Article: Conservation of an American Icon: the Reconstruction of the Lincoln Interpositive
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Conservation of an American Icon: The Reconstruction of the Lincoln Interpositive

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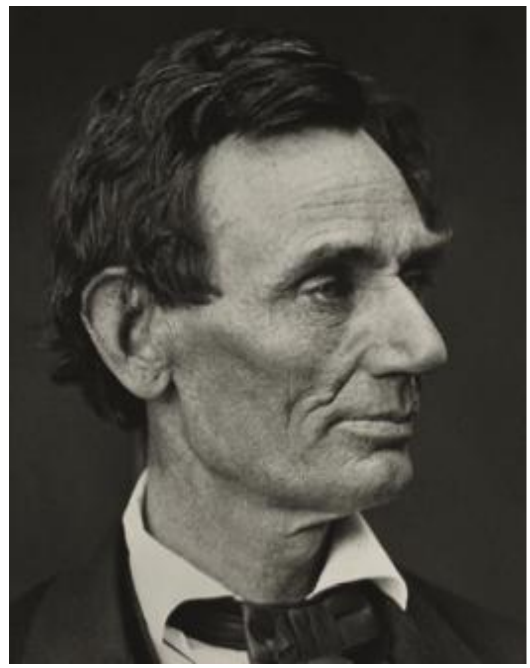
ABSTRACT

There is one photograph that is widely credited as being responsible for Abraham Lincoln's election in 1860. Often referred to as O-26 in the Ostendorf system, Lincoln himself said of the image "That looks better and expresses me better than any I have ever seen" (Ostendorf, 47).



The subject of this case study is a 22x28 cm gelatin glass plate interpositive of Abraham Lincoln made by George B. Ayres circa 1895, from a Collodion negative originally taken in 1860 by Alexander Hesler. The purpose of this case study is to share some details of the treatment, namely vertical assembly and adhesive choices that the author explored in the course of her research as a fellow in the fourth cycle of the Advanced Residency Program in Photograph Conservation at the George Eastman House International Museum of Film and Photography in Rochester, New York.

The artifact was broken into 26 pieces with 4 areas of loss. There was an even patina of mirroring on the emulsion side. The adhesive residue was removed with acetone swabs and the glass side cleaned with Ethanol/ water (30:70) swabs. The blind cracks were stabilized and the shards were adhered with warm 25% B-72 in Toluene. The losses were filled with epoxy and toned with pigment ink-jet prints on transparency stock. The repaired interpositive was ultimately supported by a silicone backing and housed in a custom-built wooden display case, with backlighting.

INTRODUCTION

Glass has been used in photography since its beginnings in the early 19th century. During the mid-1800s and into the early 1900s glass was the predominant support for photographs; consequently it is present in almost every institution's photograph collection. The treatment of broken photographs on glass has been an issue in photograph conservation for some time. There are many questions as to the best methods for the consolidation of flaking emulsion, the filling of losses and the repair of broken supports.

HISTORY

The artifact was brought to the George Eastman House conservation laboratory in the spring of 2007 by an intermediary and assigned an Eastman House Conservation Department treatment number: CNS 0511:54:01. The interpositive arrived in a paper folder (fig. 1) with handwritten notes naming the assistant to the original photographer and other details as follows:

"Geo. B. Ayers
Lincoln no. 2 positive
2 22x28 negatives made from this Nov 13, 1900
WHR"

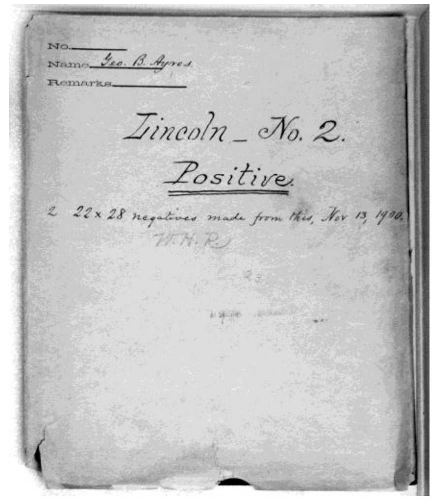


Fig. 1. The original paper folder.

Initial Assessment of the Artifact:
Previous Treatment: There was adhesive and paper tape residue along the main piece (#1) and pieces 5 and 6, indicating that this plate was probably broken at two times in the past: once diagonally along the center and repaired with the paper tape and adhesive, and then again when the repair failed, shattering the lower half of the plate.

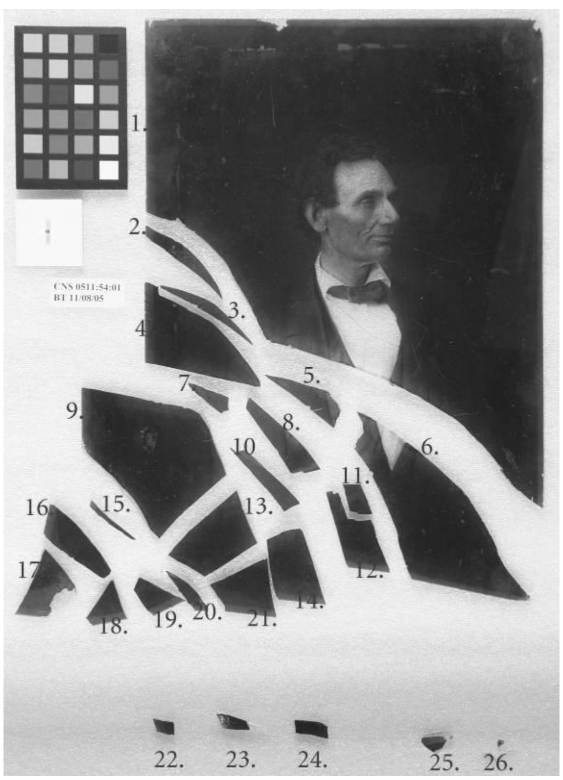


Fig. 2. Fragments of the broken glass plate.

Fig. 3. Silver mirroring visible on the surface.

Glass Support: The plate had been broken with 26 pieces present (fig. 2.) The pieces were assigned identifying numbers, later used in the virtual assembly (below.) Piece #1 had been broken from the left central edge to the bottom right corner and had cracked in the top right corner and along the left edge, 9 cm from the top, and on the right edge, 23.5 cm from the top. #5 has broken into 2 pieces without breaking the emulsion (hereafter referred to as WBE), #4 into ~9 pieces WBE, #6 into 6 WBE, #7 has many internal fractures, #8 into ~10 WBE, #10 into 2 WBE, #11 into ~7 WBE, #12 into 2 WBE, #14 into 2 WBE, #16 into ~10 WBE, #19 into ~5 WBE, and #24 into 2 WBE.

There were tiny shards that had been lost along all the break edges. #17 had been crushed in one area with splintering and losses. There was minor soiling overall with fingerprints. There was yellowed and very dry adhesive residue along the break edges of pieces 1, 5 and 6. There were some minor scratches overall.

Emulsion: There was some delamination of the emulsion from the glass along the break edges. There were some minor losses associated with the breaks, and in the four original corners of the plate from normal use. There was minor soiling and fingerprints on all of the pieces. There was some yellowed adhesive residue in the bottom right corner of piece #1. There were some minor scratches over all. There was some slight yellowing associated with the age of the plate.

Final Image Material: There is mirroring overall with a greater concentration along the four original edges and in the corners (fig. 3).

PRELIMINARY TESTS & RESEARCH

The iconic stature of this object necessitated extensive research into the best treatment possible. Many adhesives were considered and tested and innovative applications were explored. The requirements of the treatment were reversibility, invisibility and matching of the refractive index between the adhesive and the glass which had a refractive index of about 1.5.

Assembly Method Options:

Upon consulting Stephen Koob, head of conservation at the Corning Museum of Glass, it was determined that it would not be possible to assemble the Lincoln interpositive horizontally, while simultaneously assuring that all of the pieces find and stay in perfect alignment.

The accepted method of reconstructing non-planar glass in glass conservation is to assemble the object vertically, using gravity's pull to fit the pieces together. Not only does the non-planar glass have subtle ripples on its surface (a consequence of its method of production—"cylindrical glass blowing"), but each fracture surface, though smooth, is undulating and irregular in its third dimension. Two adjacent shards will fit together perfectly in only one combination of planes. With experience, a conservator can learn when this position is attained. There are methods of assembly and tools available that will aid in the reconstruction of broken glass supported photographs. The improvements to this method that have been made are innovative in the field of photograph conservation, and promise to solve many problems that currently plague conservators of photographs on glass.

The accepted procedure in non-photograph glass conservation for assembling non-planar glass is as follows: A stable shard of glass is supported perpendicularly to the working surface, permitting no shifting during assembly. The object is then assembled by hand, using pressure sensitive plastic tape to hold the shards together. The shards are aligned by visual inspection and feel.

It is important that the object be assembled completely before any adhesive is applied between the shards in order to ensure continuing precise alignment of all aspects. In the case of an object such as the Lincoln interpositive that was broken into 26 pieces, the smallest misalignment during reconstruction would inevitably influence assembly of the subsequent pieces. This would lead to an additive combination of misalignments by the end of the process. By waiting until the entire object is assembled, these misalignments can be recognized and corrected before the adhesive is applied. Once the object has been assembled completely, adhesive is wicked into the shard interfaces and allowed to cure. The object is then removed from the vertical support, the tape is removed, and excess adhesive is cleaned up.

One innovation that has been applied to this working method is the use of a fiber-optic array of lights in a "light line", which aids in the alignment of the shards: if they are misaligned in any direction, it is instantly apparent because the reflected image of the light line will not be straight on the surface of the object.

A second innovation was to use Vigor sticky wax to hold the shards during assembly, instead of pressure sensitive tape. Plastic tape, while easy to use and completely removable, has a flexible plastic carrier that gives minimal support. Vigor sticky wax becomes soft with low heat and hardens at room temperature, providing a stiff support for the assembled pieces. It is also very easily removable once the adhesive has been applied. An added benefit of using fiber-optic lighting on the edge of the glass is that it illuminates the shard interfaces during assembly and allows the conservator to know when the proper amount of adhesive has been applied.

This method of assembly will also insure that the gelatin side of the plate is disturbed as little as possible. As seen in the initial examination report, there is, on the surface of the gelatin, an even silver patina that is very easily marred. The vertical assembly method insures that as little as possible will touch this surface.

For a full description of the vertical assembly process, please refer to *Topics in Photographic Preservation*, Volume 12 (Whitman and Wiegandt, 2007).

Adhesive Options:
To achieve an invisible repair of clear glass the adhesives used at the fracture interfaces must match the refractive index of the artifact's glass (Koob). Accordingly, the adhesives tested were Paraloid B-72 and Epoxy. Other transparent adhesives, such as Beva, were also considered, but eliminated due to reasons stated below. Ideally, the adhesive would have a refractive index that matches the artifact's, would have a suitable working time, and be thin enough to wick into a shard interface, all the while providing strength in the final cure. It is ultimately important that every process be completely reversible. There is no perfect adhesive available at this time.

Ultra-violet curing adhesives were not considered because they are unstable over time. They tend to discolor and crack because there are too many accelerators in the mix.

Vinyl resins such as PVAC and PVB were discussed. PVAC was ruled out as an adhesive because it has a low Tg (glass–liquid transition) of 28°C and is prone to cold flow. PVB has an appropriate refractive index of 1.49, but it cross-links on prolonged exposure to light (rendering it non-reversible) and should therefore be considered insoluble in the long term. UV setting adhesives were ruled out because they are very unstable over time, resulting in discoloration and cracking: there are too many accelerators in the mix.

Beva is a heat seal adhesive that is widely used for the lining of oil paintings, heat seal facings, and the making of laminates with fiberglass. Since BEVA 371 is completely dry at room temperature, it is easy to reassemble fragments and secure them in the right position with a tacking iron. BEVA 371 was specially formulated to have an activation temperature of 65-70°C. It is available in a film, which would solve our coating problems, but was deemed inappropriate for this repair because it is slightly opaque and the high temperature required for activation presented a risk to the image.

Epoxy resins used in conservation are typically composed of two parts, a di-epoxy component and a polyamine cross-linking agent, both of which are combined with diluents and catalysts. Epoxies have a refractive index of approximately 1.55. This adhesive is very strong and has low shrinkage upon curing. The disadvantage is that epoxy tends to yellow with time and exposure to light and is virtually irreversible.

Paraloid B-72 is an acrylic copolymer, made of ethyl methacrylate and methyl acrylate, with a refractive index of 1.48. It is soluble in a variety of organic solvents and has a Tg glass transition point of 40°C (approximately 104°F). A solution of 50-70% B-72 in a solvent is recommended for the assembly of glass fragments. A small amount of fumed silica (approximately .01% by weight) should be added to the solution to improve application and drying properties of the adhesive (Koob). The B-72 will set hard in 1-2 hours (possibly longer for very thick glass). A problem with B-72 is that when it is used with a solvent (an aromatic), over time as the repair cures and the solvent evaporates, "snowflakes" (actually tiny air bubbles) can appear in the repair areas (fig. 4), thereby making the adhesive inappropriate for glass plate photograph repair where an invisible, clear repair is desired.

Fig. 4. "Snowflakes" formed within a break mended with Paraloid B-72.

However, it has been proposed by Ralph Wiegandt of the George Eastman House that if B-72 were dissolved in the appropriate solvent, coated upon a repair surface, and allowed to fully cure, the air bubbles ("snowflakes") would not form, because air would not be trapped within the repair site. Then, if the object is assembled, putting these pure B-72 sites into contact, and stabilized, the object could then be placed in an environment where the temperature is slowly raised to 40°C, the Tg of B-72. The B-72 in the repair sites would then soften and adhere the shards together. Upon cooling, the B-72 will again harden, with no snowflake formation. We opted against this method because of the risk engendered in heating the plate to 40°C.

Cyanoacrylate adhesives are generally unsuitable for glass restoration, except for effecting temporary repairs. These adhesives are reversible, have a refractive index that match plate glass, and have good working properties, but are not used in glass conservation because the alkaline nature of glass causes the adhesive to "snap bond" upon contact and create a very brittle bond.

Backing Options:
It was deemed necessary to provide a secondary support to shore up the repaired interpositive because it consisted of many shards and was approximately 8 x 10 inches in size. P4 clear silicone from Silicones Inc. passed the photographic activity test (PAT) and is appropriate for use with photographic materials. In this case, the silicone was used as a barrier layer between the glass side of the repaired plate and the borosilicate backing glass.

TREATMENT

Testing of Materials:
After narrowing the field of adhesive and backing options down to B-72 and silicone, the Photographic Activity Test (PAT) was conducted on both by the Image Permanence Institute at Rochester Institute of Technology. Both materials passed the test and were deemed the appropriate choices for the treatment.

Practice:
In the months leading up to the final reconstruction, I honed the vertical assembly technique by practicing on blank sheets of both planar and non-planar glass. After a level of proficiency had been gained, I moved on to practicing on 'cadavers' – otherwise worthless broken glass-plate negatives that had been donated to the Eastman House by an insurance company. This practice was essential in gaining the skills and confidence necessary to take on the Lincoln.

Preparation:
Cleaning: Cotton swabs dipped in acetone were used to remove the adhesive and paper residues from the glass side and shard interfaces of pieces #1, #5 and #6. . . On the gelatin side of the pieces there was some residue that was removed with acetone swabs applied in a light, rolling and dabbing motion to discourage the delamination of the image gelatin. The adhesive from the previous treatment had migrated under the gelatin in a few areas on shard #1. I soaked it out as well as possible with acetone swabs.

Virtual assembly: In another innovation, prior to any real-world conservation, I assembled the artifact virtually in Photoshop. This method reduced the handling of the shards thereby reducing the chance of further damage. It also alerted us to the loss of shards.

To assemble the artifact in Photoshop, the entire plate was scanned using a flatbed scanner with transmitted light capability. The document was then opened in Photoshop and each of the shards was made a layer within the document. Each of the shards could then be selected and manipulated using the rotate and move tools. The final, virtually assembled shards were each given a number for handling ease (Figure 2).

Consolidation of lifting emulsion: Lifting emulsion was consolidated with 2% photographic-grade gelatin in distilled water. It was applied with a small brush (size 000) and covered with a piece of silicone release Mylar, applied with gentle finger pressure. This was then left to set under light weight.

Stabilization of blind cracks: The shards with blind cracks were stabilized by wicking in warmed B-72 in toluene with a small brush. Excess adhesive was cleaned up with a dry cotton swab and the pieces were left to cure, under weight, for three days. After that time, the pieces were stabilized by adhering sticky wax to the glass for the remainder of the curing time.

Assembly:
The shard interfaces were cleaned with acetone swabs before the assembly was begun. The plate was assembled vertically, with the image upside-down and stabilized with sticky wax. Towards the end of the process, the remaining pieces were too small for vertical assembly. The object was laid flat on a Silpat© mat and the pieces were fit into place. Because the sticky wax is a large blob, small dabs of Apollo Cyanoacrylate were applied to hold the tiny pieces in place.

The assembled plate was then brought back to a vertical position and 25% B-72 in Toluene was wicked into the shard interfaces.

The plate was then left in position to cure overnight. After that time, the plate was laid emulsion side down in a padded box and left to cure for two weeks.

Cleanup:
Once the adhesive was fully cured, the wax was removed from the glass with a heated scalpel and mineral spirits. Any excess adhesive was removed with acetone swabs.

Post-Assembly:
Dealing with the missing shards: After much research, it was determined that epoxy fills would be created then covered with inkjet transparencies to replicate the losses. The factors that lead to that decision were that epoxy is clear, has a similar refractive index as plate glass, and it can be poured into the loss areas. First, the areas of the non-emulsion side of the glass bordering each of the losses were coated with microcrystalline wax, and Mylar was applied on the glass side of the plate. This was to keep the epoxy contained within the loss. Dental wax was then applied to back the Mylar to seal off the reservoir for the pouring of the epoxy. The shard interfaces of the losses were coated with B-72 to create a barrier between the glass and the epoxy fill. The plate was then made level in preparation for the epoxy application. Finally, the epoxy fill was poured. Special care was taken to top off the fill as the epoxy set and slightly contracted. (For a full description of this process, see Koob, 2007).

Silicone backing preparation and application: After more research and PAT testing, a P4 clear silicone bed from Silicones.inc was settled upon for the backing material to support the stabilized interpositive plate. A Plexiglas tray was made to fit the plate and the emulsion side was protected with a wax sealed cover glass. Then the liquid Silicone was poured onto the glass side of the interpositive so it would be in total optical contact with the glass. For a full description of the silicone backing process, see Whitman and Wiegandt, *Case study: Repair of a broken glass plate negative*, Topics Volume 12.

Inkjet toning of infills: Digitally reproduced inserts on transparency stock were created to mask the blank fill areas. These are visible as dark areas when the transparency light is off and clear areas when the light is on.

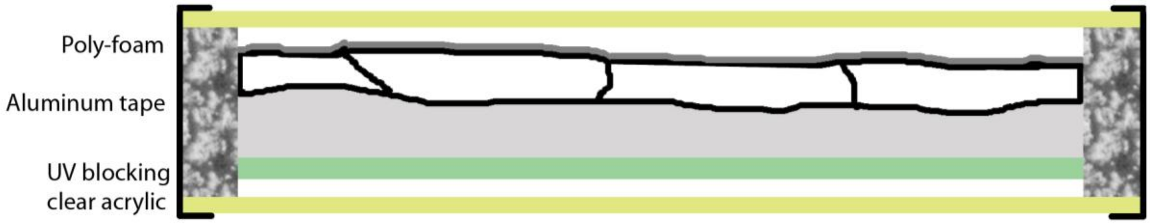


Fig. 5. A cross section of the plate package's housing.

Final housing: The final plate package design, created and executed by Ralph Wiegandt, was simple and effective. The silicone bed was backed with glass, and then encased with a polyethylene foam surround that supports a UV light blocking clear acrylic cover on both sides. The unit is bound around the perimeter with aluminum tape (figure 5). This unit can be safely handled separately from the decorative display case that only allows the conserved image to be seen.

Fig. 6. Before treatment.

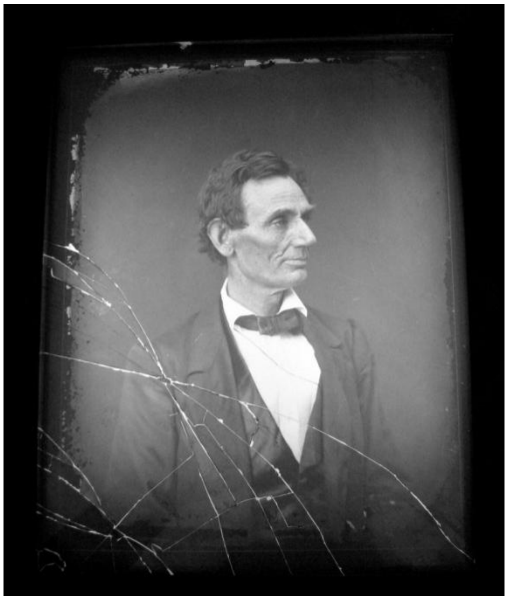


Fig. 7. After treatment.

Design and fabrication of the unique wooden "reliquary" presentation case was provided by Arnold Van Denburgh. The doors of the case feature quarter-matched crotch mahogany veneer panels. While the case is closed the light is off, protecting the image. A toggle switch in the top left hand corner turns the light on when the case is opened.

Fig. 8. Wooden "reliquary" presentation case.

CONCLUSIONS

The vertical assembly method, using a light line and sticky wax to hold the pieces in place, is a viable process for the assembly of non-planar glass. The method protects the emulsion side of the artifact, preserving any mirroring and preventing the migration of adhesive that can occur with the traditional horizontal assembly method.

The use of B-72 as the adhesive can be up for debate since the appearance of bubbles or "snowflakes" in the join is possible, although it did not occur in this treatment. While I believe that B-72 was the best possible choice at the time of the treatment, further research and development are suggested.

It could be argued that the losses of image area along the shard interfaces are distracting (see figure 7). Further research may lead to a reversible method to mask these losses if desired.

The final assembled artifact is now stable and housed at the George Eastman House in Rochester, NY. It was an honor to be part of the conservation and restoration of such an iconic piece of history.

MATERIALS and SUPPLIERS

Silicone release polyester film - Talas, http://talasonline .com
Ethafoam - Talas, http://talasonline .com
Permalife paper - Talas, http://talasonline .com
Paraloid B-72 – Conservation Resources International, http://conservationresources.com
Vigor sticky wax – Kingsley North Inc., http://www.kingsleynorth.com
Sintered Teflon – Plastomer Products Coltec Industries, Newton, PA (800) 618-4670
Clear P-4 Silicone – Silicones Incorporated, http://silicones-inc.com/p4.pdf

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