

## The Challenge of Scale Revisited: Lessons Learned from Treatment and Mounting an Exhibition of 160 Illuminated Manuscripts

### FOREWARD

This paper is a sequel to “The Challenge of Scale: Treatment of 160 Illuminated Manuscripts for Exhibition,” as presented by Debora Mayer at AIC Toronto 2016 and published in volume 35 of the 2016 *AIC Book and Paper Group Annual*. The Challenge of Scale (Mayer and Puglia 2016) details the project to prepare more than 160 illuminated manuscripts from Harvard libraries in a two-year period for the exhibition *Beyond Words: Illuminated Manuscripts in Boston Collections*. The exhibition opened in September 2016 in three simultaneous venues. That work covered the estimating procedure used to calculate the time required to treat the manuscripts and how staffing and workflow were planned to match the scale of the project. The paper also highlighted the treatment protocol developed by the Weissman Preservation Center staff for the consolidation of friable and flaking media typical of illuminated medieval and renaissance manuscripts. The protocol detailed procedures to evaluate, treat, and document the consolidation of the manuscripts to ensure uniformity in treatment and judgment among the 10 conservators working on the project.

Although some details from the prior work (Mayer and Puglia 2016) have been summarized and included in the following, readers will find this paper more informative if they familiarize themselves with that work before proceeding.

### INTRODUCTION

This paper follows the completion of the exhibition process and continues through a critical review of 16 manuscripts following the exhibition.

Exhibition preparations will be discussed briefly and include some management and organization approaches, cradle fabrication, and condition checking procedures.

Installation and the strapping technique using nylon monofilament thread are discussed.

Following the exhibition, 16 manuscripts were re-examined for changes in media condition that might have occurred as a result of exhibition and retreated as needed. The pre- and post-exhibition consolidation documentation was closely compared to identify new or resurgent areas of insecure media. This paper discusses consolidation time estimates, changes incurred by the manuscripts, and efforts to evaluate and refine the treatment protocol for unstable media as developed in Harvard University’s Weissman Preservation Center.

### ORGANIZATION OF EXHIBITION PREPARATIONS

Organizing exhibit preparations eventually became full-time work for two Houghton library staff. The preservation librarian at Houghton Library acted as registrar for all manuscripts from Harvard libraries. This work included preparing the venue installation notebooks and documentation; coordinating all communication with conservators, registrars, and staff at Boston College McMullen Museum of Art and the Isabella Stewart Gardner Museum (ISGM); arranging for art shipping to and from the two off-site venues; and planning for installation at all three venues.

Following conservation treatment, the Houghton Library conservator organized all cradle and mount making and condition checks at Houghton Library. This work included generating all tracking spreadsheets, tags and labels for cradles, and documentation forms; preparing cradle and condition check candidates on a daily basis; performing final quality control checks; and shelving completed manuscripts and cradles by venue. Further, the Houghton Library’s conservator and Houghton’s conservation technician assembled all supplies and equipment needed for off-site installation.

Extensive support from Houghton Library was required, as six non-Houghton staff members were required to measure manuscripts and fabricate cradles but were unable to access Houghton Library’s Aeon circulation software and were unfamiliar with Houghton Library’s storage areas.

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Poster-sized printouts of spreadsheets listing manuscripts for each venue provided a low-tech but highly effective tracking method accessible to all team members. The printed spreadsheets were reassuring since progress was clearly visible as items were checked off, and next steps were obvious at a quick glance.

#### CRADLES AND MOUNTS

Black mat board cradles are the preferred style in Houghton Library and were selected as the cradle of choice for the majority of volumes due to their low cost and ease of manufacture. Black mat board cradles also had the advantage of blending with the exhibition designs at all three venues. Plexiglas cradles were specified only for the largest, heaviest manuscripts where board cradles would not suffice. A local fabrication company, Altec Plastics, was contracted to manufacture 25 Plexiglas cradles.

Figure 1 shows a typical cradle along with the organizational aids used for all manuscripts. A color-coded tracking slip on the bottom of each cradle identified the manuscript, specified the exhibition venue, and included an image of the opening to be displayed. The polyethylene strap on the side reiterated the venue and included a manuscript identification number linked to case layout maps for each venue. Installation notebooks for each venue included case layouts, item identification, and installation details as needed for individual items.

A detailed specification for cradle design was prepared and made available to the two off-site exhibition venues to improve consistency. The ISGM contracted with the North Bennet Street School (NBSS) to fabricate cradles for some of the ISGM manuscripts. An NBSS student working as a summer intern at Harvard University's Graduate School of Design received hands-on training in cradle fabrication at the Houghton Library and provided continuity in style and manufacture as she worked on the NBSS team fabricating cradles.

#### CONDITION CHECKS

Condition checks were performed at four stages for all materials traveling to off-site venues: before materials left Houghton Library, on receipt at each venue, as materials were deinstalled, and on receipt back at Houghton Library. Condition notes were made on paper forms using some check boxes, simple narrative information, and color-coded pencil annotations to printed images. Digital photographs were made of particular details as needed throughout the process.

The Weissman Preservation Center staff investigated tablets and other digital methods of recording condition check information. Commercially available documentation systems were considered for benefits and drawbacks. Due to the complexity of this exhibition and its deadlines, we chose not to implement a new condition checking system for this



Fig. 1. Sample black mat board cradle with color-coded label and identification strap.

exhibition. Following the exhibition and consolidation review process, exhibition/loan documentation systems using tablets will be reviewed and a system compatible with the Weissman Preservation Center's conservation database will be developed.

#### STRAPPING MATERIAL

Although traditional polyethylene strapping can be made reasonably discreet, a more minimalist look was preferred. We opted to follow the lead of other institutions and planned for a double strapping method—polyethylene straps on the leaves below the opening to provide the strength, then one, or occasionally two, strands of hair silk would be used on the leaves of the opening to minimize the visual impact of strapping.

However, the hair silk purchased for strapping purposes was found to be unsuitable. The silk thread was particularly weak and broke easily. Further, the thread had not been properly dewaxed, and it left an oily residue on any surface it contacted. Dewaxing the silk was considered, but that would not have resolved the weakness of the thread that was of concern since addressing any thread failures at the two off-site venues would have been difficult and time consuming.

The lesson learned in finalizing the strapping technique was to be cautious when acquiring new materials, even when recommended by colleagues. The quality of supplies changes over time, sometimes rapidly. Fortunately, a suitable replacement was found on short notice.

Instead of hair silk, light-weight quilter's thread was used. Five different varieties of thread were compared on black mat



Fig. 2. Manuscript held open with nylon monofilament. Arrows point to thread locations.

board and on sample manuscripts in a variety of lighting situations. Wonder Invisible Thread, .004 Nylon Monofilament, was selected as the preferred strapping material. It was significantly stronger than the silk, had a slight stretch that allowed easy adjustment of the tension across manuscript pages, and had such a minimal visual impact as to be virtually invisible under exhibition lighting (fig. 2). We believe that the monofilament is superior to hair silk, and it is now being used as strapping material for in-house exhibitions.

#### INSTALLATION AND STRAPPING

Installation was carefully coordinated with teams of 8 to 10 staff working at the non-Houghton venues. The registrar was responsible for removing all materials from transport crates, matching manuscripts to their corresponding condition reports, and identifying case locations. Manuscripts were delivered to individual conservators to complete the required “as received” condition check. As sufficient condition checks were completed, two-person teams formed to begin strapping and keep work moving smoothly. As required, one staff person either worked on a strapping team or assisted the registrar by matching cradles to manuscripts and then delivering strapped items to their case locations.

Working in teams of two for installation strapping was found to be the most effective approach. Passing poly straps and nylon thread through the cradles between two people was efficient and safest for the manuscripts. One person could adjust and position straps and threads safely while the other held the manuscript open. While one person finalized a strap or completed a knot, the other could prepare the next strap, producing a very efficient workflow.

The installation approach used was very efficient and met tight time windows at the off-site venues, resulting in

97 manuscripts, including two 10- to 20-ft. scrolls, being installed at Boston College’s McMullen Museum of Art in less than three full days.

#### PRE-EXHIBITION TREATMENT TIME ESTIMATES

Because of the short time frame and scale of the project, it was not possible to consolidate all illuminations in every manuscript. In consultation with other institutions, we adopted a policy to examine and treat as necessary only the illuminations within a 20-leaf spread of 10 leaves before and after the display opening. Illuminations on the first leaves were also included, as these are the pages that receive the most frequent, often excessive, handling.

The time estimate for media consolidation, using three minutes per square centimeter of illumination, was 2800 hours. Oversize manuscripts, structural repairs, documentation, and fabricating or modifying housings were estimated to require an additional 2200 hours. Binding and structural repairs focused on issues that would impact handling during consolidation and travel to off-site venues, and allow the manuscripts to remain open for the exhibition, which was expected to last three to four months.

Combined, an estimated 5000 hours of conservation treatment time were required to prepare all materials for exhibition, and 5000 hours over two years correlated to roughly three full-time conservators dedicated solely to this project. Cradles and mounts, condition checks, and installation were not included in this estimate.

#### CONSERVATION TREATMENT TIME ACTUALS

Out of a total of 160 manuscripts, 104 were transferred to the Weissman Preservation Center for conservation. Initial treatment estimates reflected a worst-case scenario, and many treatments turned out to be more modest than expected. Actual treatment time totaled 4397 hours, which was comfortably below 5000 hours.

Beyond conservation treatment, 1741 hours of conservation time were required for fabricating cradles, performing condition checks, and installing and deinstalling the Harvard materials. The carefully coordinated team approach described by Debora Mayer was equally necessary for this work. As consolidation efforts tapered off, team members shifted focus to other exhibition tasks, and the pace of work actually increased over the last six months as additional staff were involved.

#### CONSOLIDATION PROTOCOL REVIEW

Completing the installation of the Harvard Library’s portion of the *Beyond Words* exhibition allowed the conservation team to take a step back. Debrief meetings were held to identify lessons learned throughout the process. Exhibition preparations

and installation had gone well, and we were confident that the consolidation protocol was a valuable tool, but there is always room for improvement.

In addition to the debrief discussions, the Weissman Preservation Center had an opportunity to systematically review a large body of our conservation work. The conservation team had been pleased with the results as manuscripts were completed in the conservation lab. However, without reviewing manuscripts following the exhibition, there was no way to know if we had successfully stabilized the manuscripts against the rigors of exhibition and the associated handling. Following conservation but before the exhibition, many of the manuscripts had been fully or partially imaged for the catalog, reviewed multiple times by curators and researchers developing exhibit catalog entries, measured and fitted for cradles, and installed and eventually deinstalled. Use of some of the manuscripts by patrons and Harvard classes continued during the exhibition preparation period, further increasing handling.

#### CONSOLIDATION PROTOCOL

Key principles of the consolidation protocol included the following (Mayer and Puglia 2016):

- » *Consistent procedures.* An example is the use of the same magnification (15x) and tools to judge stability/friability of media.
- » *Uniform judgment parameters.* The decision to treat is based on the actual detection of loose or friable media. Consolidation is not considered a proactive measure. Media that is cracked or looks horrible but tests stable is not treated.
- » *Quality control.* One conservator treats a given illumination and a second conservator reviews the work to ensure treatment success. In this way, we ensure that we do not miss areas, the consolidation is effective, and there is no change in media appearance.
- » *Open and frequent communication.* Best practices are achieved through collective and collaborative understanding, which requires discussion, being open-minded, sharing observations, and letting go of ego.

#### SUMMARY OF CONSOLIDATION TREATMENT PROCEDURE

While looking through the microscope, the conservator used an endontic paper point, instead of a brush, to lightly touch the media to detect media insecurity. Chips of media were lightly touched to watch for movement and to see if a shadow line increased or decreased. Powdery or friable media was detected when small particles moved as the paper point lightly touched and stroked the surface (fig. 3).

Flaking and friable media were consolidated with dilute gelatin, typically applied with a small brush at the edge of chips



Fig. 3. The microscopy station as seen from above, including tools, consolidation supplies, the computer monitor displaying the treatment image of the illumination, and the notebook of treatment notes and records.

or along crack lines in the paint and over granular surfaces. In most cases, bovine gelatin (Acros Organics, type B, ~100 bloom) at a 1.5% w/v solution in deionized water was used. In certain instances, high molecular weight (HMW) fish gelatin (Norland Products) was used when stronger adhesion, better flow, or higher tack at greater dilution was warranted.

A digital image of the illumination was displayed on a computer monitor and was marked up using Photoshop to delineate the areas of consolidation treatment. At the same time, in the treatment notebook, a black and white printout of the image was also marked up to record treatment locations and progress across the page, and served as a place to share notes with all team members.

Once an illumination, or section of illumination, was completed, it was allowed to dry at least 12 hours. The same illumination was then reviewed and checked by a different conservator to ensure that no unstable areas were missed and that treatment was successful. Treatment was considered complete when two different conservators had reviewed the same illumination and confirmed the media was stable (Mayer and Puglia 2016).

#### ORGANIZATIONAL CONCERNS

Discussions during debrief meetings identified two areas where key principles had not been followed as closely as expected throughout the treatment phase of the project. Uniformity of treatment had been inconsistent in small ways due to a particular breakdown in open communications.

To meet the demanding exhibition schedule, the consolidation work flow required 10 conservators, divided into two consolidation teams of 5 conservators, with each team working 25 to 30 hours each week for two years. The procedures



and communication within each team had been excellent. Documentation notebooks at both microscope stations had included copies of the treatment proposals, articles and research relating to the manuscripts, and printed photos of all leaves to be treated. Page by page, media issues and treatment notes were recorded in these notebooks. Discussions between conservators within each team had been frequent, as treatment was handed off from team member to team member after each 2- to 3-hour shift. Work was consistent, uniform, and of good quality. However, during debrief discussions, it was discovered that communication and procedures *between* the two teams had drifted apart slightly over time.

Each team had been faced with a unique combination of manuscripts with their very different support pages, media, bindings, and so on. As each team addressed their unique circumstances, they had created their own small variations on treatment techniques and handling. In and of themselves, none of these variations were of great consequence; however, it was a surprise that we had not anticipated. In some cases, the changes and efficiencies might have been helpful across both teams, such as refinement on how and when alcohol was used with certain pigments. The pressure of maintaining production had created extremely efficient teams but had narrowed our focus to the team level, and communication between the teams had not been as open as expected.

This is an embarrassment of riches since few conservation labs are large enough to field two consolidation teams of five conservators each. Realistically, the Weissman Preservation Center may never need two teams again, but if it does, lesson learned: maintaining open communications under pressure is a challenge, and it needs to be between teams as well as within teams.

#### PROTOCOL AND CONSOLIDATION REVIEW POST-EXHIBITION

Judging the effectiveness of our consolidation work required returning to a selection of manuscripts, re-examining the same range of pages, and retreating them if necessary. This was a much more significant undertaking than a few debrief meetings. An initial estimate for the review project was 630 hours—a substantial time investment considering that the exhibition had already required more than 6000 hours. The additional conservation time for the review project was approved, and thus two consolidation teams were reformed and the review work moved forward.

Drawing from lists of manuscripts treated and by taking suggestions from the teams, 16 manuscripts were selected for review—approximately 15% of the 104 treated manuscripts. The selection was fairly representative of the whole and reflected the range of media conditions and the degree of treatment that had been required during exhibition preparations.

We chose to perform the review as a blind study as much as was reasonable. We hoped to make our observations and treatment decisions as objectively as possible but did not want to repeat any unsuccessful treatment approaches. Team leaders and the project coordinator reviewed the pre-exhibition treatments to identify adhesive choices and other key areas of concern, then relayed that information to the consolidation teams. Team members were certain to remember particular manuscripts but would not preview the photographic or written documentation from the pre-exhibition treatments.

The blind study was very effective. Although it was very tempting to peek at the documentation, all team members supported the blind study approach. In a few cases, specific questions were raised and the team in question asked a member of the *other* team to review the previous treatment file to locate required information. Only a few problematic items required a more systematic review of the earlier documentation.

#### RESULT

Approximately two-thirds of the manuscripts reviewed, 11 of 16, required only minor additional consolidation treatment in small spots in isolated areas. For these manuscripts, treatment times during the review were significantly reduced from the first round of consolidation, down to just over two minutes per square centimeter. Treatment was approaching the minimum time required to simply check all media for stability and consolidating only occasional small areas. The sound condition of the illuminations in these 11 manuscripts indicates that the consolidation protocol was successful in stabilizing these illuminations against the rigors of exhibition.

Further, the review of these 11 manuscripts also reinforced the base time estimates for consolidation using our protocol. The estimate of three minutes per square centimeter with time increasing for more complex manuscripts seems to be an accurate time for estimating consolidation projects overall.

The remaining five manuscripts reviewed had been substantially stabilized by the pre-exhibition treatment but were found to have more media instability than was ideal following exhibition. These five manuscripts were not a surprise, as they were among the most challenging manuscripts treated prior to the exhibition.

Overall, the results are very positive for the success of the consolidation protocol. As noted earlier, we had specifically wanted to know how the least stable materials had fared throughout the exhibition process. The selection had been weighted toward some of the most problematic and severely damaged items yielding a higher percentage of challenging manuscripts in our sample set than was present in the entire group. The percentage of manuscripts in the exhibition with minor to moderate condition issues was considerably higher than two-thirds. Therefore, we feel confident that the majority

of the manuscripts remained relatively stable throughout the exhibition process. Further, even the worst manuscripts had been significantly stabilized by the pre-exhibition treatment.

#### PHOTODOCUMENTATION PROCESS

Working in Photoshop, all areas treated with a consolidation adhesive were marked in a fluorescent or other bright color. For the review, returning to the pre-exhibition treatment images would not have been a blind study. To be able to accurately compare before and after exhibition treatments, and to reduce handling of the manuscripts, the unaltered before-treatment images from the pre-exhibition treatments were used for the review.

Composite images were created by combining the marked up pre- and post-exhibition treatment images, allowing the two treatment campaigns to be viewed together. Areas of new instability were clearly visible and resurgent instability was easily identified where pre- and post-exhibition treatments overlapped.

Please note that the printed version of this paper is accompanied by black and white illustrations. These printed images will not allow accurate interpretation of the treatment documentation presented in the following. The PDF/web version of the paper includes the color illustrations necessary to properly interpret the details comparing pre- and post-exhibition media consolidation.

#### CASE STUDIES

##### *Case Study 1: Ms Typ 443.1*

Figure 4 shows an example of a manuscript page requiring modest consolidation pre-exhibition that required no treatment during post-exhibition review. This is an example of a generally stable manuscript leaf, representative of many full manuscripts as well as individual leaves within problematic



Fig. 4. An example of a minor treatment pre-exhibition requiring no treatment post-exhibition. Book of Hours and Missal, Ms Typ 443.1, Houghton Library, Harvard University.

manuscripts, which remained stable throughout the exhibition process, including imaging and occasional researcher use.

##### *Case Study 2: Ms Typ 464*

Figure 5 shows an example of a more involved pre-exhibition treatment that required only minor stabilization treatment post-exhibition. This is one of the manuscripts where the reduced treatment time indicates an overall improvement in the manuscript's condition and that the illuminations remained stable throughout the exhibition process.

In reviewing Ms Typ 443.1 and Ms Typ 464, one with moderately significant media instability before exhibition, it was found that even moderate media issues were successfully stabilized using the Weissman Preservation Center's consolidation protocol. We are confident that many of the manuscripts withstood the rigors of the exhibition and associated handling quite well.

##### *Case Study 3: Ms Lat 267*

Figure 6 shows a detail image of the upper margin of one leaf. The media included significant areas of exposed soft, easily abraded off-white ground that was crumbling in spots. This



Fig. 5. An example of moderate treatment pre-exhibition requiring only minor treatment post-exhibition. Book of Hours, Ms Typ 464, Houghton Library, Harvard University.





Fig. 6. Detail image of an illumination with severe media instability. Pre-exhibition treatment was moderately successful, but new and resurgent instability was found post-exhibition. Treatment was halted pending future conservation to address the complete manuscript. Breviary, Ms Lat 267, Houghton Library, Harvard University.

manuscript received fairly extensive treatment prior to the exhibition, marked in magenta.

The full manuscript contained 423 leaves; however, stabilization for the exhibition had been limited to only 21 leaves, 10 on either side of the opening, plus the frontispiece. Within those 21 leaves, stabilization had targeted only the most unstable areas of media. The limited consolidation approach to this manuscript was considered only because it was to be exhibited at Harvard's Houghton Library and not subject to the rigors of transport.

Consolidation had been generally effective, but some previously treated areas were again friable and crumbling despite the prior consolidation. Surrounding untreated areas, which would have tested as being reasonably stable before exhibition, had areas of more active media loss following exhibition.

A review of the 21 leaves treated for the exhibition was of minimal benefit to the manuscript, and continued testing would not have added significantly to the knowledge gained from the review. The manuscript required a systematic

treatment of the complete manuscript. A few small test treatments using variations in adhesive and alcohol application, shown in cyan and green, were performed to guide future work. Ms Lat 267 was returned to Houghton Library with a strong recommendation that handling and use of the manuscript be restricted until a full treatment could be completed.

#### Case Study 4: Ms Typ 207

Figure 7 shows a detail of one leaf in a manuscript of only 29 leaves. The locations of pre-exhibition consolidation are shown in magenta, and post-exhibition consolidation is shown in green. Consolidation during the post-exhibition review was generally applied in previously untreated areas. This indicates that the earlier consolidation had been effective where it had been applied. This raises the possibility that the pre-exhibition media testing had not been thorough enough and these areas had been missed. However, the protocol includes extensive cross-checking procedures by multiple conservators, so it is unlikely that this was the case.



Fig. 7. Detail image of an illumination with moderate media instability pre-exhibition with moderate new media instability identified post-exhibition. *Les diz moraulx des philosophes*, Ms Typ 207, Houghton Library, Harvard University.



Fig. 8. Detail image of a second illumination from Ms Typ 207. As in figure 7, moderate new media instability was found post-exhibition. Consolidation is more clearly associated with creases and other areas where the leaf flexes during handling. *Les diz moraulx des philosophes*, Ms Typ 207, Houghton Library, Harvard University.”

Figure 8 shows a detail from a second leaf from Ms Typ 207. As in figure 7, the new consolidation is concentrated in previously untreated areas. However, in figure 8, it is more obvious that most of the treatment follows a series of creases in the leaf.

In addition to the creases, Ms Typ 207 also had significant cockling in the gutter that caused or was made worse by an inappropriate, modern rebinding. These issues had been very apparent before the exhibition. No matter how carefully the volume was handled, turning the leaves produced cringe-worthy “snap, crackle, pop” sounds as concave and convex areas flexed. The creased areas were also at higher risk from page movement, as these lines flexed more easily than other areas of the leaves.

In reviewing this manuscript, our judgment was that use and careful handling is the primary condition issue for this media. Even the most careful handling in the conservation lab was suspect.

The importance of careful use and handling is not a new concern, but manuscripts like this highlight the significance. Even the most careful, effective stabilization treatment is not proof against handling, no matter how careful. Further, even manuscripts that have been fully conserved cannot be put entirely out of mind, as even the best conservation treatments may fail over time, particularly when stressed by handling.

Unfortunately, limiting access to manuscripts can be a difficult decision. Restricted access must be carefully considered and weighed against Harvard University’s teaching mission. Use by patrons, faculty, and students is considered the primary goal of our institution.

Although this is not a change to the consolidation protocol, Weissman Preservation Center staff will continue to work closely with curators and access services staff to review handling and use guidelines for manuscript collections.

#### Case Study 5: Ms Typ 252

The binding on this manuscript was extremely tight, and opening beyond 100° was not advisable. Much like Ms Typ 207 in Case Study 4, cockling in the gutter posed a risk for media. Despite these issues, only three leaves in the entire manuscript showed severe media damage and a few other leaves had moderate damage.

Figure 9 shows one of the most severely damaged pages. Marked in magenta are significant losses where the loss edges were treated with bovine gelatin prior to exhibition. However, even at the highest concentration we were comfortable using, the bovine gelatin was not effective at stabilizing the media. Marked in yellow around the perimeters of the losses, many of the same areas were then successfully stabilized using HMW fish gelatin. The HMW fish gelatin was selected for its higher tack at lower concentrations, improved flow during application, and ease of preparation. HMW fish gelatin is

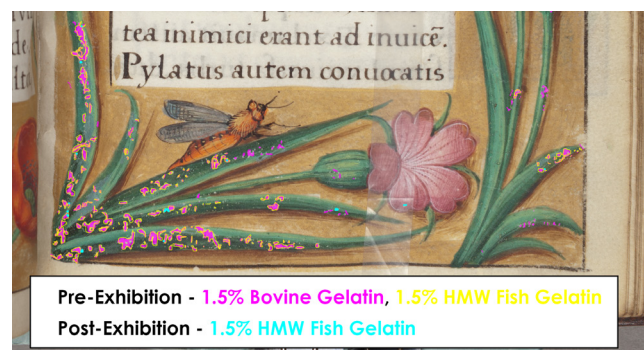


Fig. 9. Detail image of an illumination with significant losses and severe media instability. Pre-exhibition treatment started with bovine gelatin but moved to HMW fish gelatin. Moderate media instability was found post-exhibition and was treated with HMW fish gelatin. Gospel readings for Holy Week, Ms Typ 252, Houghton Library, Harvard University.





Fig. 10. A second example of a severely damage illumination from Ms Typ 252, also found to have moderate media instability post-exhibition. Gospel readings for Holy Week, Ms Typ 252, Houghton Library, Harvard University.

being investigated at the Weissman Preservation Center as an alternative to isinglass for consolidation and is currently being used as the preferred adhesive for parchment repair.

The post-exhibition review treatment again used HMW fish gelatin, which is marked in cyan. The review treatment was a mixture of retreatment of some previously stabilized areas plus treatment of some new areas following the exhibition. Although treatment was required, the amount of treatment during the post-exhibition review did not seem excessive given the condition of the page and the handling required for the exhibition process.

Figure 10 shows a second page with the same severe deterioration pattern. In this case, the issue with bovine gelatin was identified early in this page's treatment and fish gelatin was the primary adhesive, so fewer areas of magenta are marked. During the post-exhibition review, this page required a more significant amount of treatment, shown in cyan.

The amount of new and retreatment did not represent a major failure of the protocol but was sufficient to raise a concern. This manuscript and page generated a very lively discussion, but we were unable to identify any particular aspect of the protocol that would be considered a failure in this situation. However, in examining the manuscript more closely, one factor that appears to be common to the most damaged leaves is the artist who executed the illuminations. Figure 11 presents one of the leaves with the same color palette but is in excellent condition. The leaves appear similar, but closer examination reveals differences in the media of the gold backgrounds, the fineness of pigment preparation, and the skill of execution. Approximately one-third of the manuscript appears to have been illuminated by one particular artist whose work seems more prone to instability and required the majority of treatment in the manuscript.

#### STABILITY FACTORS

In reviewing the five problem manuscripts, we were unable to identify any major flaw in the consolidation protocol that

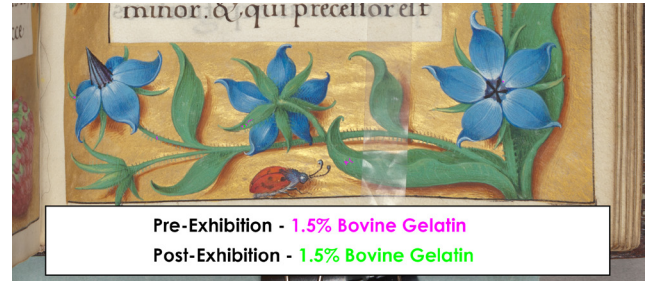


Fig. 11. Detail image of an illumination from Ms Typ 252 with the same color palette as figure 10 but in excellent condition. Comparison to figures 9 and 10 reveal a second artist, whose work was less susceptible to media instability. Gospel readings for Holy Week, Ms Typ 252, Houghton Library, Harvard University.

might lead to the problems observed. Instead, the manuscripts all presented inherent stability issues that would have been difficult to address in the best of circumstances. Addressing these issues had been complicated by the deadlines imposed by the exhibition schedule. Another complicating factor was the extensive handling for the exhibition, as well as the often frequent, heavy use in a research library environment.

The most challenging manuscripts treated, both before and after exhibition, posed one common question that was difficult to answer: when should we stop the treatment? During treatment, it was obvious that the worst manuscripts had been significantly improved, but they were still not as stable as we would have liked. Continuing treatment was sometimes accompanied by a sense of diminishing returns. In other cases, there was a concern that handling in the course of treatment might be causing media instability at the same time other media was being stabilized.

#### PROTOCOL ADJUSTMENTS

After consideration, it was decided that the Weissman Preservation Center's consolidation protocol was sound, and only minor adjustments and some elaboration was needed to address issues found during the review process.

One general principle required further emphasis—open communication. Even small changes and ideas can be of benefit to a larger group, and care must be taken to be certain that such information is communicated as widely as possible within the teams and, of equal importance, between teams. Consolidation treatments will continue in the Weissman Preservation Center, and observations and developments in technique will be discussed within the consolidation team(s) and recorded in the documentation notebook or protocol to ensure communication to all.

The issue of diminishing returns and criteria for determining when to cease treatment will be considered. Quantifying when to step back will be a challenge, but there is a point where further intervention is of limited benefit and may even be harmful.

Common factors affecting media stability will be identified in the protocol as red flags for attention. Approaches and treatment techniques that have been found helpful in such situations will be included. Particular areas for consideration are gutter cockling, ceases, glazes, and overpainting and restoration.

Adhesive selection to suite particular situations also requires further elaboration in the protocol. It is hoped that we will be able to identify the most appropriate adhesive sooner in the consolidation process. Although bovine gelatin was the preferred adhesive for most consolidation work, the HMW fish gelatin was more effective for some challenging media.

#### FUTURE RESEARCH

Selecting adhesives for consolidation is a subject that requires more investigation and research. Even common consolidation adhesives, such as bovine gelatin, are not well understood, particularly when one considers the variety of grades that are available, such as photo, lab, and pharmaceutical grades, each with their own physical, chemical, and working characteristics that might affect media. Future research will involve working with a conservation scientist to pursue materials testing and potentially accelerated aging. The goal will be to develop a better understanding of the range of adhesives available for consolidation and how they interact with some of the most beautiful but fragile objects in our care.

#### ACKNOWLEDGMENTS

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#### REFERENCE

Mayer, D. D., and A. Puglia. 2016. The challenge of scale: Treatment of 160 illuminated manuscripts for exhibition. *AIC Book and Paper Group Annual 35*: 61-69.

#### SOURCES OF MATERIALS

Strapping thread:  
Wonder Invisible Thread, .004 Nylon Monofilament  
YLI Company  
Locally sourced, widely available

Paper points:  
Kerr Endodontics Absorbent Points, XX-Fine (16215)  
Darby Dental  
<https://www.darbydental.com/scripts/ProdPage.aspx?grp=8540198>

Adhesives:  
Acros, Gelatin type B (#61225-5000)  
VWR Scientific  
<https://us.vwr.com/store/product/18604377/gelatin-type-b-laboratory-grade>

Norland High Molecular Weight (HMW) Fish Gelatin  
Norland Products  
<https://www.norlandprod.com/fishgel/himol.html>

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