC is 11 years old and has approximately 50 volunteers, all being highly educated conservators or scholars in their fields. Research results are disseminated, through the ERC website, to those who preserve cultural heritage and representatives in 40 states. The webpage has many resources, including publications and periodicals and lists of upcoming conferences and courses. Everyone is invited to submit papers for publication to *Conservation Update*, the peer-reviewed periodical of the ERC. Dr. René Larsen, who spoke later in the panel, is one of the founders of ERC and a board member.

Dr. Engel discussed *MuLiBiNe*, a multilingual bibliographic database that searches more than 100 periodicals on conservation literature. One can access any article's abstract via keywords and reach the full article via a long-distance loan (interlibrary loan).

Dr. Engel has been working with leather for many years and presented two research ideas based on her observations and experience. The first is to create a comprehensive survey of leather used on Armenian manuscripts. Dr. Engel's second idea is to compile a history of leather conservation. She has already started a history of parchment conservation, but leather conservation still needs to be done. She is looking for project funding for these two projects, which it is difficult when both U.S. and European researchers are involved. Perhaps a group effort is needed?

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LARA KAPLAN
USING MODERN LEATHER IN CONSERVATION TREATMENTS:
AN OBJECT CONSERVATOR'S
PERSPECTIVE

Lara Kaplan is an objects conservator at the Winterthur Museum and is an affiliated assistant professor at Winterthur/University of Delaware Art Conservation Program, where she currently teaches the conservation of organic materials. Ms. Kaplan does not often use leather in her practice, in part because of deterioration concerns. She also finds that using other materials works equally well, if not better, in most of her treatments. Not using leather regularly also means that she does not have a ready stash of suitable repair leathers, leatherworking tools, or the highly honed leathercraft skills that would be necessary to use the material in a nuanced way. Despite this, she does feel that modern leather has a place in conservation treatments and is sometimes the best choice for the situation.

Ms. Kaplan gave two examples of times she has used leather in her practice. The first was a hair on hide drum head, where more hair on hide leather was the only material that gave a satisfactory visual match to fill losses. In the second, she used leather to replicate missing parts, in this case the ears from a rope-tension drum, because leather was simpler, faster, and gave good results.

When choosing materials for treatments, Ms. Kaplan is guided by her experience and collaboration with her colleagues at Winterthur, where she co-teaches much of the leather content with Dr. Melissa Tedone. She provided a range of materials that she uses in lieu of leather, making sure they are compatible with leather both visually and chemically, versatile enough to be both structural and aesthetic, and can be easily reversed (fig. 2).

A "go-to" option for her is solvent reactivated Lascaux 498 HV on Asian paper for mending tears. She finds it neat, quick, adaptable, and effective. It both blends in and works well on surfaces that are hard to reach or clamp. Ms. Kaplan has been experimenting with synthetic textured fills using silicone molds and acrylic media. She finds the process engaging and effective, and is interested in seeing how the fills age.

Repair Materials for Skin and Leather		
Backings	Adhesives	Application Methods
Asian papers	PVA emulsion (e.g. Jade 403)	Direct
Spunbond synthetics (Hollytex, Cerex, etc.)	PVA emulsion + methyl cellulose or wheat starch paste	Solvent reactivated (vapor, liquid)
Goldbeater's skin	Lascaux 498HV,	Heat reactivated
Synthetic suede (e.g. Ultrasuede)	Lascaux 303HV	
Hard Tyvek	BEVA film, stock solution, gel	
Synthetic textured fills		

Fig. 2. Lara Kaplan, repair materials for skin and leather.

In summary, Ms. Kaplan finds that the more tools conservators have accessible, whether leather or not, the better, as every treatment is different and needs to be approached with its specific needs in mind.

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ROSIE BOLTON

Rosie Bolton is the studio manager at the Leather Conservation Centre (LCC) in Northampton, UK. She treats a wide range of leather objects from historic books, furniture, armors, and modern supercar interiors for clients including museums, libraries, and historic houses.

For many objects, Ms. Bolton chooses to use Japanese paper or nonwoven textiles in lieu of leather. She uses these in combination with acrylic paints and mediums, BEVA 371, BEVA film, SC6000, acrylic polymers, wax mixes, klucels, wheat paste, and polyvinyl acetate (PVA).

Some objects, such as car upholstery and furniture, require “heavy-duty repairs” to ensure continued functionality. These repairs often need to be leather patches. Leather is also sometimes the best material to use because of a particular mechanical property it can impart. For example, a tied repair on a leather screen needed a repair using new leather due to the leather’s impermeability. Adding a nonpermeable material as a laminate with a nonwoven material in this case could have inhibited the desired qualities and made the treatment more difficult.

When selecting leather, Ms. Bolton takes care to match the type of repair leather to the original leather. For example, for a vegetable-tanned leather object, she would use an unfinished vegetable-tanned leather and finish it herself to match the original object using the same paints, polymers, or coatings that would be applied to nonleather materials. She also noted the importance of having a range of leathers, as this allows her to find a suitable match for any treatment.

When considering longevity, Ms. Bolton referenced leather research indicating that adding aluminum in the tanning process helps to buffer the pH, thereby improving the leather’s archival properties. More generally, she prefers to use leathers with hydrolyzable tannins, such as sumac or oak bark.

Ms. Bolton pointed out that selecting leather is more complicated today since a skin is often initially tanned in the country of the animal’s origin, generally using mimosa (a condensed, less stable tannin) to preserve the skin for shipping. She expressed concerns that even after stripping the original tanning agent, fibers are ultimately still tanned using

the original, typically condensed, tannins. Thus, the sumac or oak bark on these skins is just imparting the final characteristics, not imparting the longevity that is needed in the conservation field.

Other characteristics Ms. Bolton looks for when selecting leather for a treatment are species, surface texture, and handle. She takes care to match the original leather to ensure compatibility both from movement and environmental fluctuations. She also considers which part of the skin to use for the treatment based on what the treatment needs. Stronger treatment needs require the strength from spine leather, whereas more flexible ones might be better taken from the belly area.

For repairs requiring a heavy modern finish, Ms. Bolton does not try to find a leather prefinished to match it. Rather, she will re-create the finish herself on unfinished vegetable-tanned leather using a selection of the adhesives and finishes already described.

She will avoid leathers with unknown tannages or provenance, newer experimental tannages, or those with no known results from aging tests. She also avoids leathers with modern polyurethane finishes because they are unstable and will harden and crack as the plasticizers evaporate.

Ms. Bolton tries to retain knowledge about leathers she has on hand and includes this information in treatment reports. It is also useful to maintain good relationships with nearby tanners and industry experts, which helps ensure that she is considering factors from all angles when choosing leather for repairs.

Ms. Bolton discussed specific treatment techniques such as patching losses from the verso, where she pares the edges of leather to ensure no stray edges that might show through. She also sometimes patches from the recto if access is poor, or if this is necessary for aesthetic purposes. This works best with a more textured leather, such as goat, and requires paring the edges very thinly and then sometimes using pigmented BEVA 371 to secure them and prevent catching.

Alum tawed and oil tanned leathers also have a place in Ms. Bolton’s practice. Although she will sometimes use Asian papers for these repairs, she occasionally uses traditionally tawed or tanned leathers to pair “like-with-like.” Which repair method to use depends on the context of the object and client requirements. With these treatments, she is more confident that the tannages are stable, and that conservators understand the aging properties. Pre-Industrial Era vegetable tanning fits into this category as well, although the modern processes introduce more uncertainty and require caution.

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LEROY GRAVES

Leroy Graves is the senior upholstery conservator for the Colonial Williamsburg Foundation, where he has been employed for 53 years. He is a pioneer in the field of early American upholstery and devised and implemented a nonintrusive system now known as the “Graves approach.”

Mr. Graves works with leather frequently and uses modern leather in his practice in several ways. Most often, he uses it to create reproductions and sometimes uses it to repair historic leather. Upholstery tends to have large sections covered in leather. In some situations, these sections are larger than available hides, so several hides must be stitched together from the underside using a linen support.

Upholstery leather has many of the same issues seen on books and other objects. Cracking, flaking, and red-rot have been observed. Mr. Graves has consolidated and filled losses using layers of toned or painted Japanese paper in the past, but in recent years has chosen instead to add a protective layer in the form of a nylon net slipcover to deter further damage.

When necessary, he will fill losses and large tears using modern leather. An example of this is Lord Dunmore’s side chair from the late 1700s, which had a large loss in the middle of the seat (fig. 3). Modern leather was toned and manipulated to match the historic leather and applied to the underside of the original leather. In this case, Mr. Graves chose to use

buffalo hide because of its rigidity, which matched the project’s needs. Mr. Graves’ treatments focus on retaining the historic materials in their original locations, so the leather being repaired remain in situ whenever possible.

Mr. Graves most often creates reproduction seat covers using modern leather. One example he showed during the panel included a 1790 side chair with original under upholstery. Mr. Graves used the technique he devised to create a nonintrusive cover for the original chair using modern leather. The new cover fits perfectly over the original frame. He pares leather using a razor blade. Paring focuses on the areas that must be folded, such as the corners, and most of the leather is left at its original thickness.

Many of the reproduction objects at Colonial Williamsburg are also accessioned objects that are used and handled by guests. Thus, the lab also repairs these reproductions when needed. Modern leather is chosen for these repairs when the situation requires it.

Modern leather is selected based on its durability and how well it matches the project needs. Heated rollers are used for impressing patterns; skivers, razors, and knives are used for paring; and spirit-based Orasol dyes mixed with ethanol and acetone are used for toning. The lab prefers to purchase leather pre-dyed for overall reproductions, but for patches the leather is purchased undyed and toned in-house. To obtain an ideal aesthetic match for original leather, the new leather may be heated and “worn” to visually age it.



Fig. 3. Leroy Graves, Dunmore side chair with leather repair.

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SUMMARY OF PANEL 2: TANNERS

The tanners on the panel demonstrated their approaches to leather manufacture. Three of the four presenting groups specialize in leather marketed for conservation use. The fourth specializes in producing accurate leather using pre-historic tanning methods. This provided both modern and traditional perspectives. The tanners discussed hide sources, tannin selection, and process determination. As with so many of our suppliers, today's specialist conservation tanners are working within an industry with suppliers that market products to much larger producers for economic purposes, making it difficult to fully return to traditional production methods. However, they are all open to discussions with conservators and scientists and are actively working to meet conservators' needs from both a workability standpoint and longevity.

STEVEN SIEGEL AND ERIC THEM MEN SULFUR- AND METAL-FREE FULL VEGETABLE-TANNED AND SUSTAINABLE CALF LEATHER FOR BOOKBINDING AND RESTORATION

Steven Siegel has been in his family's leather business since childhood, and Eric Themmen is a tanning specialist and export manager with Gruppo Biokimica in Italy. Mr. Siegel and Mr. Themmen gave a joint presentation on a new product, Sulfur Free Calf, which they are developing in collaboration with Dr. René Larsen who spoke later in the panel (fig. 4). Siegel Leather is dedicated to producing a historically accurate chemical representation of bookbinding leather and aims to find a long-lasting solution to the deteriorating bookbinding leather of the past couple of centuries.

The new product is a sulfur- and metal-free 100% vegetable-tanned calf leather, which they started producing a few years ago and continue to develop. The substances used in producing the leather are all naturally occurring (except the fungicide) and sulfur free. Thus, there are no synthetic, sulfited, sulfated, or sulfonated oils or tanning agents. The substances that are used in the process were chosen to avoid potential oxidation, which would result in degradation.



Fig. 4. Steven Siegel and Eric Themmen, Sulfur Free Calf Project.

Mr. Themmen described the tanning process, pointing out that Sulfur Free Calf avoids typical unhairing chemicals, focusing on hair removal rather than hair destruction. It is a pyrogallol/hydrolysable vegetable-tanned leather with no grain manipulation. The skins are drum tanned. The end result is a leather with good organoleptic properties that tools well. The decision to avoid using certain materials is based on recommendations from mid-20th century research. The team classifies this leather as “theoretically archival” and durable long-term. They hesitate to apply the term *archival* to any leather, yet they believe this leather will last longer than any other vegetable-tanned leather currently available.

The team carried out a variety of tests on the completed leather, both fresh and after aging. These include quantitative analysis of organic sulfur, heavy metal analysis, dry fiber coherence assessment, tensile strength, tear load, distortion, and grain strength via ball burst, flex resistance, and the internal tropical test. The results of the latter are available on YouTube in a video titled *Tropical Testing Popular Bookbinding Leathers!* (note 1). The results from the tests showed that the leather’s sulfur content is below the detection limits and is completely metal free.

Determining what to use for this engineering project was difficult and complicated, requiring the team to expend a lot of time and resources. The project is deeply personal for Mr. Siegel, and he will continue to support it until it is complete. The end goal for the team is to make sure the science behind this leather is correct and results in the best product possible. This is an open-ended project, and the team is seeking collaborators and feedback.

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DAVID LANNING
GOING L4 LEATHER FOR AIC

David Lanning is the sales director for J. Hewit & Sons, a specialist tannery for bookbinding leather. He discussed sourcing hides, which varies by leather type depending on how the hide will be used. The hides are sourced from the Indian subcontinent, New Zealand, and Northern Europe. The leathers marketed for conservation are “naked,” meaning

they have no finish to the grain layer. To provide the skins without a finish, they source the best-quality skins possible, finding hides with few marks, holes, or blemishes. To select these skins, they have spent many years developing relationships with the hide suppliers, which ensures that Hewit is provided with the best-quality skins possible.

Skins are purchased in one of two ways. The first is pickled. For this, the hair is removed and the skins limed in their country of origin. They arrive at Hewit in a mild pickling solution that is not much different from that used for pickling vegetables. These skins can move directly into Hewit’s tanning process, which allows Hewit to retain complete control over the tannins and chemicals used (fig. 5). However, the skins are expensive to ship this way because they are wet and heavy. The other method is purchasing the skins native tanned. The initial tannins used in this method are condensed/catechol or synthetic and not ideal for bookbinding leather. The tannins are stripped out prior to retanning at Hewit. These skins are dry, easier to ship, and do not risk degrading during the shipping.

Tanning at Hewit is done using quality pyrogallol tannins such as sumac and tara, which yield leather that is stable and not prone to oxidation. Chestnut and synthetic tans may also be added in certain situations to impart a specific desired characteristic into the leather.

J. Hewit & Sons was an integral part of the CRAFT project conducted in the early 2000s. Their report on this project, titled “The Development of Archival Quality Leather” is published in the *Skin Deep* periodical and is also found as a direct download on their website (note 2). The CRAFT project was a pan-European consortium that included tanners, bookbinders, conservators, and scientists. The project built on the already established 1991 British Standard for archival bookbinding leather, as well as two other pan-European projects: the STEP and Environment projects. The CRAFT project goals were to develop an archival leather that retained the organoleptic properties and ease of use important to bookbinders and conservators. Additionally, it showed that the use of aluminum sulfate as a retanning agent improved leather’s longevity, a component that researchers had already shown to be effective prior to the establishment of the 1991 British Standard, which recommends it. As a result of this research, Hewit now adds aluminum sulphate to several of its archival tannages.

Hewit provides both undyed and dyed skins. The dyed skins are drum dyed and air-dried using water-soluble acid dyes. The actual recipes and concentrations of the dyes are tailored to the particular leather in question, as different concentrations and types of tannages require different combinations of dyes. When undyed leather is tanned using pyrogallol tannins, such as sumac and tara, it results in a creamy color. This leather is also strong and easy to manipulate. After dyeing, it is difficult to tell for certain how a



Fig. 5. David Lanning, pickled skins sorted, stacked, and ready for tanning.

leather was tanned. Hewit supplies leather unfinished (aniline) and with a casein finish, both which are suitable for tooling.

Mr. Lanning also addressed the thickness of the leather, indicating that the perception that a strong leather ought to be thick is not necessarily the truth. Rather, the more important factor is the ratio of grain to corium after the skin is shaved down to the substance that a conservator or bookbinder can use. This allows the leather to be “fit for its purpose.”

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JESSE MEYER

Jesse Meyer is the current owner and president of Pergamena Parchments & Leathers Incorporated. His family has been in the tanning business for more than 470 years, first in Europe and, since the early 1800s, in New York State. They specialize in leather and parchment for bookbinding and conservation, book and manuscript production, leather goods, and interior design.

Mr. Meyer is always researching methods and techniques to improve Pergamena’s leather and parchment offerings, keeping a focus on traditional processes while also trying to adapt to modern applications and aesthetics. He started working with the Guild of Bookworkers in the late 1990s and encourages feedback from leather users. Mr. Meyer emphasized that he utilizes both newer information from user feedback and research developments, as well as older information from traditional recipes and processes, to guide changes to his tanning process.

Pergamena uses mainly vegetable tannins for bookbinding leathers but also employs other tannins for different purposes such as leather goods and furniture. When considering leather, Mr. Meyer referenced Tolstoy, quoting “All happy families are alike, but every unhappy family is unhappy in its own way.” He extrapolated this to postulate that all leather that is good has “checked all the boxes” that make it good leather, but leather that is not good could be due to any number of issues that contributed to its poor quality at some stage of the process.

Pergamena selects hides from local sources to ensure they are well preserved. The tannery has a working relationship with local farmers and hunters, which helps ensure that the animals were well treated, humanely slaughtered, and expertly processed creating a hide free of cuts, holes, or

grain abrasions. The proximity of the hide sources allows them to receive hides raw and salt them quickly for initial preservation.

Salting the hides must be done properly, however. Receiving the hides in a raw or salted state also allows Mr. Meyer to see their true initial condition when choosing which ones to tan for which purposes. He showed an example of bugs present on a raw deerskin that was not initially processed correctly by the hunters. Although evidence of the bugs would not be seen after the tanning process, the damage they did before tanning could create problems later. Mr. Meyer showed another example of a pile of salted goat skins exhibiting “red-heat,” which demonstrated how salting is not an indefinite preservative for skins. In warmer weather, the salting effectiveness decreases and red-heat results, which is halophilic bacteria establishing itself on the hide. Red-heat can sometimes appear later as purple spots on the leather. To avoid this, Pergamena moves salted hides into the next phase of tanning as quickly as possible.

Pergamena uses both vegetable and synthetic tannins on leathers. However, Mr. Meyer emphasized that the company works with users to determine the preferred tannins, and this practice will continue. The vegetable tannins they use are pyrogallol, such as chestnut, and they formulate their tanning process to avoid catechol tannins entirely.

Mr. Meyer pointed out that they have started marking leather to make it possible to trace it back to its point of origin (fig. 6). This is especially useful for customers who wish to know more about the animal itself, such as where it was raised, why it was raised, and what it was fed.

The end goal for Pergamena is to make quality leathers that meet clients’ needs. They strive to maintain sustainability and traceability, and to make it archival.

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THERESA EMMERICH KAMPER

Theresa Emmerich Kamper has a PhD in experimental archaeology and more than 25 years of experience in prehistoric skin tanning. She researches, tans, and tailors skins in a traditional manner for replicas for museums, period-appropriate television clothing, reenactment items, and modern fashion commissions. She does a significant amount of research on archaeological leather, analyzing tannage, manufacturing methods, and end-of-life use characteristics. She uses this research to create a “biography” for the artifacts she studies. Dr. Emmerich Kamper also teaches hands-on

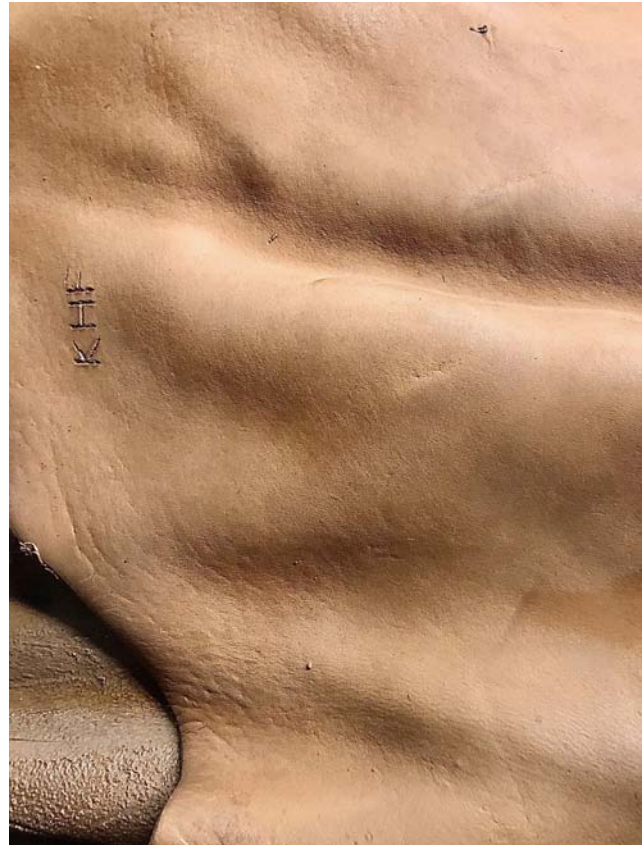


Fig. 6. Jesse Meyer, marking allows the leather to be traced back to its point of origin.

tanning courses and gives demonstrations for open-air museums (fig. 7).

Dr. Emmerich Kamper selects hides based on the time period of the artifact. This must take into account what types of animals were in the area at the time, either based on evidence of use or analysis results from DNA or proteomics studies. She matches the breed or variety from domesticated animals, selecting heritage breeds from the appropriate area. Because the time period starting around 10,000 BP has no extant evidence, Dr. Emmerich Kamper selects hides based on the type of animals likely present, the environment in the area during the time period, and the product’s end use.

Most of the skins are locally sourced in the UK. Some of the animals are sourced from other locations based on availability. For example, she receives reindeer from Finland and other fur-bearing species from North America via the fur harvesters’ association in Canada.

Although she does do some vegetable tanning, her primary focus is on rawhide or fat tanning because those were the primary processes used on prehistoric leathers. She aims to create a wide variety of qualities using a single tannage



Fig. 7. Theresa Emmerich Kamper, tanning and working leather using historic processes.

type to replicate what was available to the people originally implementing these processes. Her decision making is based on the extant qualities of the artifact, as well as the functional requirements for its use. As for durability, Dr. Emmerich Kamper emphasized that when one item wore out, the remaining good parts of the leather were recycled into another item. This means that parts of the leather might wear out, whereas other parts remained usable for future purposes.

She occasionally dyes leather but most often leaves it the color imparted by the tannin, which can be quite dark. This is partially due to a lack of archaeological evidence regarding dyes. However, there are ethnographic samples that demonstrate dye use. Therefore, the client has the option of a minimalist replica using only scientifically verifiable information or a dyed replica using colorants inferred from what would have been available at the time. In all cases, Dr. Emmerich Kamper only uses naturally available dyes that she collects herself. Some of these dyes are very colorfast because they contain tannins, which act as a mordant, like black walnut hull (brown), bracken fern root (yellow), and willow bark (pale brown or rose). Others contain no tannins, and some are more fugitive. Some examples include lichens (multiple colors), fungi (multiple colors), and cochineal (red), woad and other indigotin-containing plants (blue), and berry stains (pinks and purples).

Leather use in prehistory conveyed many things about the creator and owner, such as skill, status, identity, or wealth.

Leather was used to create functional items that ran the gamut of everyday life. Leather was not expected to last for generations; however, it was ideal for its initial purpose and reusable for patches or items requiring smaller pieces.

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SUMMARY OF PANEL 3: RESEARCHERS

Several leather experts presented their research, covering ancient DNA analysis, proteomics, fiber and sulfur analysis, and nanocellular analysis. Many of the research projects are ongoing, yet they did have recommendations for conservators to consider when treating, selecting, and storing leather.

They suggested that conservators use either the micro hot table (MHT) method or a fiber coherence test to assess the current state of leather deterioration. Nanoclays may help with consolidation. The use of sulfur, which is especially common in the dehairing process, may be detrimental to the longevity of the skin. The LDG is still assessing the impact of the microbiome on leather. Proteomics are useful for determining not only the type of skin but also some of the other proteins present from adhesives and consolidants.

LAURA WEYRICH

TRACING THE HISTORY OF BUGS IN OUR BOOKS

Laura Weyrich, director of the Ancient Biomolecules Research Laboratory and associate professor of anthropology at Pennsylvania State University, specializes in reconstructing ancient microbial communities, or microbiomes, present on humans, animals, and in the environment. Dr. Weyrich is a microbiologist by training and is enthusiastic about bacteria, fungi, virus, parasites, and other micro-organisms. She emphasized that the entire world, including human bodies, is completely coated in micro-organisms and everything has its own microbial signature, referred to as microbiota, which can be analyzed using metagenomics. Her talk challenged listeners to consider all of the microbes that might be living on the surface of our books. The microbiota of the book can lend information such as where the book has been, who handled it, what it is made from, whether it is breaking down, and its age (fig. 9). Ancient DNA analysis can help recover the information about the previous microbiome for a book. This technique has already been applied to archaeological leathers and to analyze how different tanning processes influence the recovery of ancient DNA. However, successfully recovering micro-organisms from ancient leathers has yet to be accomplished. Using these techniques on book-bindings can help us understand the sources of the leathers, as well as the sources of damages to the leathers.

Usually, microbes in leathers indicate degradation. Some of this degradation can be the result of bacteria on the leather before tanning, whereas degradation of leather after tanning is usually attributed to fungi. Dr. Weyrich hypothesized that this may be why different fungicides are used in various tanning processes. She also mentioned the red-heat that Mr. Meyer showed examples of earlier in the panel. The red-heat is attributable to halophilic bacteria, but thus far it is unknown what type of specific species contribute to this, let alone what they might actually be doing to the leathers.

Only one study so far has taken a metagenomic approach to this sort of analysis. That study demonstrated that different microbial communities are associated with damaged versus undamaged parchment. The study Dr. Weyrich is pursuing in conjunction with the LDG will take this approach to leather at different stages in the tanning process. It will use ancient DNA and different metagenomic approaches to identify the source of the leather, explore the method of tanning, and identify microbes associated with degradation. Using these approaches can help us understand different mechanisms behind deterioration and hopefully lend some insight into techniques to combat it in the preservation and conservation process.

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ELENA BADEA

THE POWER BEHIND MICRO-CALORIMETRY: ABOUT LEATHER MAKING AND ITS PRESERVATION OVER THE MILLENNIA

Elena Badea holds a PhD in engineering chemistry and is the project director for National Textiles and Leather in Bucharest, Romania, where she oversees the Advanced Research for Cultural Heritage (ARCH) Laboratory. She is also an associate professor for the Faculty of Sciences at the University of Craiova, where she teaches chemistry of materials and chemical thermodynamics. She is a specialist in advanced methodologies of the study of ancient and historic collagen-based materials.

The ARCH Research group Dr. Badea heads is doing research on both new and historic leathers and parchments. On historic materials, the team is looking at deterioration patterns and damage quantification, as well as leather consolidation materials and methods. They use a multitechnique approach that allows her team to examine all of the structures within parchment and leather. This approach looks at the formation of damaged intermediate states in parchment and the detanning of leather. This is done on several scales: from molecules to fibrils to solid materials. The leather consolidation research is geared at working with conservators to meet their specific needs.

On modern materials, they are examining and developing tanning and retanning agents, fillers, additives, and the changes to the processes when upscaled in industry. Often this encompasses upholstery, fashion, and automotive leathers and meeting sustainability requirements or a need to impart specific properties, such as hydrothermal highs and lows, to the leather. They also research hydrothermal stability, fire resistance, and hydrophobicity.

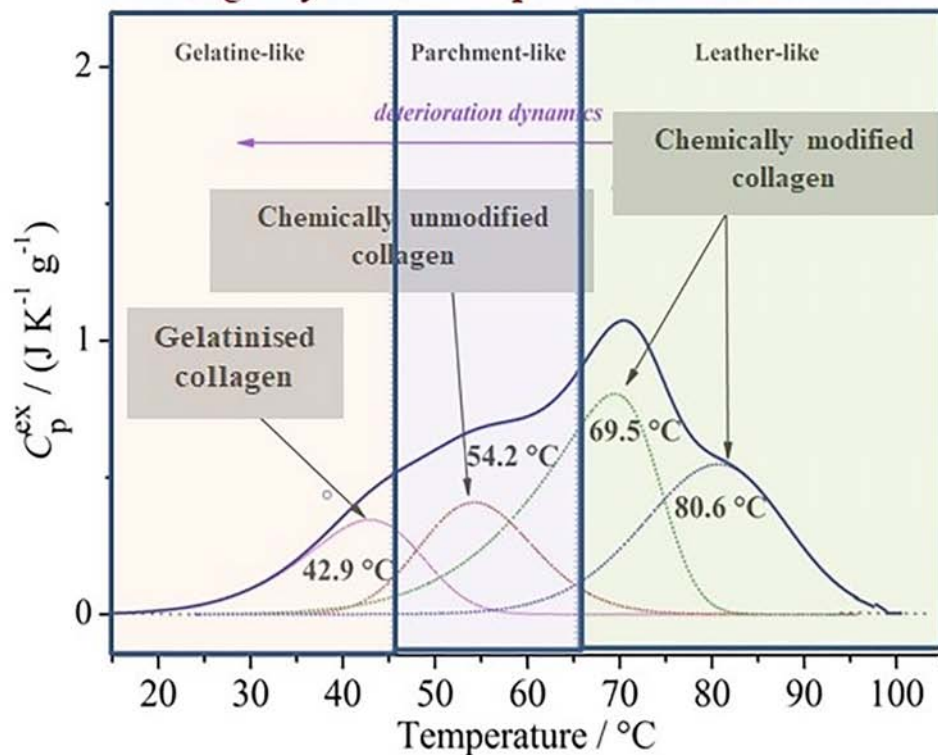
With a background in physical chemistry, much of her research implements techniques such as differential scanning calorimetry (DSC) on both the macro and micro scale (DSC and micro DSC). DSC is one of the best techniques for assessing the thermostability of proteins, which is a vital property for the longevity of either leather or parchment. It can be used in combination with other techniques, such as solid-state nuclear magnetic resonance (NMR). Optical microscopy in polarized UV and infrared, SEM, atomic force microscopy, and spectroscopy like Raman and FTIR that target the molecular fingerprint of collagen. Another technique extensively used, especially with historical samples, is the MHT method, which is a thermal microscopy widely used in the past several decades in conservation laboratories.

Dr. Badea suggested using the MHT method to test for the quality of leather in our conservation labs. It works nicely, is quite simple and inexpensive, and is backed by extensive research. It is best to consider the analysis of all shrinkage intervals and temperature and perform it jointly with other

Damage assessment in historical leather by micro DSC

Sword hilt (1837) – The National Military Museum “Ferdinand I”, Bucharest

Damage dynamics - qualitative assessment



Leather-like interval (L) collagen-tannin matrix	$65^{\circ}C < T < 85^{\circ}C$
Parchment-like interval (P) de-tanned collagen	$45^{\circ}C < T < 65^{\circ}C$
Gelatin-like interval (G) gelatinised collagen	$T \leq 45^{\circ}C$

Fig. 8. Elena Badea, qualities contributing to the longevity of skin.

complementary analyses to avoid over- or underestimating the condition of the parchment or leather. MHT has been used in conjunction with other techniques to assess the effect of conservation treatments after artificial aging, and it works very well for that as well.

Concerning what qualities contribute to the longevity of a skin, Dr. Badea postulated that it depends on the skins' thermal stability and tanning homogeneity (fig. 8). She showed figures representing the microcalorimetric signals of collagen denaturation for two different vegetable-tanned

leathers exposed to gamma radiation in doses from 10 to 100 kilogray (KGy). A leather tanned with mimosa extract was highly stable even after being exposed to 100 KGy of gamma radiation. This leather had a thermal stability of more than 65°C. The second example, which had a thermal stability below 65°C, showed observable detanning after a dose of 25 KGy of gamma radiation and gelatinization after 100 KGy. This research is published in *Radiation Physics and Chemistry* under the title "Micro-DSC, FTIR-ATR and NMR Mouse study of the dose-dependent effects of

gamma irradiation on vegetable-tanned leather” (note 3). Dr. Badea emphasized that 100-KGy gamma radiation is very harsh, as just 25-KGy exposure renders an environment sterile.

In addition to this, Dr. Badea addressed the effects of leather consolidation treatments, including recent research she has done exploring halloysite nanotubes (HNT) loaded with nanoMgO for the purpose of increasing thermal stability. Even one treatment on historic leather increases the thermal stability and decreases the collagen molecular distribution, contributing to the overall chemical and mechanical stability of the skin.

In summary, the analysis techniques discussed demonstrate why and how collagen survives in parchment and leather, revealed clues as to how leather thermal stability results from hydrogen bonding and covalent cross-linking of collagen with traditional tanning agents, helped find ways to reinforce fragile artifacts, and inspired ways to develop modern leather by reinterpreting ancient technologies.

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CAROLINE SOLAZZO
PROTEOMICS ANALYSIS OF LEATHER AT MCI

Dr. Caroline Solazzo is a research scientist in the Proteomics and Biomolecular Mass Spectrometry Laboratory at the Smithsonian’s MCI in Washington, DC, with extensive expertise in proteomics of ancient animal fibers.

Dr. Solazzo gave a presentation describing proteomics as a method of analyzing leather. Proteomics is used to characterize and describe all proteins in a system, typically analyzed by mass spectrometry. Collagen, the primary component of animal skin, is a structural protein, which makes leather an ideal candidate for proteomics. Proteomics can identify both the species of animal used to make the leather and proteinaceous additives such as binders, adhesives, and consolidants, as well as assess the level of degradation present in the collagen proteins in the skin.

First, the proteins are extracted and converted into peptides by solubilization and subsequent digestion with trypsin, which cuts the proteins at the amino acids lysine (Lys) and arginine (Arg). The peptides are separated by liquid chromatography and analyzed by mass spectrometry (LC-MS-MS) and further fragmented into their amino acid sequences that are then searched against a protein database.

Collagen, a family of large proteins containing about 1500 amino acids, is the most abundant protein component in skin

tissues. Other less abundant proteins are typically removed during the cleaning and scraping of the skin, leaving three major protein chains identified in leather by proteomics: collagen I alpha 1, collagen I alpha 2, and collagen II alpha 1. Tests on modern bovine leather processed with different methods showed that oil tanning and alum tawing resulted in higher percentages of these proteins being recovered than with chrome and vegetable tanning. In the latter, the proteins did not completely solubilize, highlighting the more efficient binding of collagen in these tanning methods.

Dr. Solazzo then discussed the results of the proteomics identification for 18 leather samples from historic bookbindings and modern vegetable-tanned leathers (fig. 9). The historic samples were in a range of conditions, from highly degraded to generally good. About half of the historic samples were cow, five were sheep, two were goat, and one was horse. The goat samples also had bovine markers, but this was probably from hide glue. Hide glue may have been present in the others, too, but can only be positively identified if it comes from a different species. Milk, egg white, and wheat paste were also identified.

To assess the leathers for protein degradation, both rates of hydrolysis and deamidation were determined. Multiple samples were taken from the leathers—one in a more damaged area and one in a less damaged area. Hydrolysis is measured as the breakdown of protein chains at nonenzymatic positions, whereas deamidation is the modification of asparagine and glutamine into aspartic acid and glutamic acid, respectively. Some of the samples had advanced hydrolysis, but all were affected by high levels of deamidation. Deamidation increases as leather ages, so this was expected for the historic leathers. However, deamidation in a modern leather and/or rapid increase with aging may be a useful parameter to indicate a shorter anticipated lifespan for that leather.

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RENÉ LARSEN
SULFUR- AND METAL-FREE FULL VEGETABLE-TANNED
AND SUSTAINABLE CALF LEATHER FOR BOOKBINDING AND
RESTORATION

René Larsen is a conservator, educator, and biochemist who was the scientific director for the STEP project, as well as several other European Union leather projects. He gave the final talk of the panel.

Dr. Larsen gave a short background history on previous leather projects, starting with the Athenaeum project in

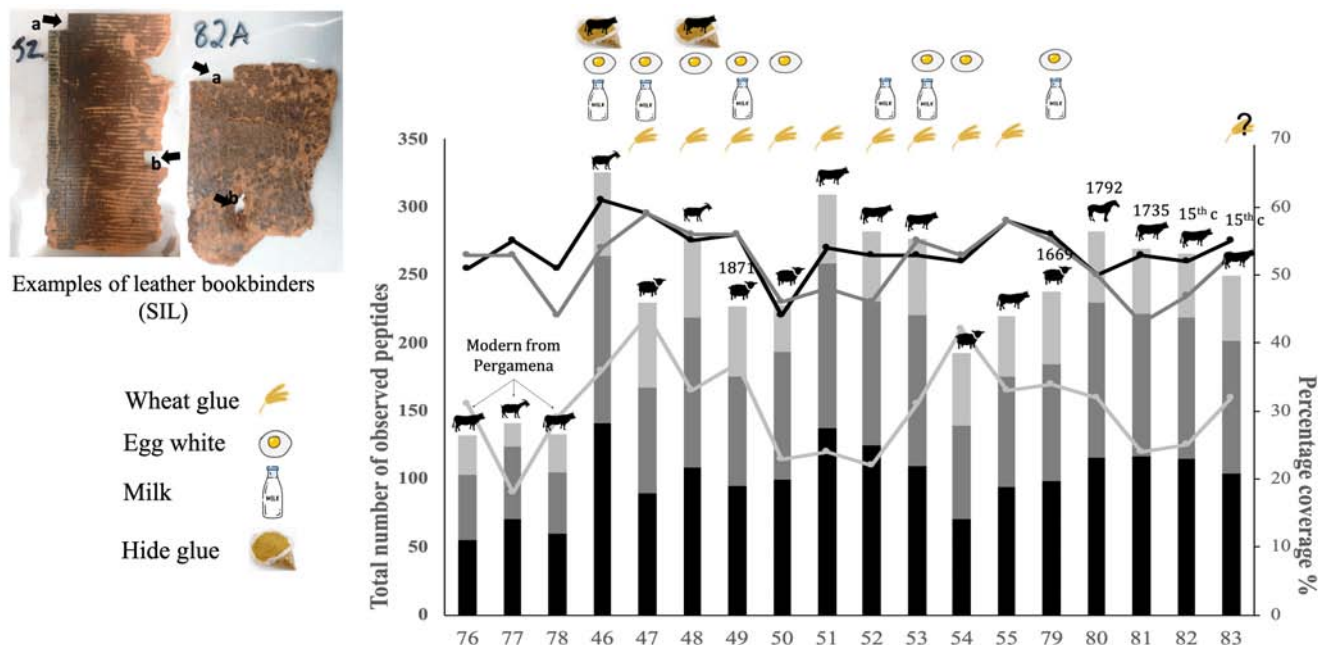


Figure 1: Number of collagen peptides and protein coverage for collagen I alpha 1 (black), collagen I alpha 2 (dark grey) and collagen III alpha 1 (light grey) in all 18 leather samples (15th c. to 21st c.). Species identification (cow, sheep, goat or horse) of the leather is based on the presence of specific collagen markers. The presence of protein binders is indicated above (with legend on the left).

Fig. 9. Caroline Solazzo, proteomics identification of leather bindings.

1843, the Royal Society of Arts Committee on Leather for Bookbinding at the turn of the 20th century, the British long-term storage trial, and the STEP and ENVIRONMENT European Commission projects. The early projects attributed leather decay to pollution in the environment, as well as the tannins used, and so the long-term storage trial included both hydrolyzable and condensed tannins. It was conducted jointly in polluted London and relatively pristine Aberystwyth, Wales. The European Commission projects also used the leather on these bindings leading to valuable information regarding the deterioration of naturally aged leather in different environments and recommendations regarding a long-term durable archival leather.

In 2019, Dr. Larsen joined the Sulfur Free Calf project. It was originally intended to be a durable vegetable-tanned leather with good organoleptic properties for bookbinding and is now retitled the “Sulfur and Metal Free Vegetable Tanned Archival Calf Leather” to also convey its intended longevity. It was tested by external labs for sulfur content, and the results were under the test detection limits in all cases. Another test, to determine mineral tannins (ISO 17072-2:2019), compared the aluminum, chromium, iron, titanium, and zirconium contents of five leathers including the Sulfur Free Calf. According to UNI EN 15987, to be metal free, the sum of all tannin metals must be less than or equal to 0.1% metals mass/total dry weight of the leather.

The Sulfur Free Calf was the only one of five leathers to pass this test.

This leather (SF KLO) was tested along with commercially available conservation leathers in several ways (fig. 10). Dr. Larsen discussed the results of these tests. The first was to assess the coherence of dry fibers before and after aging in dry heat (120°C) for 24, 48, and 96 hours and also after natural aging. He also recommends the coherence of dry fiber assessment to conservators for use on a regular basis. To do this, a very small number of fibers are scratched from the surface and then classified in one of five ways: (1) very coherent, (2) coherent and slightly powdered, (3) equal parts coherent and powdered, (4) slightly coherent and powdered, and (5) completely powdered. SF KLO retained its coherence, reaching only a state of 2 (coherent and slightly powdered) after 96 hours of dry heat aging. The other tested leathers reached a state of 4 (slightly coherent and powdered) in the same amount of time.

Additionally, the test results on the commercial leather showed that this leather, which was from the same East German producer but purchased for different purposes and at different times, clearly will behave differently under different aging/storage conditions.

The future test regime will include three accelerated aging systems, six standard physical and chemical tests for leather, and the tropical test with slightly elevated

SAMPLE	HOURS	COHERENCE	TANNAGE
KLO ref	0	1	Hydrolysable
KLO 24	24	1	“
KLO 48	48	1,5	“
KLO 96	96	2	“
IFV ref	0	1	Condensed
IFV 24	24	2	“
IFV 48	48	3,5	“
IFV 96	96	4	“
NAT. AGED	YEAR		
HW7	≈ 1995	2	Metal / condensed/ hydrolysable
HW6C	≈ 1995	2,5	“
HW6B	≈ 1997	3	“
LEF8A	≤ 1989	4	Condensed

Fig. 10. Rene Larson, artificial aging test results of the new sulfur-free leather versus commercially available conservation leather.

temperature and nitrogen oxide pollution. There will be five micro analytical methods developed for conservation laboratories—including the dry fiber coherence test and the hydrothermal stability test presented by Dr. Badea. Once these methods are completed, he intends to publish a comprehensive guide to them.

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DISCUSSIONS

Leather Users

The discussion began with a question about the decision to use leather versus alternative materials. Generally, the panelists feel that leather is desirable due to its mechanical properties, which are difficult to replicate using other materials. Alternate materials, however, have properties that leather cannot replicate. Mr. Minter noted that leather is easily moldable into whatever shape is needed. Ms. Bolton agreed and noted that the strength and flexibility of leather and the ability to pare it up to the edge are key benefits to using leather as a repair material. At the LCC, she noted that leather is used when repairing furniture that is still in use due to the ability to thin the leather at the edges so the leather repairs will not lift when the furniture is in use. For furniture that will not be used, BEVA applied around the edges of the repair can reduce the step at the junction of the original leather and the repair leather. Ms. Kaplan finds that the decision to use leather is a practical one based on the specific item being treated and tends to treat objects that are decorative or no longer functional. As a result, the demands on the repair material are less. Usually, she does not need the mechanical properties of leather. If she needs a structural repair, then leather is sometimes the better option, although she also uses Tyvek and spunbond polyester because they give enough strength for her needs. Ms. Bolton agreed that spunbond polyester, which is thin and strong, can be useful for repairs where it is necessary to add as little bulk as possible.

This line of thought led to a question about determining the desired thickness of leather to use as a repair material. Some leather users prefer to thin the leather significantly, whereas others prefer to use a thicker, stronger leather. Mr. Siegel interjected to say the hide type is important. If making gloves, one needs a thin leather such as Ethiopian hair sheep that is strong but thin, at 0.4 mm, whereas when making Western saddles, steer leather, which is much thicker at 7 to 8 mm, is used. However, paring down the steer leather to 0.4 mm would leave it with no strength due to the intertwined construction of leather. Shaving it down 50% equates to the loss of 70% to 80% of the strength of the leather. Leather should be used at as full a thickness as possible when strength is an issue. In the repair process, choosing a leather of the same thickness as the original leather is the best course of action. With bookbinding leather, if the ideal thickness is 0.6 to 0.8 mm, one should start with a smaller skin from a younger animal. Mr. Minter agrees that using leather as close to the original thickness as possible is preferable. Dr. Larsen added that the full thickness of the leather allows the highest physical strength, which is in the middle of the corium.

A member of the audience asked whether any of the panelists have used other, nonmammal leather, such as fish

leather. Ms. Bolton responded that at the LCC, one of the primary characteristics they look for is visual appearance. As a result, they match the repair leather species to the species of the original leather, which is not often fish skin. She pares the edges of repair leather to a thin edge, but the area where the actual area of loss is located will be left to as full a thickness as possible. If thinness is the goal, then Japanese tissue, a nonwoven material, or a laminate of Japanese tissue and Remay (to double the strength) is used. Ms. Kaplan agreed with Ms. Bolton and added that even when she is repairing fish skin, she will quite often create a substitute that mimics the original material. Despite appearances, it may not move and flex in the same manner as the original material. An audience member commented, and Ms. Kaplan agreed, that training strongly influences whether one is comfortable working with leather, and this influences decision making.

Ms. Wright then asked the panelists whether they are using leather as often as they did at the beginning of their careers and whether the philosophy behind using leather has changed. Mr. Minter answered that during his apprenticeship, rebacking or rebinding were common practice, whereas now the philosophy is to save as much of the original binding as possible. Many curators prefer less intrusive treatments. Ms. Bolton reiterated that the materials they use are dependent on the client. Generally, museums prefer leather alternatives, whereas private clients prefer leather. Dr. Engel noted that conservators who use a lot of leather are probably not experimenting with other materials. She tends to use leather in her private practice due to her training. Ethically, she feels it is the best match for leather repairs. She works closely with the tanneries on specifications for the skins she uses. She does not use synthetic adhesives, choosing glue or paste instead. For adhering leather, she uses wheat starch paste that is cooked for 20 minutes, as it has strong adhesive forces. In rare cases, she uses isinglass or parchment glue.

Tanners

The tanner discussion started with a question about using tannin-based dyes for color fastness, economy, and their environmental friendliness. Can these dyes still be applied in lieu of aniline dyes? At Hewit, Mr. Lanning stated that Hewit uses dyes that work in an acid environment. Many steps in the tanning process occur in an acidic environment including dye application as the acid environment fixes the dye to the leather. He does not believe that Hewit's process would work well with natural dyes. Dr. Emmerich Kamper explained that there would be no benefit to using tannins as a mordant on vegetable-tanned leather, as that would overtan the leather, applying one tannin over another. However, using tannin-based dyes on fat-tanned leather is beneficial because the skins become less stretchy. Mr. Meyer has used vegetable dyes in parchment with different tannins providing different coloration. In the process, he noted that if care is not taken, the parchment will

be tanned instead of dyed, creating an undesirable velvety surface. He has conducted a trial using cochineal dye, and the result was so light that it was barely discernible. Mr. Lanning added that shades of brown are relatively simple to achieve with tannins but that any of the brighter colors, such as blues, yellows, greens, and bright reds, are much more difficult. Mr. Siegel does use vegetable dyes for tanning hides in Nigeria that have been used for hundreds of years and produce very bright colors. There is a wide range of dyes available, but he is unsure if they are archival.

Ms. Wright then asked whether the market for dyed or undyed skins is greater. Mr. Themmen said that the Sulfur Free Calf has a natural, undyed color. Opinions vary, but generally clients purchase it undyed and dye the leather to their specifications after purchase. Dr. Emmerich Kamper generally does not use dyes, producing 80% of her leathers in natural colors from cream to smoke, depending on the tannins used. Mr. Lanning noted that most of the calf they sell is dyed, yet most of the goat they sell is undyed. Mr. Themmen added that the sulfur calf is dehaired in a nondestructive way, creating a white base for the tannins and resulting in a cream-colored skin that the client would find easy to dye.

An audience member asked about the practicality of making leather with the current market processes, using pre-1830 materials, wondering whether those materials are even available. Mr. Siegel described previous research into leather degradation, which concluded that using sulfur compounds in the dehairing process is detrimental. The chemistry of dehairing a hide in the modern age without using sodium sulfide is difficult, as is tanning leather without using a sulfide tanning agent. Mr. Themmen added that modern leather production is based on speeding up the processing time. The solution is to research how tanning was done in the past and find a modern way to replicate it. Artificial aging, to mimic the lifespan of 200 to 300 years, is key to see how well the leather ages. Mr. Siegel stated that the sulfur-free leather they are making in Nigeria is archival and even takes no more than four weeks to produce using techniques that have existed for hundreds of years.

Researchers

Ms. Wright asked the researchers to recommend how best to translate the testing results into practical use when treating historic objects and selecting modern leathers for treatments. Dr. Larsen responded that it is important to note that many of these research methods look at similar mechanisms but from different angles. It is up to the scientists to analyze the data and translate the results so that they can be used by the conservation community. It is also key to develop simple testing methods that can be conducted in conservation labs. Dr. Weyrich agreed, noting that many of the methods discussed today cost hundreds of dollars per sample and often require an advanced degree to interpret. What researchers can do is

take the information and translate it back into simple techniques. Better yet would be for researchers to work on the same materials so they can combine all of these efforts and understand how the results from different testing methods overlap, ultimately telling more of the story.

Ms. Wright then asked if the researchers think conservation treatments (e.g., dyeing leather or applying consolidants and leather dressings) are affecting leather longevity. Dr. Larsen says that extensive studies of the Domesday Books and the Codex Sinaiticus show that the treatments conservators are doing are accelerating the deterioration of leather and parchment. Dr. Weyrich added that from an ancient DNA perspective, conservation may alter or create a new DNA signal making the recovery of the original DNA impossible. She praised Dr. Solazzo's study highlighting that leather is not the only animal material used in bookbinding. There are layers of animal and plant materials, and when a book is conserved, further layers may be added. Molecular methods may be able to shed information on the original DNA signatures.

An attendee posed the question of whether conservators should be concerned with new repair material corrupting DNA, mass peptide fingerprinting, or proteomic tests. Dr. Weyrich stated it is a concern and is writing a paper considering whether these treatments affect trace recovery by adding DNA or destroying existing DNA. Dr. Badea responded that added leather or parchment can usually be identified using the normal physical, chemical, and analytical methods. She gave an example of using PVA in Marco Polo's will, where there is definite interaction between the collagen in the parchment and the added PVA. Conservators need to ensure that there will be no interaction between the leather and added compounds. The problem is that some of these reactions do not become visible for 10, 20 or even 30 years. From analysis that Dr. Badea has conducted, it is clear that for most items, be it books or furniture, that treatment was not favorable to the artifact. Dr. Larsen added that, if possible, conservators should retain original samples of untreated leather or parchment before treatment is started for future analysis.

When asked how those samples should be stored, Dr. Weyrich stated that for DNA and protein preservation, it is ideal if the samples can be frozen, which she realizes is untenable. Other techniques require different storage solutions, so this should be further explored to determine a feasible solution.

All Panelists

Ms. Wright then opened up the discussion of the ways in which conservation treatments affect the longevity of the historic objects to the entire panel. Dr. Engel noted that the approach of the owners of the objects has changed. In the past, conservators were asked to make items look "new" again, clean, and flat. This necessitated treatments such as humidifying parchment and leather to flatten them. She feels

it was not only the materials that conservators added to the items that caused damage but also some of the treatments themselves.

Mr. Lanning countered with a question about long-term storage of leather for future testing. He understands the theoretical need for this, but in the case of tanneries, the environment itself is dirty with chemicals in the air and the warehouse where different leathers come into contact with one another. In this working environment, how is one expected to ensure no cross contamination occurs? Dr. Weyrich stated that it was eye opening for her to see the differences between the conditions in a tannery and the conditions in a microbiome lab. In her work with Mr. Meyer to try and trace different microbial signatures through the tanning process, they are intentionally trying to avoid cross contamination where possible even though this is not feasible in a typical tannery environment. In her testing, she will be able to ascertain the number of microbes that are maintained across all skins versus those specific to individual skins. Tracking this information will be valuable. Does the information shift according to season, the type of animal hide, or in industrialized versus nonindustrialized environments? The answer to these questions might be important in explaining how leathers are preserved over time.

An attendee asked whether microbes are still viable and whether conservators should be concerned. Dr. Weyrich explained that many of these microbes are not adapted to living in the human body and are not present in high enough quantities to cause concern. This is compounded by the fact that the goal of tanning is to stop microbial growth. Mr. Siegel added that all modern tanning is done with biocides. Mr. Meyer added that experiments could be done to tan without biocides. Mr. Siegel postulated that fatliquor purchased from a chemical company already has added biocides. Mr. Meyer countered that in his experience, if they do not add biocides after fatliquoring there will be mold growth, indicating that there may be biocides in the fatliquor but not in sufficient quantities to inhibit mold growth. Mr. Themmen added that there are laws that govern the amount of preservation agents that can be added to chemicals, and that the key is to change the biocides and bactericides used as the microbes build resistance to the formulas. Mr. Lanning stated that there is no choice but to use biocides and fungicides and to switch the ones used for this reason. He also added that some pathogens, such as anthrax, can survive the tanning process. Dr. Weyrich finds this fascinating when thinking about preindustrial tanning. Now tanners know to add biocides and fungicides to control mold growth, but what were people doing before to inhibit this growth?

An audience member asked whether smoke tanning or other indigenous tanning methods acted as a biocide or fungicide. Dr. Emmerich Kamper responded that the small batches tanned in the pre-Industrial Era were tanned in pits

that were periodically drained. The balance of the acidity and alkalinity in the pits inhibited bacterial growth. In the smoke-tanning method, smoke is filled with formaldehyde and oleic compounds that act as fungicides. However, even a well-brain-tanned leather will rot if left in water for a prolonged period of time. As a result, researchers do not have many leather samples from ancient times, although some Roman-era leather survives, as well as other ancient leathers from dry sites.

A question was posed to Dr. Badea, from an audience member, about using confocal microscopy for evaluating degradation in historic skins. She responded that atomic microscopy can be used, but because the surfaces of leathers and parchments are not smooth, it is difficult to produce clear images. It is also expensive testing to undertake. However, it does work to measure the distance in between the fibers, which can help determine damage. There are easier and cheaper tests that can be performed that are more realistic in a conservation lab. Dr. Larsen added that wet parchment testing using a transmission microscope provides the same general results as with SEM. Researchers need to take these findings that use advanced testing techniques and find a way to obtain the same results with less complicated techniques.

Ms. Wright then asked whether the many changes to the tanning process made after the extensive leather research in the 19th and 20th centuries resulted in significantly improved leather quality. Has modern leather achieved similar characteristics to medieval leather? Mr. Lanning says, from the tanner's perspective, that they are all trying to produce the best leather they can. Tanners can only work with available research results. For example, Dr. Larsen was very involved in the STEP project, Mr. Lanning was involved with the CRAFT project, and Mr. Siegel is researching and testing his sulfur-free leather. Mr. Siegel added that what is being produced today is certainly better than what was being produced 100 years ago. What he does not know is whether the leather being produced today is as good as leather produced 500 years ago. Perhaps further testing will be enlightening. He suggested that researching what has gone on in the past to help guide future choices is complicated by proprietary formulas. It would be helpful if tanners producing leather for scientific and conservation use would share those formulas. At least writing these formulas down now would allow researchers in the future to have access to the knowledge of what worked and what did not work. Mr. Lanning noted that all of Hewit's processes are recorded but are commercially sensitive. In 50 years, he can share those formulas but cannot share current proprietary formulas. Mr. Themmen added that the practice and science are far apart, and Dr. Larsen noted that having scientists involved in research projects means that their test results will be made available even when the formulas remain proprietary. This gives conservators insights into the durability of the leather and the main types of tannages that were

used. It also offers assurance as to the quality of the final product.

Ms. Wagner followed up asking the tanners if they retained their historic recipes. Hewitt has an archive, but there were two fires, one in the late 1800s and one in the 1950s, that destroyed many of the records. They do have records from 1950 onward. Pergamena also has detailed records going back 50 years, but they reference many chemicals that are no longer used (because they are carcinogenic or no longer produced for other reasons). Their older records typically contain recipes that are very general, such as “use a bunch of bran” or “use a barrel of cod liver oil,” making it difficult to re-create a viable recipe. Mr. Lanning encountered the same vagueness in the older Hewitt recipes, which sometimes have baffling instructions like “a yoghurt pot of this.” In producing leather, the formulas also change frequently, even yearly, due to the availability of chemicals. They are frequently dropped and replaced in the UK. As small users of these chemicals, they do not have much ability to influence the industry.

Ms. Wright asked whether the leather users are currently performing any of the recommended tests in their conservation labs. Ms. Kaplan said that Winterthur uses the MHT method. The audience asked what inexpensive tests can be incorporated in the conservation lab—for example, what is another option for a leather shrinkage test? Dr. Badea stated that the MHT results are all open source and can be used with microscopic observation. She said it is not too difficult to access DSC testing, but it is a test that is not used in tanneries. However, the test is important because it sheds light on the bonding of tannins to collagen. This can assist in the understanding of the mechanism of deterioration. DSC is important for historic leather but also when designing a new product. For tanners, measuring leather shrinkage is not enough when designing and producing high-quality leather. There are many more chemicals in modern leather than there were in ancient leather because of the need to produce the leather more quickly and in a cost-effective manner. Producing archival leather is more expensive than producing chrome-tanned leather, but one can only charge so much for the archival, vegetable-tanned leather.

The panel was well received and led to enlightening and engaging discussion. Attendees indicated that leather, as a topic,

is important in the current conservation climate. Panelists expressed interest in continuing the discussions in the future, and the group is already planning periodic virtual meetings. Research, both previous and current, will be summarized on the Leather Research page of the AIC BPG wiki. Furthermore, the group is open to discussions during future AIC annual meetings.

NOTES

1. Siegel Leather, *Tropical Testing Popular Bookbinding Leathers!* Uploaded November 2020 at YouTube.com. Video, 03:57. <https://youtu.be/M20eeDusJlc>.
2. <https://www.hewitt.com/download/fs-craft.pdf>
3. <https://doi.org/10.1016/j.radphyschem.2021.109712>

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