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The Challenge of Scale: Treatment of 160 Illuminated Manuscripts for Exhibition

ABSTRACT

The senior conservators at the Weissman Preservation Center at Harvard University routinely establish protocols for the treatment of large collections and projects. These protocols are designed to integrate expert skills and techniques, quality control, and an efficient workflow. This paper highlights the principles for the consolidation of flaking and friable media that was used to prepare 160 illuminated manuscripts for exhibition. This protocol is rigorous and includes procedures to evaluate, treat, and document the consolidation of the manuscripts.

The protocol ensures uniformity in treatment procedures and judgment. Consensus is an essential component on large projects involving many conservators. We have learned that the degree of uniformity and treatment quality is substantially greater when multiple conservators collectively agree and follow the same guiding principles. This approach goes beyond procedural processes—it aligns decision-making and judgment.

The result of having all conservators follow the same protocol gives the appearance that one person treated the entire collection. Best practices are achieved through collective and collaborative understanding. The process of developing the protocol requires extensive discussion, being open-minded, sharing observations and suppressing ego. A team approach (of two or more people) is essential to help ensure the development, refinement, and execution of best standards of practice. By sharing the workload, large quantities of high-quality work can be performed throughout the entire project without burnout and in a reasonable time frame.

INTRODUCTION

This paper outlines the strategies for workflow and treatment that the conservators at the Weissman Preservation Center—the special collections conservation and preservation unit for the Harvard Library—implemented in the preparation of the largest-ever exhibition of Medieval and Renaissance illuminated manuscripts mounted in North America, and did so on short notice. Concurrently, the conservators took this opportunity to refine and codify our own best-practice procedures for the consolidation of flaking and friable media.

While there is never quite enough time it seems for any conservation project, our task was to prepare over 160 illuminated manuscripts in barely two years for the exhibition, *Beyond Words: Illuminated Manuscripts in Boston Collections,* which had three simultaneous venues, beginning in September 2016. Each manuscript required close examination, documentation, and in most cases, media consolidation and structural repairs as well as exhibition cradles. Alan Puglia and Debora Mayer, senior conservators at the Weissman Preservation Center, managed the conservation workflow.

The first portion of the paper covers our estimating procedure and how we grappled with staffing and workflow to match the scale of the project. The second portion highlights the treatment protocol the Weissman Preservation Center staff developed for the consolidation of friable media typical of illuminated manuscripts. The protocol incorporates expert skills and techniques, uniformity in judgment, quality control, efficient workflow, and a schedule sensitive to staff fatigue in order to maintain high-quality workmanship throughout the project—regardless of who is performing the treatment. The workflow for media consolidation in this project utilized two stereo binocular microscope stations [figure 1].

THE WEISSMAN PRESERVATION CENTER AND OVERVIEW OF THE MANUSCRIPTS

The Weissman Preservation Center is a fully equipped facility with a staff of 25 conservators, technicians, and interns. The Center is responsible for the conservation and preservation of the vast holdings of special collections in the Harvard Library,

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Fig. 1. One of two stereomicroscopy stations for consolidation. The floor stand makes this microscope ideal for large format materials.

Fig. 2. Manuscript supported in temporary corrugated board cradle for consolidation. Detached and fragmented board. MS Lat 129. Breviary. Houghton Library, Harvard University.

Fig. 3. Large manuscript supported with foam cradle. MS Typ 79. Gradual. Lippo Vanni. Houghton Library, Harvard University.

the rare and unique materials of 73 individual repositories. Given the magnitude of the holdings, the Center routinely develops strategies to care for and treat individual items and entire collections.

This project however, was the Center's first experience in treating so many individually complex, challenging materials, and structures within a firm deadline. Furthermore, all treatment work required conservator-level experience and expertise in media consolidation utilizing the stereomicroscope.

The illuminated manuscripts in the exhibition date from the 9th to the 16th centuries and include bibles, books of hours, antiphonals, graduals, breviaries, and secular manuscripts. They range in dimension from pocket manuscripts that fit in the palm of a hand to large and heavy antiphonals that require two people to lift. [figures 2 and 3] The manuscripts vary in condition structurally from original, intact bindings to manuscripts with detached boards and broken sewing. The media varies from full color medieval palette applied in multiple layers of paint and gold leaf covering most of the parchment page to minimal drawing and pale washes of color.

Typical types of media damage include abrasion to the media surface in which the disturbed area is friable while surrounding surface is stable [figure 4], flakes of paint sometimes standing on edge [figure 5], massive loss of media [figure 6], and loss of media from flexing of the parchment [figure 7]. We learned by prior humbling experience that visual observation alone, even with magnification, was insufficient to judge the stability of media. Media that appears stable is not necessarily so, and media with major losses may not necessarily be unstable as seen in figure 6. Therefore, we test all media for stability, regardless of visual appearance.

Each manuscript is in itself a unique object and worthy of technical study. Although we were able to study some manuscripts in more detail, the exhibit deadline did not permit extensive study.

TREATMENT PARAMETERS AND ESTIMATING TREATMENT TIME

Because of the short time frame and scale of the project, we could not consolidate all illuminations in every manuscript —our preferred approach when preparing them for exhibition or imaging. After consultation with several conservators in other institutions, we adopted a policy of examining, and treating as necessary, only the illuminations within ten leaves of the display opening. We also included any illuminations on the first leaf, recognizing that it most often receives excessive handling. We focused on binding and structural issues that would impact handling during consolidation, travel to off-site venues, and for the manuscript to remain open for the three to four month-long exhibition.

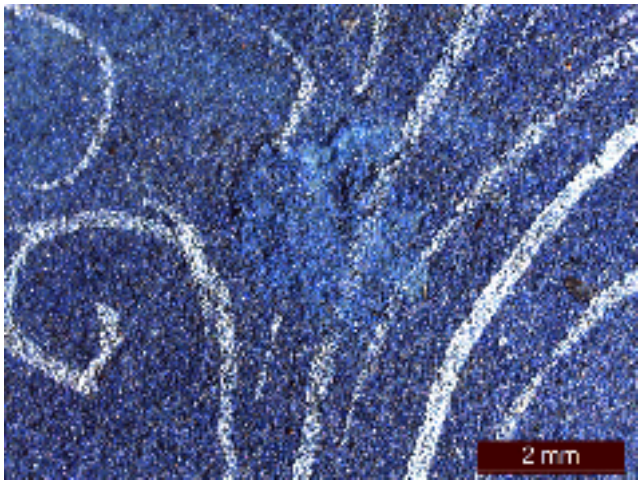

Fig. 4. Friable media resulting in loss of surface design, likely caused by abrasion. 15x. MS Typ Inc 2756. Missal. Houghton Library, Harvard University.

Fig. 5. Chips of paint standing on edge and friable. 15x. MS Typ 489. Houghton Library, Harvard University.

Fig. 6. Despite massive loss of media overall, the remaining media tested stable and did not require treatment. MS Typ 322.

Fig. 7. A typical loss of media caused from flexing of the parchment support, as viewed in transmitted light. MS Lat 161. Houghton Library, Harvard University.

With these parameters in mind, conservators reviewed all manuscripts considered by the curators—systematically collating information that impacted treatment and display.

DATA GATHERING

To estimate time for consolidation treatment, we measured all of the illuminations on the folios to be examined. This measurement became the core of our consolidation treatment estimate. We learned from prior consolidation projects that our procedure takes, on average, 2.5-3 minutes per square centimeter to complete.

For structural issues, any limitation of the binding opening was noted and used to determine the angle of display opening. Time estimates were made for recommended repairs, such as board re-attachment or other structural stabilization.

Extra time was added for unusual, heavy, or large items.

The estimate included time for the examination, report writing, and extensive imaging.

Other non-treatment information gathered for the project estimate included housing needs, cradle making, framing of single leaf manuscripts, condition checking, packing, and installation. The time for these activities was substantial and impacted the treatment timeline; however, these aspects are not addressed in this paper.

Excel worksheets were used to tabulate the time to treat all the manuscripts as well as the time to treat each manuscript individually. From this information, we planned workflows.

THE ESTIMATE RESULTS AND PLANNING THE WORKFLOW

Data collected from the reviews revealed that there were 57,000 square centimeters of illumination to examine and potentially treat. 57,000 square centimeters of illumination is

comparable to a 2 x 3 meter or 6 x 10 foot tabletop filled solid with illumination. Thought of in this way, the total seemed smaller than expected but we recognized that consolidation is meticulous work performed through the microscope, one millimeter at a time. The consolidation estimate alone, at three minutes per square centimeter, was 2800 hours.

Consolidation was more than half of the total conservation estimate. Oversize manuscripts, structural repairs, documentation, and fabricating or modifying housings were estimated to require approximately 2200 hours.

The two estimates combined resulted in 5000 hours of conservation treatment time. This correlates roughly to three conservators working full time, solely on this project and no other treatment-based projects. Unfortunately, the manuscript exhibit was only one of numerous conservation and exhibition projects that needed to be completed throughout the two-year time span.

The deadline for completing conservation treatment was set by counting back from the installation dates the time required for fabricating cradles and sealed framing packages, performing condition reviews for loaned materials, and installation time itself. We determined that with ten of our conservators, essentially all our book and paper conservators, working half-day shifts, we could finish the consolidation work by the deadline. The team approach would allow us to avoid staff fatigue and continue with other concurrent projects.

THE WEISSMAN CONSOLIDATION PROTOCOL

Our challenge was to form a team of ten conservators with different backgrounds and approaches to work collectively in an efficient workflow.

The Weissman Consolidation Protocol evolved over the years. Book and paper conservators, working alongside curators, discussed goals and researched trends in media consolidation to create a manual, for staff to follow.

KEY ELEMENTS OF THE PROTOCOL

A shared goal of the protocol was to achieve *excellence and uniformity in treatment* so that all the work appeared to be performed by one hand. This was obtained by implementing:

- *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 make sure that we do not miss areas, the consolidation is effective and that 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.

THE MICROSCOPY STATION AND TOOLS

An overview of the microscopy station is seen in figure 8. In the center of the image, the manuscript is supported with a cradle and strapped so that the page being treated is relatively planar. Because the illumination on the verso of the leaf is being treated, the manuscript is oriented upside down to the viewer, a setup which is arranged for right-handed conservators. On the far right is a dilute solution of bovine gelatin- our typical consolidation adhesive—in a mini Erlenmeyer flask warmed in a *bain marie* or water bath on a cup warmer. We find that keeping gelatin at about 100 degrees Fahrenheit or 38 degrees Celsius yields a more viscous solution that sets faster and reduces the risk of penetration into the parchment. The working solution also degrades slower over the course of a week than gelatin kept at a higher temperature. To achieve the desired temperature, the cup warmer is plugged into a variable transformer placed on the floor.

The magnification and focus knobs on this microscope are separate from the body of the scope and can be positioned per operator preference. Removing the controls from the main body of the microscope allows greater access to the

Fig. 8. The photograph is a slight panorama so the desk looks a bit round. The microscopy station from right to left includes; an assortment of tools, consolidation adhesive warmed on a cup warmer plugged into a variable transformer, the manuscript supported in a cradle, bench top magnification and focusing controls with foot pedals below, the computer monitor displaying the during treatment image of the illumination, and the notebook of treatment records.

gutter of the manuscript and rapid focus adjustments. This microscope also has an option for foot petal controls so both hands can be free to hold tools. The foot petals are on a step stool under the bench.

The computer monitor displays the before treatment digital image of the illumination—enlarged and focused on the area being treated. Using Photoshop, all treated areas are color-coded in a bright color to indicate the type of adhesive used—typically magenta for bovine gelatin.

Below the monitor is the treatment notebook which includes documents relating to the manuscripts currently in treatment. The notebook contains a copy of the treatment proposal, a time sheet, and a print-out of each illumination being treated. The paper print-out serves as the written platform for communication between team members and records the status of treatment.

Fig. 9. The microscopy station as seen from above, including ergonomic arm support.

Fig. 10. Paper point for media testing mounted in a pin vise.

A view of the consolidation work-station from above can be seen in Figure 9. Everything needed is close at hand. Notice the arm support which can be used to steady the arm and reduce worker fatigue. The microscopy station is considered its own space and conservators sign up to use the setup on a shared calendar.

The typical consolidation tool set-up includes gelatin on the cup warmer, an assortment of fine brushes, spatulas, paper points, and ethanol which is sometimes used to modify the gelatin application. The tool used to test for media stability is a fine paper point inserted into a pin vise. Paper points are narrow, feather-weight rolls of paper commonly used by dentists to wick fluid and adopted by conservators for inpainting. [figure 10]

THE TREATMENT PROCEDURE

While looking through the microscope the conservator uses the paper point to lightly touch the media to detect media insecurity. We settled on this technique because team members consistently reached the same determination of media stability or instability when using the paper point. During trials using a fine brush we did not reach consensus and judged situations differently. [figure 11]

A typical example of cracked media and granular pigment surface at our working magnification of 15x is seen in figure 12. Crevices and surfaces are both tested for loose particles and flakes. Using the paper point we can, more often than not, precisely locate the area of instability resulting in a targeted placement of the consolidation adhesive. We found testing with a brush was less straightforward and precise. [figure 12]

For the presentation at the conference, a series of videos, taken through the microscope, were shown to demonstrate the three-part procedure for consolidation: evaluating media, applying consolidation adhesive, and re-testing the area for treatment success. To detect loose media, especially around an area of loss, observe the paper point as it lightly touches the chip of media, watching to see if a shadow increases or decreases. [figure 13] A change in the shadow profile shows that the chip is loose and indicates that there is blind cleavage- and the flake should be treated to secure it in place. To detect powdery or friable media, observe if small particles move as the paper point lightly touches and strokes the surface. Offset of media to adjacent areas or to the facing page is a clue of disturbed media and the corresponding area may require treatment.

Loose flakes and friable media are generally consolidated with dilute gelatin, typically applied with a small brush into the area of loss to secure the chip of paint or the friable surface. When the adhesive application goes according to plan, it flows perfectly under the flake and secures it in place or into the porous interstices of the paint matrix. [figure 14] If, by chance, the adhesive application is excessive, the absorbent paper point can be used to wick the excess gelatin. The

Fig. 11. Endontic absorbent paper points used for media testing. Conservator steadies hand with pinky finger on fiber optic light stem.

Fig. 12. Absorbent paper point in use at 15x, the magnification used for media testing. MS Typ Inc 2756. Missal. Houghton Library, Harvard University.

Fig. 13. Frame capture from a video of testing media for stability. Observing change in shadow profile as the chip is lightly touched with the paper point. 15 x. MS Typ 443. Houghton Library, Harvard University.

Fig. 14. Frame capture from a video of applying gelatin adhesive to flow underneath the paint chip. Same area of loss as in figure 13. 15 x. MS Typ 443. Houghton Library, Harvard University.

adhesive is applied sparingly to avoid over-wetting of the media and parchment. If additional adhesive is required, it is applied after the area has dried.

Following initial consolidation treatment, the entire illumination is checked both for unstable media that was missed or treated media that requires additional attention. At least one full day is allowed after treatment to ensure that adhesives have set and dried fully. The checking procedure is exactly the same as the initial testing process described above. Success is determined by no movement of the media as indicated by: no change in shadow, friable media is no longer dislodged, and there is no visible change to the media surface from treatment. In the video you could see that after treatment, the chip did not move when touched with the paper point, there was no change in the shadow as before and the media surface was not visibly altered. The evaluation, treatment, and checking steps are repeated as necessary with successive rounds concentrating on problematic areas to ensure success.

The checking step is a key feature of the protocol. Since all consolidation work is performed with magnification, there is no other way to verify treatment success except through the microscope. And we have learned that two sets of eyes and hands ensure that we have performed the best job possible. In the team approach, ego must be set aside as one's work is reviewed by fellow conservators. Open, non-judgmental minds allow the team as a whole to learn from mistakes, improve techniques, and produce results superior to working alone.

As treatment progresses, the digital image displayed on the monitor is marked up using Photoshop to delineate the areas of consolidation treatment. At the same time the photocopy in the binder is also marked up and serves as a place to write

notes. The marked up areas on the images will not be obvious in the printed black and white images but can be seen in the downloaded version in color from the web. [figure 15]

The left photocopy in figure 16 shows a straightforward treatment. The conservator signed and dated the photocopy when they treated the illumination. The diagonal line across the bottom corner signals that the illumination is ready to be checked. After a day or more has passed, a different member of the team checks the entire illumination and signs off that it is OK—meaning all media was found to be secure when they did the check.

The right photocopy in figure 16 shows a more complex treatment. Notice the commentary, which we often leave for each other, about our observations of trouble areas or sometimes information regarding material inquiry or delight. This manuscript required multiple checks and re-application of adhesive in selected areas before the consolidation was considered complete.

Most often we use bovine gelatin (Acros Organics, type b, ~100 bloom), at a 1.5% w/v solution in deionized water, with the addition of a few drops of ethanol. In certain instances, fish gelatin (Norland Products, high molecular weight) is used when stronger adhesion, better flow, or greater dilution is warranted. In the dry granular form, bovine gelatin is amber in color and the fish gelatin is the color of light cream. In this project we found that brush application of the consolidation adhesive worked very well. In other consolidation treatments we have used a nebulizer to create an adhesive mist to apply, often through a template or shield, to broad fields of powdery and friable media.

Some favorite tools are fine brushes, rounded dental tools, Delrin spatulas (polyoxymethylene) and standard spatulas fitted with an extension of silicon-coated release Mylar. The spatula has a slight arc to keep the Mylar oriented upward to avoid an accidental touch or poke of the media. The rounded dental tools and the Delrin spatulas are used when slight pressure is needed to encourage adhesion. [figure 17]

Setting down gold leaf is a common instance where slight pressure may be helpful. Occasionally fish gelatin is used when prior application of the bovine gelatin is insufficient. After the adhesive is applied, encouraging adhesion is a two-step process. First the silicon release Mylar is laid in place as a barrier and then the Delrin spatula is used to apply slight pressure through the release Mylar. [figure 18] It is important to wait several seconds after the adhesive is applied before applying pressure so the media is not too wet during the procedure.

After all treatment is completed, a final report is written which includes tasks performed, materials used as well as the names of the conservators who worked on the manuscript. The report and all the images (before and after treatment as well as the marked up images in Photoshop) are incorporated into the treatment record database and uploaded into a digital

Fig. 15. Computer screen shot showing during treatment image with areas of consolidation treatment marked in magenta using Photoshop. The photocopy in the treatment notebook (below) is marked in red pencil to denote areas of treatment.

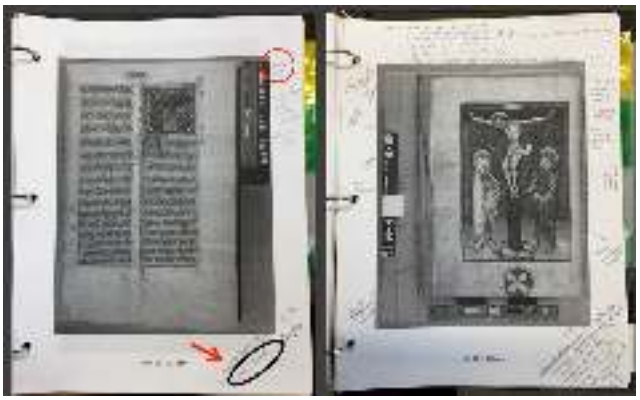

Fig. 16. Left: An example of a treatment tracking sheet for a straight forward consolidation treatment. One conservator consolidated the illumination and a different conservator checked the manuscript for treatment success. No issues noted. Right: An example of a tracking sheet for a complex consolidation treatment. Note the various notations in the margins to inform all team members of problem areas, areas of interest, and the multiple re-checks.

Fig. 17. Typical selection of hand tools in our consolidation process. Short handle brushes 4/0 to 5/0, round-ended dental tool, home-made shaped Delrin spatula, and spatula with extension of silicon-coated release Mylar.

Fig. 18. Following application of fish gelatin, a Delrin spatula is used to apply gentle pressure through silicone-coated release Mylar to encourage adhesion of gold leaf. 15x MS Typ 127. Houghton Library, Harvard University.

Fig. 19. Completed treatment report from ACORN, the Weissman Preservation Center's record keeping data base and the accompanying screen view of completed during treatment image with a label denoting that gelatin was the consolidation adhesive used. MS Typ Inc 2756. Missal. Houghton Library, Harvard University.

repository for permanent record storage. [figure 19] For more information on the Weissman Preservation Center's record keeping database, see Debra Cuoco's 2016 AIC Conference poster on *ACORN*, our conservation documentation system.

CONCLUSION

We have learned that consolidation treatment is a relentlessly demanding activity that is ultimately humbling.

We believe a team approach consisting of two or more people is ideal with regard to consolidation of illuminated manuscripts. By sharing the workload and setting standards, large quantities of high-quality work can be performed without burnout and in a reasonable time frame.

The conservators at the Weissman Preservation Center have also learned that the quality of treatment and the degree of uniformity are substantially greater when multiple conservators collectively agree and follow the same guiding principles. This approach goes beyond procedural processes—it aligns decision-making and judgment.

We hope this presentation illustrates the benefits of establishing protocols. Keep in mind that these procedures can be adapted to fit your lab needs by using your preferred tools and techniques, selecting different adhesives, and even altering judgment parameters.

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SUPPLIES AND TOOLS

MICROSCOPE

- Leica MZ16 microscope: Leica Microsystems, http://www.leica-microsystems.com .63 objective, 10x eyepieces, Ergo tube 10 deg. to 50 deg., Motor focus with inclinable column, Motor focus footswitch and manual bench-top control knobs
- Schott, KL 1500 LCD: http://www.us.schott.com/lightingimaging/english/microscopy/products.html

CONSOLIDATION TOOLS

Paper points

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

Brushes: Brush options come and go frequently. Current favorites are:

- Escoda Perla synthetic 5/0 and 4/0, round, short handle, http://www.dickblick.com/products/escoda-perla-toray-white-synthetic-round/

- Escoda Barroco Toray gold 5/0 and 4/0, round, short handle, http://www.dickblick.com/products/escoda-barroco-toray-gold-synthetic/
- Kolinsnky Raphael 5/0 and 4/0, may no longer be available

Nebulizer
- Pari LC Plus nebulizer
- Devilbiss Traveler compressor

Delrin micro spatula (Fabricated in-house)
- Delrin: 1/8" x 1" wide, sourced from McMaster-Carr http://www.mcmaster.com/#8739K11

ADHESIVES
- Acros, Gelatin type B (#61225-5000): Sourced from VWR Scientific, https://us.vwr.com/store/product/18604377/gelatin-type-b-laboratory-grade
- High Molecular Weight Fish Gelatin: Norland Products, https://www.norlandprod.com/

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