TOPICS IN

PHOTOGRAPHIC PRESERVATION

VOLUME FIFTEEN

Photographic Materials Group

The American Institute for Conservation of Historic & Artistic Works

2013

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Papers presented at the following meetings:

the Photographic Materials Group Session of the American Institute for Conservation Annual Meeting in Albuquerque, New Mexico, May 2012
and
the Joint Meeting of the Photographic Materials Group & the International Council of Museums Committee for Conservation, Working Group Photographic Materials in Wellington, New Zealand, February 2013

Compiled by Jessica Keister

Photographic Materials Group

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Foreword

Topics in Photographic Preservation is a biennial publication of the Photographic Materials Group (PMG) of the American Institute for Conservation of Historic and Artistic Works (AIC). It provides a means of exchange of information, experiences, and techniques relating to photographic science, conservation treatment, preventive conservation, and the field of photograph conservation in general.

Topics in Photographic Preservation, Volume Fifteen primarily consists of post-prints of presentations given at PMG meetings in 2012 and 2013, with some additional papers. In some cases authors chose to submit abstracts or extended abstracts when full papers were not available. The 2013 Winter Meeting was the second joint meeting of PMG and the International Council of Museums Committee for Conservation, Working Group Photographic Materials (ICOM-CC WGPM). This was another successful collaboration between these two organizations and PMG is pleased to include papers and abstracts from our ICOM-CC WGPM colleagues in this volume. Poster presentations at both PMG meetings will also be represented in *Topics in Photographic Preservation*.

Articles in *Topics in Photographic Preservation* can vary greatly, from informal tips to detailed research. However, *Topics in Photographic Preservation* should not be considered a substitute for, or an equal to, the *Journal of the American Institute for Conservation (JAIC)*, the authoritative reference published semiannually by the AIC. Unlike *JAIC*, articles in *Topics* do not undergo a formal process of peer review. Although compilation is aided by a certain degree of uniform formatting, the style of the body of each paper is left largely to the discretion of the authors. Editorial intervention is minimal unless requested by the author.

I sincerely thank the contributors to *Topics in Photographic Preservation, Volume Fifteen* for taking the time to share their research and experiences with the PMG membership. PMG members are urged to consider submitting articles to future volumes so that *Topics* can remain a useful resource for our field.

Jessica Keister
Compiler 2012-2013

Abstract: Effects of Enclosure pH on Cyanotypes and Blue Prints (Prussian Blue)

Lauren Held, Daniel Burge, and Douglas Nishimura

Presented at the PMG session of the 2012 AIC Annual Meeting in Albuquerque, New Mexico.

The purpose of this experiment was to determine whether the belief that cyanotype prints will be adversely affected by buffered enclosures in long-term storage is truly valid. This belief has been supported by anecdotal reports, experiments with alkalis on Prussian Blue, and experiments with calcium carbonate paste directly on cyanotype prints. The effect is not known to have been established using actual, commercial buffered and non-buffered storage papers (interleave tissues, envelope papers, folder stocks etc.). Contrary to the above, it has been theorized that since calcium carbonate buffering is in a mostly solid form in paper (it has a low solubility and the moisture content of paper is typically very low), it is not likely to be reactive with the cyanotype colorants (or other imaging colorants such as chromogenic dyes or binders such as albumen). In fact, ISO 18902 *Imaging materials -- Processed imaging materials -- Albums, framing and storage materials* now allows the use of buffered papers for storage of all photographic materials; however, cyanotypes are not discussed specifically. Archival suppliers would prefer to stock only buffered papers as they are more widely used. It is also becoming more difficult for suppliers to find paper mills willing to produce high-quality non-buffered papers. It would also make it easier on institutions if one enclosure paper could be used for most if not all print types. These contradictions between theories, experience, experimental results, and standardized recommendations need to be rectified. In these new experiments papers of varying pH as well as commercial buffered and non-buffered papers were artificially aged in contact with prints created using several historic cyanotype formulations. It was found that some cyanotype formulations were more sensitive to alkaline damage than others, but all were sensitive to both alkaline and neutral papers. Only acidic papers fully protected the images.

This paper was published in full within Topics in Photographic Preservation, Volume 14:
Held, L., D. Burge, and D. Nishimura. 2011. The effects of acidic, alkaline, buffered, and non-buffered enclosures on cyanotypes. *Topics in Photographic Preservation*. 14: 237-249.

Lauren Held, Daniel Burge, and Douglas Nishimura
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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Abstract: Further Studies in Digital Print Preservation

Daniel Burge

Presented at the PMG session of the 2012 AIC Annual Meeting in Albuquerque, New Mexico.

According to a 2009 survey of museums, archives, and libraries, the vast majority of cultural heritage institutions now have modern, digitally printed materials (e.g. inkjet, color electrophotography, dye sublimation) within their holdings. Most of these institutions have also reported seeing signs of deterioration among these new collection materials including abrasion, fade, yellowing, bleed, and other types of damage. A thorough understanding of the chemical and physical properties of these materials from the time of their creation and throughout their usage lives will be critical to their preservation. The Image Permanence Institute (IPI) has previously reported on its research into several aspects of the permanence of digitally printed materials including their thermal stability, their sensitivities to ozone exposure, the effects of low and high humidity, their resistance to abrasion, and potentially harmful interactions with enclosures. Since the last report, IPI has completed several additional studies on the stability of these materials including their sensitivities to light and the air pollutant nitrogen dioxide, their resistance to scratch (which does not always correlate with abrasion), their ability to withstand damage during water disasters such as floods, and adverse effects from common mounting adhesives (such as staining and bleed). The results from each of these new areas of study will be explained, and their impact on care strategies discussed.

Additionally, while much as has been learned in these previous investigations, the road to developing a set of best practices for the preservation of these materials is still filled with obstacles. These include development of a common terminology, advanced identification methods, and effective damage mitigation strategies. The pathway to overcome these barriers as well as IPI's current and future work in this area will be summarized.

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Abstract: Early Motion Picture Fragments at the Library of Congress

Dana C. Hemmenway

Presented at the PMG session of the 2012 AIC Annual Meeting in Albuquerque, New Mexico.

The practice of submitting positive paper print copies of early motion pictures to secure copyright began in 1894. It wasn't until 1912 that a copyright law was written to accommodate the new medium of cinema. As a result, the Library of Congress holds a truly unique collection of positive gelatin silver photographs, contact prints from the original nitrate negative movies. The paper print copies have fared somewhat better than their nitrate masters (most of which no longer exists). Indeed it is the paper prints that provide much of what is know about early cinematic history.

Paper prints were submitted as either a full record of all frames in a film, or by presenting choice segments from individual scenes called fragments. The fragment collection contains a wealth of information currently unavailable to researchers: many of the films represented exist only in this fragmentary form and no place else. Some of the fragments contain intertitles that are not present in motion picture copies; other fragments are marked with tinting records, which can help restore films to their original color.

The fragments arrived to the Library of Congress in a wide variety of physical formats: rolled, cut into individual frames, cut into strips and stacked, enlarged and mounted. Providing safe access to these treasures required developing strategies tailored to the unique formats and in some cases extremely poor condition. This paper will discuss the condition assessment, and logistical challenges surrounding the treatment and rehousing of this treasured collection.

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Panoramic View of Mexico City by Photographer Claude Désiré Charnay

Maria Estibaliz Guzman-Solano and Diana Lorena Diaz–Cañas

Presented at the PMG session of the 2012 AIC Annual Meeting in Albuquerque, New Mexico.

ABSTRACT

Désiré Charnay, a well-known travel photographer and archaeologist, left an important legacy in Mexico—photographic documentation of different cities and archaeological sites from his first trip to Mexico between 1857 and 1861. His work includes many examples of historic photographic techniques such as salted paper prints and albumen prints. One of his most beautiful and impressive works is a panoramic view of downtown Mexico City, circa 1858. This highly detailed image is composed of five photographs contact-printed from five collodion glass plate negatives. The photograph was a gift to Manuel Orozco y Berra, one of Charnay's closest friends in Mexico. In 2009, the post-graduate course in the conservation of photographs at the National School for Conservation in Mexico City began studying this photograph. Extensive research was carried out over the course of three years. Teachers and students have been collaborating with scientists, historians, art historians, photographers, curators, and conservators from different countries in order to identify the photographic techniques and to propose and execute a suitable course of treatment for this masterpiece.

INTRODUCTION

This text presents the results of the conservation research of a magnificent photographic work entitled "Panoramic View of Mexico City", prepared by the French photographer Claude-Joseph Désiré Charnay, on his first trip to Mexico between 1857 and 1860. This photograph, which today belongs to Orozco y Berra Map Library in Mexico City, was analyzed and restored at the National School of Conservation (ENCRyM). Not only professors of the Postgraduate Course in Photograph Conservation and three generations of students (2009-2011) participated in this project, but also scientists, historians, photographers and curators from various Mexican institutions like the National University of Mexico, the Bank of Mexico and of the National Institute of Anthropology and History (INAH).

DESCRIPTION AND VALUE

The "Panoramic View of Mexico City" consists of five fiber-based prints, in a rectangular and horizontal format, showing the urban architecture and landscapes of downtown Mexico City at the mid-nineteenth century. The dimensions of the complete work are 199 x 29.9 cm, and the maximum dimensions of the individual prints are 41 x 29.9cm. Although there are some prints or photographs of the same topic from around 1860, this "panoramic view" is the only one that shows Mexico City in the second half of the 19th century. It is a view of the city that can no longer be seen after to 150 years of building and growth.

As a photographic product of a particular time it has a great scientific and technological value for conservators, especially because it is one of only two known copies in the world, done by a well-known photographer of the nineteenth century. Charnay gave this panoramic to his friend, the geographer Orozco y Berra. Orozco y Berra held the "panoramic view" in his private collection, and ensuring that it has been protected and stored within the files of the Map Library that bears his name. The other print is located at the National Library of France and is part of the *Album Fotográfico Mexicano*, which was given to Emperor Napoleon III as a special edition.

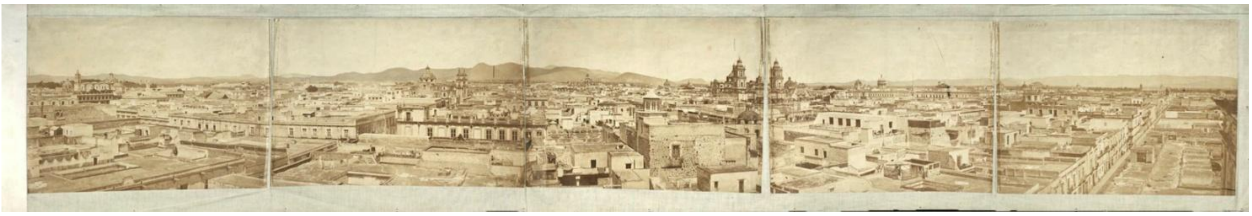

Fig 1. *Panoramic view of Mexico City*. Orozco y Berra Map Library.
Courtesy ENCRyM-INAH 2009.

ANALYSIS OF COMPOSITION MATERIALS AND PHOTOGRAPHIC PROCESSES

In 2009 the "Panoramic View of Mexico City" came to the National School of Conservation (ENCRyM), and through visual examination with the naked eye, magnifiers, special illumination, and other analytical techniques, we achieved a better technological understanding of the photograph.

The panoramic view consists of five POP photographs printed on linen paper from five collodion negatives on glass.

Looking in detail at the shadows and lights, vanishing points and perspective of the five images, it is possible to recognize a great "false panorama" of a master photographer. Charnay had a full knowledge of each frame, so the five prints would fit perfectly, creating a continuous panorama (i.e. the camera was turned five times in succession, passing time between shots, but without moving the location of the tripod).

Considering the conditions of the shot (from the roof of a church), the difficulty and technical challenges that existed in capturing and processing large 14" collodion negatives on glass, we recognize the great technological value of the negatives of this panorama.

Four of the original negatives are now stored in the Musée Du Quay Branly in France. The fifth negative is lost. These negatives were very important for our research, because they helped us to understand the original size of the prints and the author's precise cutting of the five papers, perfect for achieving a continuous panorama.

Taking into consideration the time needed to make this "panoramic view", the yellow-brown hue due to significant fading of the image (as compared to the intensity of the original retouching), the paper fibers clearly visible and a slight sheen on the surface, we recognized two possible photographic techniques: it could be either a salted paper print with a coating or a slightly albumenized print. It was important to answer this question for a deeper understanding of Charnay's work at a transitional time between two photographic techniques.

This material analysis would also determine modifications made after its creation, and better understand the effects and causes of damage, and define the most suitable materials and methods for conservation and mounting.

It was the first time that the National School of Conservation required such detailed analytical techniques to identify particular binders in photography. As a first step, we generated agreements with several Mexican institutions and laboratories with the needed equipment.

In summary, we used the following instrumental techniques:

a) Raman Spectroscopy (RAMAN) and Fourier Transform Infrared Spectroscopy (ATR-FTIR) to locate, in the respective spectral absorption, characteristic bands of the functional groups of proteins such as albumin or functional groups characteristics of other coating materials used in the nineteenth century.

b) Scanning electron microscope (SEM) to recognize the surface morphology, cross-section and identify more precise constituent elements by using the energy dispersive spectroscopy X-ray (EDS).

<u>*Raman*</u>

The first use of Raman spectroscopy was not the most appropriate for our purposes because it didn´t have the resolution needed. Therefore, we used the Raman Spectrometer Station from the Bank of Mexico laboratory. First, we analyzed different samples so we could identify patterns of powder spectra of albumin, salted paper prints and vintage albumen and reproductions, in both good and bad condition.

When we analyzed the “panoramic view”, we were surprised because the spectra showed no absorption bands corresponding to the amide functional group of the albumin protein. After many readings, we figured out that using the Raman was not good enough to recognize the presence of albumin binder in very thin layers, particularly in aged prints. Also it did not provide information on other possible coating materials.

<u>*ATR-FTIR*</u>

Subsequently we used the ATR-FTIR Spectrometer, to analyze various vintage and contemporary samples. It was possible to detect in the "panoramic view´s" spectrum, the absence of the characteristic amino groups of albumin. Therefore, the idea of an albumen coating or a light albumin binder was discarded for the “panoramic view”.

This characteristic weak link of the carbonyl functional group is present in esters, which is typical of waxes or oils.

Oil was discarded, because it does not crystallize and shouldn't show its respective absorption band. Also the possibility of paraffin was discarded because this synthetic product with long hydrocarbon chains, do not have aliphatic esters such as those shown in the spectra.

Double small absorption regions confirmed the presence of wax. Two extra peaks absorption bands are characteristic of beeswax as you can compare the spectrum in the U.R.O.G. website database.

It is concluded that the coating on the "panoramic view" is beeswax, typically applied to salted paper in the nineteenth century, for better conservation as protection from oxidizing pollutants and to improve the saturation of contrasts.

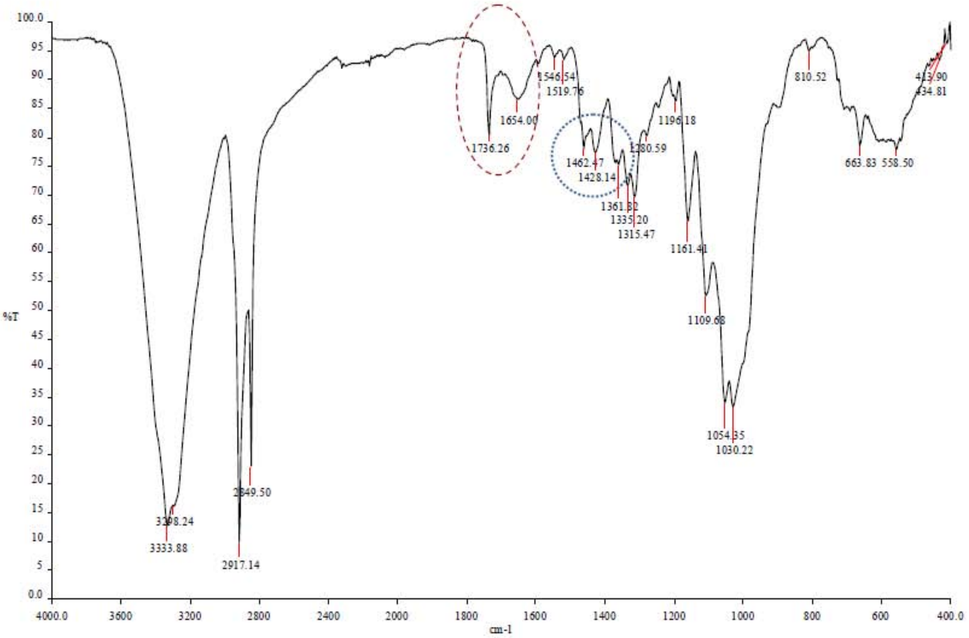

Fig. 1. *This ATR-FTIR spectrum shows esters at 1736 cm-1, absorption at 720 cm-1, 1462 cm-1, and between 1750 - 1730 cm-1, confirming the presence of beeswax.*

<u>*SEM*</u>

Finally, samples were analyzed in the Scanning Electron Microscope (SEM), which confirmed the presence of a wax coating. The difficulty of the energy dispersive X-rays (EDS) to penetrate between the fibers indicated the presence of an organic material on a non-greasy surface. Therefore the samples were washed with chloroform and acetone obtaining less flattened and cleaner fiber surfaces. EDS detected silver –from the image– and silica, calcium and chloride –dust materials–. The qualitative results of these elements were low.

There are two hypotheses about the absence of gold: either the rays do not read a coating sample covered with an organic material or it was difficult to detect so little amount of gold in micro samples. We are inclined toward the second hypothesis, because the "panoramic view" had purple retouches, characteristics of a gold toned salted paper.

CONDITION AND TREATMENT

The severity of the damage, such as distortions, cracks, brittleness, stains, and punctures were the result of improper mounting after its creation. Handling and storage conditions diminished the physical state of the photograph.

The five prints of the panorama were not originally mounted on cardboard secondary supports. There is evidence that at some point, the five images were butted with adhesive tapes. The edges had brown residues of an oxidized adhesive, probably rubber-based.

Possibly in the middle of the twentieth century someone made a second attempt to mount the five prints. The prints were adhered onto a cotton canvas, using a mixture of starch and animal glue, leaving a space between the photographs. This mixture is covering the images along the edges.

With this mounting, the photograph was folded so it could be stored vertically, hanging from shelves. This setup is typical for the maps in the Orozco y Berra Map Library, where the "panoramic view" belongs.

Most of the physical damage was due to inadequate handling and storage systems. Among other alterations, the most important were: tears, abrasion and delamination along the right and left edges of each photograph due to continuous friction of surfaces where the fabric used to be folded. There were also dark adhesive tapes residues. Apparently the carriers of the tapes were removed and this caused some breakage and delamination of the paper support.

There were also some accretions of the adhesive used for the lining in the fabric. On the verso, were evident some yellowish stains on the cotton support due to varnish residues and small wood splinters.

The adhesion of the five prints over a cotton fabric with an open weave produced planar distortion in the primary paper support of the photographs, due to the differential rates of moisture absorption between materials, but also because the textile's texture was transferred to the thin photographic paper.

On the recto, graphite inscriptions were noted at top right. These correspond to the dimensions of the prints, probably used to assist the placement of the photographs on the fabric support.

The mounting favored the horizontal alignment of each print so, in order to straighten the image and correct the lens distortion, spaces of one or two millimeters were left between each picture.

These spaces interrupted the appreciation of the complete image by giving an illusion of losses along the edges. Probably after printing this version of the Panorama, Charnay decided to cut the overlaps between images following each horizon independently, and not the horizon formed by the final image.

Due to the deterioration inflicted by the mounting, and in favor of the aesthetic appreciation of the Panorama, it was imperative to remove the fabric and provide a new mounting that avoided folding. After testing, it was decided that mechanical removal was the best option.

Once unmounted, the residues of starch and bone glue on the verso were reduced by mechanical means in order to avoid excessive wetting that could worsen planar distortion of the prints.

The next step was surface cleaning with soft brushes in order to eliminate superficial grime. The erasing of graphite inscriptions was completed under the microscope, to target only the graphite and avoid disruption of the beeswax coating.

After mechanical cleaning, the residues of starch and bone glue on the recto were removed with methylcellulose gels. The solubility of beeswax was an important issue to consider in order to remove the adhesive tape residues and the stains produced by it. Due to its functional groups, beeswax is easily soluble in non-polar solvents and alcohol, so a mixture of water-acetone (4:1 v/v) was used and applied on the suction table in order to avoid tidelines.

With this cleaning it was possible to detect the presence of optical brighteners in different materials commonly used in the conservation of photographs such as cotton, non-woven polyester support and blotters. The optical brighteners were affected by the water and migrated to the paper support. This allowed us to identify different materials, which contained brighteners and avoid its use in the following conservation processes.

After cleaning with solvents, some fibers were left from the non-woven polyester support over the print, so those were removed mechanically under microscope. Then, planar distortion was corrected by humidifying with Gore-Tex and drying under blotters, non-woven polyester support and weight. Tears were aligned under microscope and mended with Japanese paper and Methylcellulose. Filling was also made with fibers of Japanese paper and Methylcellulose.

At this point, Agustín Estrada assisted the digitization of the five prints, with high–resolution images, in order to ease the cataloging process and further consultation of the photograph.

Once the five prints were stabilized, different proposals were discussed in order to choose the most adequate mounting. From the beginning, a complete adhesion of the verso to a new board or any kind of lining was discarded because it would have been very invasive for the prints and would have hidden the back of the paper. Also it would have required wet treatments and from the beginning and due to the fragility of the paper, water was a substance to avoid.

According to the storage conditions and the policies of the Map Library, the mount should maintain the extended panorama and should respect the continuity of the image to produce a full panoramic view.

The following reasons allowed us to eliminate the spaces between each photograph:

a) If images were added trying to align the papers and not the horizon of the images, the images wouldn't have matched.

b) Recovering the planar distortion allowed the image to be seen complete and there weren't any losses along the edges. Assembling the prints by the edges produced a curved image due to the lens distortion.

c) From the comparison between this mounting with the Panorama at the *Bibliothèque Nationale de France,* it is clear that both prints were put together following the horizon, but cropped differently. The print in France was cropped so that the panorama could be kept straight, hiding the lens distortion; but the one in Mexico was cropped to eliminate the characteristic 'defects' from the collodion glass plate negative.

After evaluating both proposals, a decision was taken to assemble the five images dropping the previously existing spaces, but without overlap. Therefore, it produced the aforementioned curvature in the resulting paper geometry, but the horizon alignment was kept between images. To join the images, strips of Japanese paper adhered with methylcellulose were used as reinforcement at of the points of assembly on the verso.

In this way, a continuous panorama was obtained, to which a false margin was applied to the borders of the verso using Japanese paper adhesive with 8% Klucel.

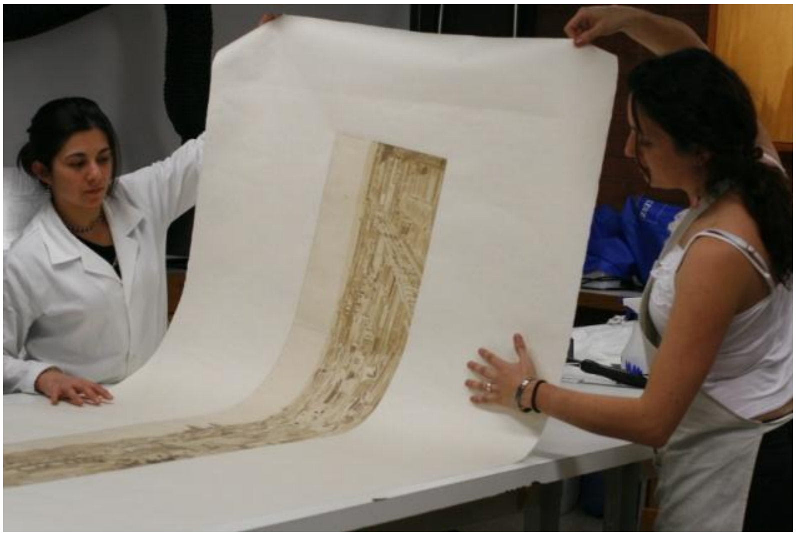

Fig 2. False margin mounting technique.
Courtesy ENCRyM-INAH 2012.

Finally, a specific mounting and storage system was done by attaching the top and bottom edges of the false margin to an 8-ply acid free board. However, the panorama (with the five prints joined together), couldn't withstand the tension and started generating new creases from stress between the junction with the false margin and among prints. Thus, the false margin was removed.

Fig 3. Detail of the new creases and distortions.
Courtesy ENCRyM-INAH, 2013.

After removing the false margin, the planar distortions were corrected by humidifying with Gore-Tex and drying under blotters, non-woven polyester support and weight. Subsequently it was placed inside a polyester film sleeve, in order to hold it in place within the mounting system. Later this sleeve was attached to a 4ply cardboard. On the verso of the acid free cardboard, a dibond backing was used to give better support to the mounting system, and instead of glass, acrylic was used in order to protect the recto. The system was sealed along the edges with aluminum tape and a frame was added to support the mounting system, to ease the handling and avoid any planar distortion.

Fig 4. *Panoramic view of Mexico City*. Before treatment. Orozco y Berra Map Library.
Courtesy ENCRyM-INAH 2009.

Fig 5. *Panoramic view of Mexico City*. After treatment. Orozco y Berra Map Library.
Courtesy ENCRyM-INAH, 2013.

CONCLUSIONS

This conservation project covered several objectives:

- Analytical techniques such as Raman and ATR–FTIR are valuable tools for the comprehension of photographs. In addition, interdisciplinary work with specialists from different fields is essential to better understand the results that a scientific tool can provide and to compliment that information with historical data.

- Complementing analytical techniques with visual and microscopic examination is vital to understanding the material state of photographs, their deterioration process and to propose adequate conservation treatments and the best mounting and storage options.

- Treatments allowed the recovery of the aesthetic values of the photograph and stabilize its physical characteristics. It eases the different functions of the photograph in the Archive.

- Collaboration between professors and three classes from 2009 to 2011 enriched different discussions and helped to achieve adequate treatments for the photograph.

- This project provided valuable information about the materials used by Désiré Charnay during his first journey to Mexico.

- This project allowed us to start new research focused on the characterization of Charnay's photographs during his first journey to Mexico.

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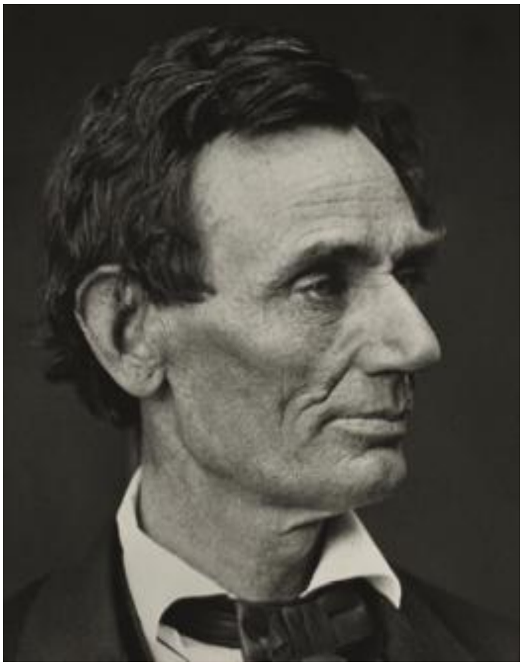
Conservation of an American Icon: The Reconstruction of the Lincoln Interpositive

Katharine Whitman

Presented at the PMG session of the 2012 AIC Annual Meeting in Albuquerque, New Mexico.

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

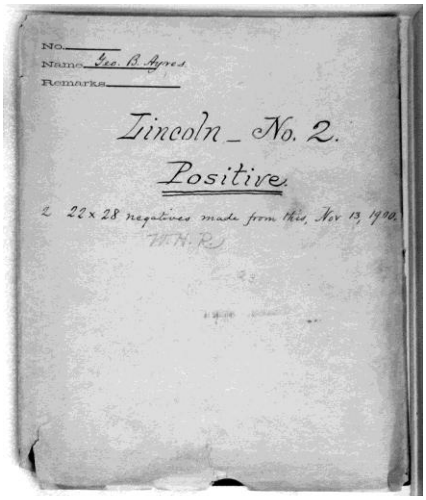


Fig. 1. The original paper folder.

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"

***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.

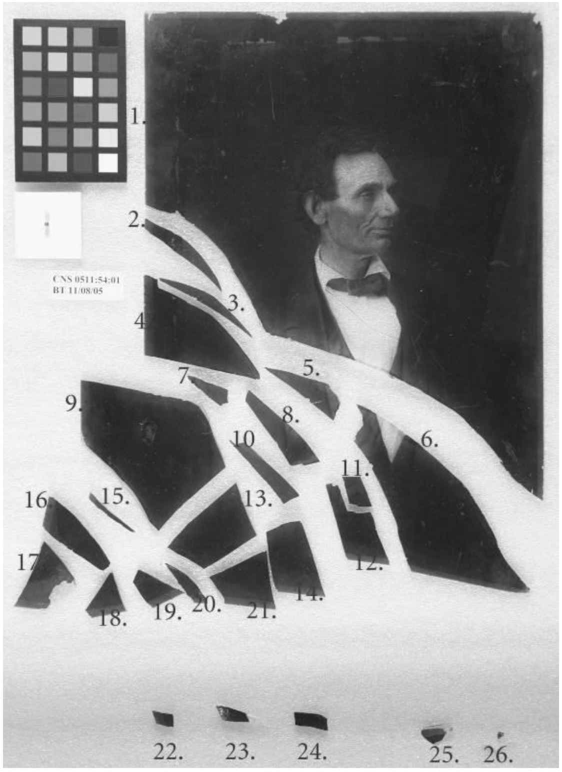


Fig. 2. Fragments of the broken glass plate.

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.

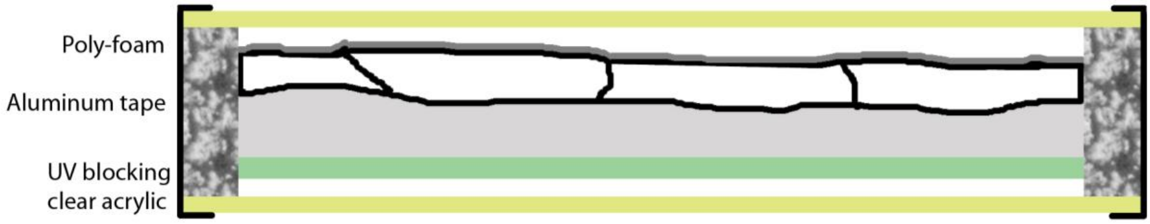


Fig. 5. A cross section of the plate package's housing.

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.

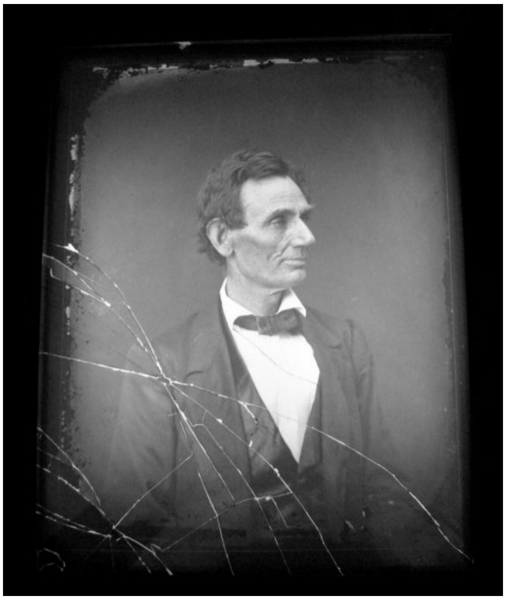


Fig. 7. After treatment.

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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Ralph Wiegandt, Stephen Koob, Jiuan-Jiuan Chen, Dan Trommater, Maryann & Doug Whitman

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Abstract: The Proof is in the Print: Characterization and Collaboration in the Thomas Walther Collection Project at The Museum of Modern Art

Lee Ann Daffner

Presented at the PMG session of the 2012 AIC Annual Meeting in Albuquerque, New Mexico.

Modernist photography developed at a feverish pace in the 1920s and 1930s, fueled by an increasing abundance of gelatin silver papers on the market, a rapid development of photomechanical technologies and a growing cadre of amateurs, journalists, and avant-garde artists. This presentation will outline the objectives and progress of the Thomas Walther Project, a four-year, multi-disciplinary study of a group of important European and American modernist photographs in the Department of Photography at The Museum of Modern Art in New York. Launched in 2010 with the generous support of a major grant from the Andrew W. Mellon Foundation, this partnership between conservation, curatorial and art-historical research is designed to advance the scholarship for characterization techniques for twentieth century photographic materials and establish a new model for collaborative research from the perspective of its material artifacts: photographic prints. Our approach to characterization builds on collegial exchange and discourse between the conservation and science communities. This project is part of a gathering momentum of materials-based art-historical research which centers on the artwork as a primary source data. In addition to a *Scholars-in-residence* program, the project aims to reach out to public audiences and share research findings and data through a variety of publication formats.

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Abstract: A Surface Texture Library for Photographic Papers

Paul Messier

Presented at the PMG session of the 2012 AIC Annual Meeting in Albuquerque, New Mexico.

Surface texture is a vital attribute defining the appearance of a photographic paper. Texture impacts tonal range, rendering of detail, reflectance and conveys subtle qualitative information about the aesthetic intent of a photographer. During the 20th century, manufacturers created a huge diversity of characteristic and specialized textures. Identification of these textures can yield important information about the origin of a photographic print, including the date range of production and region of origin.

Assembled over the course of the past decade, a photographic paper library containing over 2,000 identified surface textures has been assembled using a simple, purpose-built system for capturing photomicrographs. Alone this library has limited application for the identification of unknown textures, though recent collaborations have produced distinct methods to effectively query the library and produce best matches.

Practical applications of this work are being tested as part of the Museum of Modern Art's project to characterize a group of modernist photographs from its Thomas Walther collection. Funded by the Andrew W. Mellon Foundation, this project also affords an opportunity to test other methods to document surface texture including reflectance transformation imaging (RTI) and research is underway to develop query and retrieval mechanism for collections of these files. For the MoMA project, such files are made using a 4' (apx.) diameter dome produced by Cultural Heritage Imaging and a prototype for microscopic capture. Assuming a positive outcome, the techniques used in these studies may have application for rapidly and inexpensively assembling texture libraries of other materials such as textiles, painted surfaces as well as accessing these collections through database query and retrieval techniques.

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

An Initial Investigation into Japine: William Willis's Proprietary Paper

**Constance McCabe, Matthew L. Clarke, Christopher A. Maines, Lisa Barro,
Silvia A. Centeno, and Anna Vila**

Presented at the PMG session of the 2012 AIC Annual Meeting in Albuquerque, New Mexico.

Introduction

Surface character strongly influences the appearance of a photograph. The surface sheen of the various print types may be altered by physical and mechanical means, such as coating, burnishing, or ferrotyping. Photographic paper manufacturers went to great lengths to achieve particular surface characteristics, such as by adding matting agents to binders and imparting a regular texture in the baryta layer. The Platinotype Company of London used a less-familiar means to alter the surface of its photographic paper product line known as "Japine" (fig. 1).

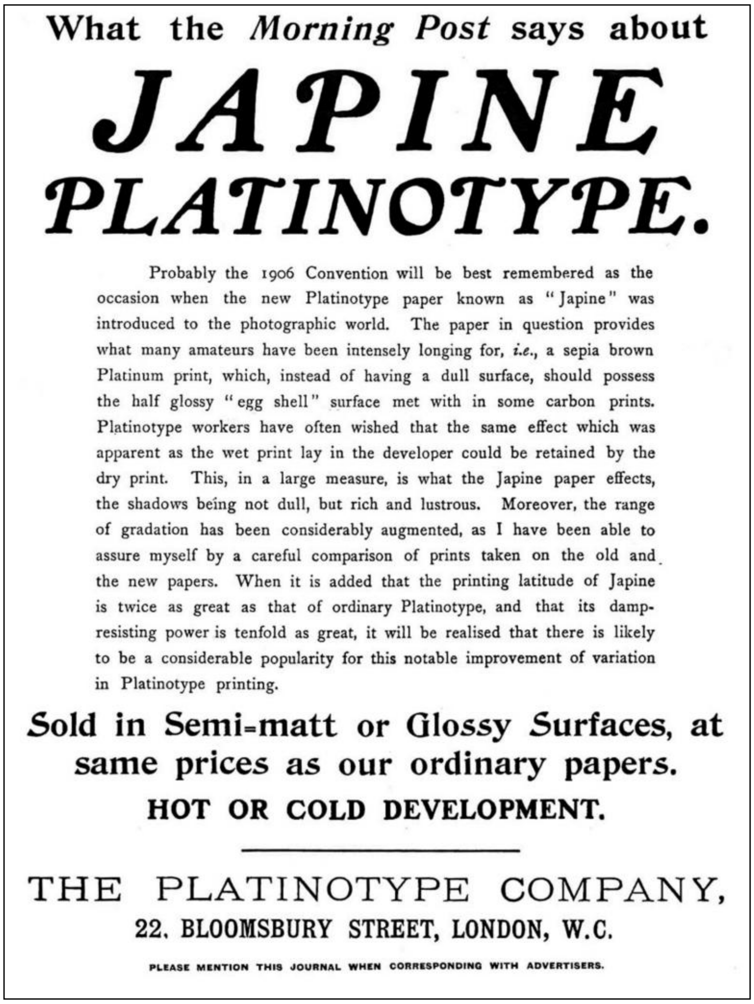

Fig.1 Early advertisement for Japine.
The Amateur Photographer, August 21, 1906, p. xiv.

Conjecture in recent years regarding the chemical nature of Japine paper, which assumed the presence of a gelatin layer, led the authors to the present investigation. The literature of the period and supporting chemical analyses provide evidence that Japine was prepared by altering the surface character of plain paper using chemical modification.

Background

In 1906, the Platinotype Company of London introduced the Japine Platinotype, which boasted a surface sheen unlike that of ordinary, plain-paper platinum prints. Until then, the company's Platinotype papers were designated by the paper color (white or cream), paper texture (smooth or rough), thickness of the paper stock (lightweight or heavyweight), and image color (sepia or black). With Japine Platinotype's introduction the Platinotype Co. began to describe the surface sheen of its photographic papers (Platinotype Company 1906).

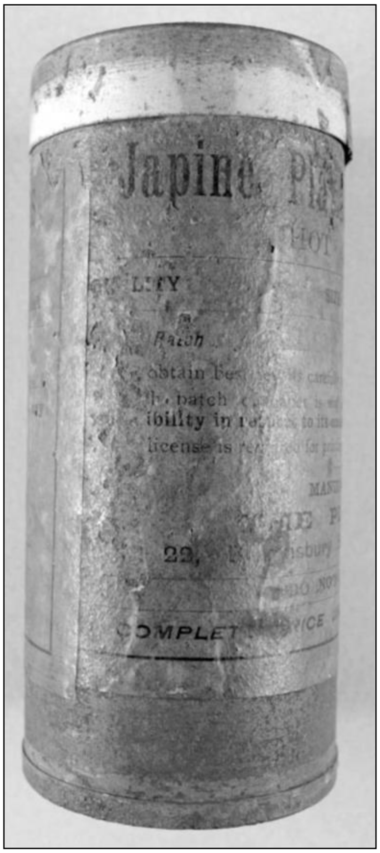

Fig. 2. Undated tin of Japine Platinotype for Sepia Tones, The Platinotype Co., London. Courtesy Photograph Conservation Study Collection, The Metropolitan Museum of Art.

The term "Japine" described a range of surface qualities of the paper, which included "half glossy," "eggshell," "semi-matt," "glossy," (see fig. 1) "matt" and "glazed" (Platinotype Company 1906). Japine was prized for its "rich and lustrous" wet-print appearance (Japine Platinotype 1906) "rich and luminous shadows" (Kimber 1907), superior wet strength in warm water and resistance to abrasion (Smith 1915), and its hard surface that lent itself to coloring (Brown 1916). The period literature describes Japine as free of gelatin (Smith 1915), "having a semi-matt surface that is not an applied coating but is integral with the paper" (Salt 1929), and providing "maximum detail and shadow transparency" (Wheeler 1930).

Few identified examples of photographs printed on Japine papers have been found, and only one sample of unprocessed sensitized Japine Platinotype paper, still in its sealed original container, has been discovered (fig. 2). Several platinum prints by Paul Strand in the collection of the Museum of Modern Art, New York, have been cataloged as "Japine," and Alfred Stieglitz mentions Japine in his correspondence with Strand. Visual examination of the paper sample and photographic prints provides clues to the physical nature of Japine. But with so few known examples available for study, the authors turned to the period literature and chemical analyses to better characterize Japine.

Willis's Japine Products and Satista Patent

William Willis first introduced his Japine Platinotype in 1906 and ceased production in 1937 (Robinson to Scott 1937). However, few hints regarding the production of Japine were revealed until the publication of his 1913 Satista patent, which includes the following statement (Willis 1913):

> I have further found that particularly advantageous results can be obtained in the above process by using paper the surface of which has been parchmentised by treatment with acid or by other well known means. The paper is coated or treated on each side with sulphuric acid sufficiently strong to attack the paper; the paper is well washed in water to free it from acid and is then dried. The acid is not left on long enough to penetrate the paper, the aim being to get a film of altered paper on each side.

Parchmentized paper, or vegetable parchment, is a cellulose-based paper that has been chemically modified by immersion in sulfuric acid. Vegetable parchment mimics animal parchment or vellum, and can be chemically modified throughout the sheet, or the process can be modified to achieve partial parchmentization, depending on the desired properties of the end product. Thoroughly parchmentized paper continues to be manufactured today for use as baking paper and to wrap cheese and meat due to its desired properties of mechanical strength and resistance to heat, moisture, and oils. Superficially parchmentized paper provides a more opaque and reflective surface for such products as writing and printing papers, and may have been a viable alternative to plain paper for use as a photographic support (Jenkins,1992).

In 1914 Willis's patent for his silver-platinum "Satista" process was accepted and, in the same year, the Platinotype Co. began marketing its Satista paper (Willis & Clements 1914 and Notes and Comment 1914), the earliest of which was prepared on Japine paper (Our Roving Commissioner 1915). The Platinotype Co. introduced Japine Silver in 1916 (Photo-Miniature 1916), and Palladiotype in 1917 (Palladiotype 1917). The earliest Palladiotype paper was described as having a "vellum-like" surface, which was likely due to the Japine paper substrate.

Vegetable Parchment and Japine

Was Willis's Japine paper produced by parchmentization with sulfuric acid? To answer this question the authors compared the single historic sensitized Japine Platinotype with other historic plain-paper samples of sensitized platinum paper and photographs.

The sensitized and unprocessed Japine sample is undated, and no designation of sheen is mentioned on the container's label, but the sample is much glossier than plain, unmodified paper. Platinum and palladium prints by Alfred Stieglitz and Paul Strand in the collections of the National Gallery of Art, The Metropolitan Museum of Art, and the Museum of Modern Art were studied for clues regarding their surface. A number of these prints displayed a surface sheen that appears similar to that of albumen prints: under magnification, paper fibers are visible through the uppermost "crust" in the low-density image areas. The historic Japine sample displays a similar surface layer.

Analyses of Platinotype Co. Platinum Papers

Scientists from the National Gallery of Art (NGA) and The Metropolitan Museum of Art (MMA) studied the undated sensitized Japine Platinotype paper sample to detect and identify any proteins, resins, and carbohydrates present. In-depth analyses of these scientific investigations and reverse engineering experiments will be published separately. However, the findings are briefly presented here. The instrumental techniques used included**:**

- Py-GCMS (pyrolysis gas chromatography-mass spectrometry, NGA)
- GCMS (gas chromatography-mass spectrometry, NGA)
- ATR-FTIR (attenuated total reflectance-Fourier transform infrared spectroscopy, NGA and MMA)
- Transmission FTIR (MMA)
- ELISA (enzyme-linked immunosorbent assay, MMA)
- Raman spectroscopy (MMA)
- SEM-EDX (scanning electron microscopy-energy dispersive X-ray spectroscopy, NGA)
- XRF (X-ray fluorescence spectrometry, NGA and MMA)

ATR-FTIR indicated that the Japine surface consisted of modified cellulose consistent with parchmentization by sulfuric acid, and did not detect protein spectral signatures. Further, the results of ELISA experiments performed to screen the Japine sample for collagen I, ovoalbumin, and gums were negative, indicating that no gelatin or any other collagen I protein, albumen, or gums were present. Raman spectroscopy indicated that the Japine surface contains amorphous cellulose, also consistent with the acid treatment of the parchmentization process. Rosin was identified with Py-GCMS**,** but was associated with the alum-rosin sizing of the paper. Carbohydrate analyses of the paper surface and base by GCMS found in each case only the monosaccharide glucose, the subunit of cellulose. This indicates that the Japine surface is composed of cellulose and/or cellulose esters. These findings support the hypothesis that Willis's Japine paper is a form of vegetable parchment.

Reverse Engineering of Parchment Paper for Platinum Prints
A ca. 1980 Crane & Co. alum-rosin sized 100% cotton paper, without alkaline buffers or optical brightening agents, was subjected to parchmentization tests. This paper was chosen because it is similar to the paper base of the historic sensitized paper. Both the untreated and parchmentized Crane & Co. papers were then sensitized and processed, yielding platinum prints of good quality, demonstrating that parchmentized paper was suitable for use as a platinum paper.

SEM Images of Platinotype Papers
Two of the Platinotype Company's undated sensitized but unprocessed platinum papers were imaged with SEM and compared, which revealed striking differences. The SEM image of a Platinotype KK (an alpha designation that indicated a heavy smooth paper with an unmodified surface) sample exhibits the characteristic appearance of an unmodified paper, its fibers distributed evenly throughout the cross-section (Willis & Clements 1908). A clearly visible surface film or "crust" is apparent in the Japine sample (fig. 3). This surface layer is consistent with the amorphous cellulose detected by Raman and ATR-FTIR.

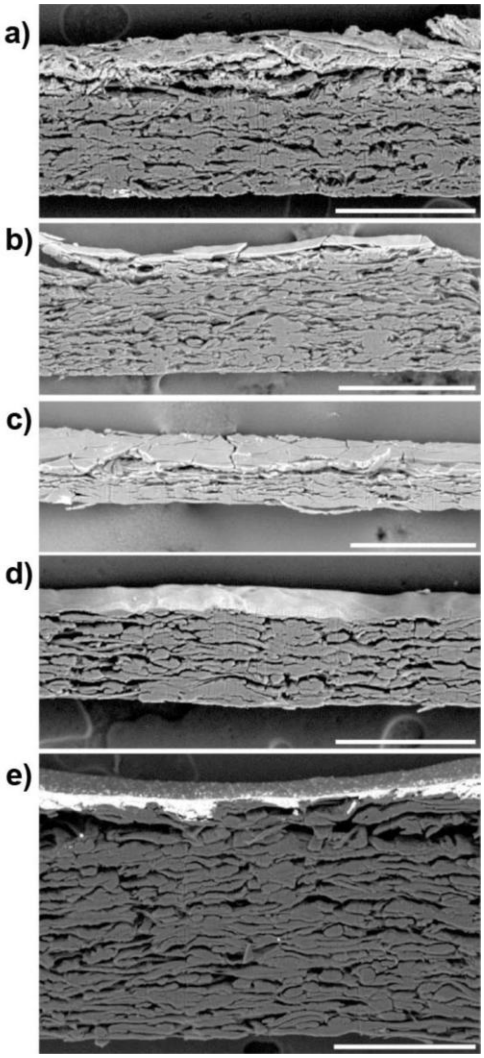

Fig. 3. SEM images of photographic paper cross-sections with different print layer structures. Samples are angled to facilitate viewing of the top surface. The scale bar is 200 µm.
a) Platinotype KK paper exhibits a single-layer structure while b) Japine Platinotype has one layer with a chemically modified surface. Two-layered structures are observed in c) an albumen print and d) a silver gelatin print without a baryta layer. Finally, a three-layered print is illustrated in e) a silver gelatin print containing a baryta layer.

It is possible that Willis was not the first to use vegetable parchment as a support for sensitized photographic paper. A photographic paper called "OXY-VELLUM" was advertised in 1901 as a product "coated on a substance similar to parchment or vellum" and may have been a precursor to Japine (E. & H.T. Anthony & Co. 1901) (fig. 4). Knowledge that such modified surfaces exist will challenge efforts to identify photographic processes. It is possible that some papers that have been assumed to be silver gelatin without a baryta layer may be silver or platinum prints on parchmentized paper.

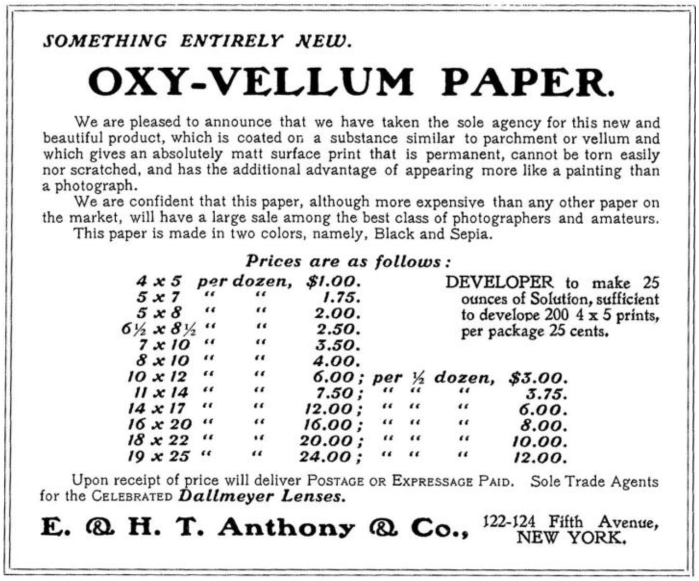

Fig. 4. E. & H.T. Anthony & Co. 1901. OXY-VELLUM Paper advertisement. *Camera Notes* 5(1).

This study demonstrates that parchmentized papers were used for sensitized commercial photographic papers, and adds to the familiar structure descriptions of photographic prints. In addition to the familiar one-, two-, and three-layered structures of photographic prints, the authors propose the new category of "one layer with modified surface."

Conclusion and Future Work

The semi-gloss surface of some "Japine" prints can lead even the most experienced connoisseurs of historic photographic prints to mistake them for two-layer prints or plain-paper prints with applied coatings. The fact that Japine has been described as having a surface sheen that ranges from "matt" to "glazed," and has been used for platinum, silver-platinum, silver, and palladium papers further complicates characterization. The dearth of identified samples makes it extremely difficult for modern observers to comprehend what constitutes a Japine print. Evidence exists that manufacturers other than the Platinotype Co. may have offered photographic papers on parchmentized paper supports, causing additional confusion regarding proper categorization of print types. Understanding the physical and chemical nature of the subtle qualities of these photographs is fundamental to the aesthetic appreciation and identification of photographic prints, and will suggest insights for their preservation and conservation treatment.

The authors' work on the subject of the Platinotype Company's Japine papers continues. The study includes the ongoing search of identified samples of Japine papers and prints, visual examination of collection prints, and chemical analyses, and physical measurements of a variety of samples. This research will be presented at the October 2014 Platinum and Palladium Photography symposium in Washington, DC, and an in-depth paper will be published following the symposium.

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Anna Vila
Centre for Art Technological Studies and Conservation
Statens Museum for Kunst
Copenhagen, Denmark

Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Development and Use of the Photograph Information Record

Erin Murphy, Nora W. Kennedy, and Amy Brost

Presented at the PMG session of the 2012 AIC Meeting in Albuquerque, New Mexico

Abstract

This article traces the origins, development and publication of the internationally endorsed Photograph Information Record or PIR, a questionnaire form used to collect details pertinent to the cataloging and care of photographs within collections. The importance of the PIR for gathering essential information for the preservation of photographs has risen with the recognition of the artist interview as a crucial tool in the conservation of modern and contemporary art. The PIR also provides a mechanism for systematically organizing and recording information about older works. First launched and made available online in 2009, the PIR has matured in use to the point where an evaluation of its content and implementation are in order. Possible modifications to the form and its future applications complete this presentation of its conception and development.

Introduction

The theme of the 2012 AIC Annual Meeting, "Connecting to Conservation: Outreach and Advocacy" served as a reminder that conservation efforts are most effective within partnerships among allied professionals. The Photograph Information Record (PIR) is the result of a multi-disciplinary, international partnership among conservators, curators, and collection managers with the goal of creating a document that can capture information essential to the cataloging and preservation of photographs. The importance of such documentation becomes more vital as photographers and artists working in photographic media move from traditional analog to digital formats, embracing a variety of new technologies, materials, methods of presentation, and even diverse attitudes toward long-term preservation.

This form was developed and executed by an international committee and has been adopted as a standard by institutions around the world. The PIR is free and publically available on the American Institute for Conservation website in writable PDF format allowing it to be communicated electronically or printed-out to hard copy. The full two-page form is appended at the conclusion of this article. Artists and galleries are encouraged to utilize the PIR to record basic cataloging information as well as materials, processes, and philosophies essential to the preservation and appropriate presentation of the artwork in order to convey this on to future owners in a concise and approachable format.

The creation, use and content of the Photograph Information Record are summarized here. Also touched upon is the collaborative process in developing the PIR, current use of the PIR in leading institutions, user-supplied suggestions for modifications, as well as possible future content and format updates. The third anniversary of the launch of the PIR represented an opportunity to re-evaluate the efficacy of the form and solicit user feedback.

Origins and Development

Record keeping varies widely according to the resources and needs of an institution or collection, but questions regarding artists' materials are universal. Capturing such information at the earliest possible moment - ideally at the time of creation, but currently more generally at the time of acquisition - and from a source knowledgeable regarding the artwork allows curators, conservators and collection managers to make crucial preservation and exhibition decisions now and well into the future. Many conservators and curators in modern and contemporary art have come to champion some form of artist interview as an indispensable conservation tool. Information gathering ranges from informal telephone conversations to written questionnaires to filmed and transcribed interviews, according to institutional needs and resources. In all cases, prior to 2006, the photograph conservation profession lacked consensus on precisely what information should be considered essential for the preservation of photographs. It seemed reasonable that a single questionnaire could be developed that would meet this need. The resulting questionnaire would provide a standard that institutions could freely adopt or use in conjunction with their existing information-gathering processes. A few notable institutions around the world have had artist's questionnaires in use for decades, collecting relevant information about acquired works of art more or less regularly, while other institutions seeking to develop questionnaires were doing so internally, without a systematic way to learn from one another.

The growing need for a universally accepted document to capture essential information about photographers' materials was voiced at a November 2006 meeting of the Photographic Materials Research Group (PMRG) in Paris, a meeting conceived and supported by Manfred Heiting, a connoisseur and collector of photography. The PMRG included conservators, scientists and curators brought together to confer about research needs in the field. Anne Cartier-Bresson, Director of the *Atelier de Restauration et de Conservation des Photographies de la ville de Paris (ARCP)*, spoke of her frustrated attempts to collect information about acquired works of art from the galleries selling them. The ARCP had an artist's questionnaire form of their own design in use at the time, as was the practice with many collecting institutions. Cartier-Bresson made a compelling case for the notion that a more universal form with international backing would carry more weight and therefore elicit a higher response rate from art vendors internationally. The topic was again discussed at a May 2007 meeting of the PMRG hosted by The Metropolitan Museum of Art where Nora Kennedy volunteered to spearhead the effort, thinking it would be a relatively simple and straightforward project. She presented this idea at the joint meeting of the ICOM–CC and AIC photographic materials groups in Rochester in 2007 proposing the establishment of a committee of volunteers to assemble existing questionnaires and edit them into a new international standard. Endorsement by major institutions and professional conservation organizations was viewed as essential to the success of the initiative. Ultimately a group of fourteen conservators volunteered to form the core group. These individuals were joined by four additional members from curatorial and collections management in the final stages to ensure that the form would be of significance to all aspects of institutional involvement. It was in Rochester in 2007 that Erin Murphy of the New York Public Library expressed her willingness to co-chair the committee. The full committee listing of colleagues and their affiliated institutions at the time is appended at the conclusion of this article.

The form was originally conceived as an artist's questionnaire and was intended to summarize and condense existing curatorial and conservation questionnaires into one short, easy-to-complete document. The PIR was born largely from the daily questions and concerns of conservators and curators collecting contemporary fine art, but the hope was that the form would extend itself to 19th and 20th century acquisitions as well, where questions regarding prior exhibition and prior conservation treatment are equally valid.

The seller of a nineteenth-century photograph (such as the one pictured in Figure 1) will not have access to precise technical details about the photograph in question, but can certainly provide information about the provenance and history of ownership, and any prior conservation treatment if known. The owner also may have researched and be knowledgeable about other known prints, publication or reproduction history, and exhibition history.

Fig. 1. Félix Bonfils (French, 1831-1885), [*Veiled Turkish Woman*], 1870s, Albumen silver print from glass negative. Image: 22.2 x 16.4 cm (8 ¾ x 6 $^{7}/_{16}$ in.). The Metropolitan Museum of Art, Funds from various donors, 2010 (2010.317).
Image © The Metropolitan Museum of Art.

The PIR is well-suited to collecting information about a single work of art and not designed for large groups of diverse materials. Contemporary artists have available to them an increasing and ever evolving gamut of inks and papers for digital printing in addition to the remaining analog offerings. Finishing techniques such as mounting and surface treatments continue to introduce new plastics and adhesives. The detailed documentation of all components making up a work of art is avidly sought by those responsible for the long-term preservation of these important icons in the history of art. The PIR is used to its best advantage, therefore, when a living artist or an agent familiar with the technical aspects of their work is available to complete the form. Yet this form and the information contained within can be and have been used for large collections, series, portfolios or groups of "like" materials – particularly where the artist or agent is still living.

Collaborative Development Process

The committee commenced the development process by submitting any questionnaires currently in use at their institutions to Committee Chairs Nora Kennedy and Erin Murphy in the summer of 2007. These questionnaires were compiled into one document, repetitions deleted and then redistributed to the committee members for review. Committee members paid particular attention to language, terminology, emphasis, and clarity keeping in mind that the document would be used by a wide audience and under many different circumstances. The goal was to condense these longer, multiple page documents into a shorter one- to two-page document that could be used as a reference for both curatorial and conservation staff. To that end, committee members had multiple conversations regarding terminology and essential information. The majority of these discussions took place through e-mail exchanges, although some in-person meetings with a small number of committee representatives also took place at national conservation conferences as possible.

Fig. 2. Lois Conner (American, born New York 1951), *Xi Hu, Hangzhou, Zhejiang, China*, 1998, printed 2011, Inkjet print, Image: 35.6 x 81.9 cm (14 x 32 ¼ in.) Sheet: 43 x 90.2 cm (16 $^{15}/_{16}$ x 35 ½ in.).
The Metropolitan Museum of Art, Gift of the artist, 2012 (2012.130.2).
Photo courtesy of The Metropolitan Museum of Art © Lois Conner.

3.4 If the support/paper is commercially produced, please identify the manufacturer and product name. If produced by hand, please describe the materials and techniques used.

Hahnemuhle 305, photorag

3.5 If this is an inkjet print, please provide ink set information (for example: Epson UltraChrome K3 ink). If the inks are altered or mixed by the artist or printer, please describe.

Printed with an Epson 9880 printer, using Epson UltraChrome K3 inks, and Quad black driver

Fig. 3. Excerpt from the PIR for *Xi Hu, Hangzhou, Zhejiang, China* by Lois Conner. In the Museum's cataloging system, this print (Fig. 2) is generically labeled as "inkjet", but having the artist provide the precise information about the paper and ink types is invaluable for its proper care and exhibition.

Considerable time was spent discussing the list of processes at the top of page two. There was eventual agreement that the major processes being acquired at the time could be summarized in four main categories: gelatin silver print, chromogenic print, silver dye bleach print, and inkjet print. Other options were to be captured in the all encompassing "other" with room for the name to be written or typed in. Standard generic process terminology was favored over specific brand names, but examples were provided to guide the less technically-oriented user. Thus "(c-print, Ektacolor)" follows "chromogenic print" and "(Iris, Gyclée, Epson, etc.)" follows "inkjet print".

As part of the draft review process, committee members were asked to gather feedback from their peers including colleagues in photography galleries, collection managers, registrars, curators, and the artists themselves. A nearly final draft was shared with curators and collection managers in the spring of 2009 for final vetting at a face-to-face meeting with some committee members at The New York Public Library. This smaller group reviewed the document content, terminology, approach, as well as design details and format. A few areas generated considerable discussion including the title of the form and the use of the word "Photograph", as well as the simplification of philosophical questions included.

Previous artist's questionnaire had asked questions such as the following:

- "Do long-term stability issues influence your choice of materials or technique? Please elaborate."
- "How much conservation intervention do you feel is appropriate?"
- "How do you feel about the display of an 'aged' or damaged (visually altered) work that cannot be improved through conservation?"
- "Is there any point at which a visually altered work should no longer be displayed?"

These questions were eliminated as being too open-ended or specific or simply because they were too complex and profound to respond to in this format. The question "Are there aspects of the work that are particularly vulnerable and in need of special care?" replaced the above and has proven to elicit more useful information than the prior variants. In section 5.3 the artist is asked to provide any further detail about the creation or preservation of the work of art, allowing ample opportunity for those eager to share their opinions and feelings to do so, adding additional documents or illustrations as desired.

Over the course of development, the draft forms had been entitled "Artist's Questionnaire", and then "Materials & Techniques Information Sheet" - the latter a cumbersome title providing no clue to the object in question. Finally "Photograph Information Record" was agreed upon, reflecting a growing emphasis on technological process and presentation aspects of the artwork rather than the artist's philosophy. The meaning of the word "photograph" itself is a much debated topic as many contemporary artworks described as photographs do not have a light-sensitive component as part of the final work of art. Yet many photographers work with inkjet and alternative media and their works are purchased by collectors, dealers and cultural institutions whose focus has been traditional, chemically processed photographs. The term Photograph Information Record, therefore, provides a generic terminology that can encompass a number of processes that are "photographic in nature" such as chemically produced photographs, inkjet prints, transparencies and multi-media artworks. In that sense, the term "photograph" can be used to broadly represent a family of artwork while the questions on the form logically move from broad to specific. An additional factor was the fact that in most collecting institutions it is the "Department of Photographs" (in addition to Contemporary Art Departments) that acquires both analog and digital contemporary artworks.

The debate over the term "photography" has and will continue to be discussed. We encountered interesting exchanges within translation committees working to convert the form into other languages. Examples of these are included below. There is no doubt we are not at the end of this discussion, but did not want this to be a barrier to having a form available for use. A great strength of online publication is the unending possibility for evaluations and revisions.

After this final review, the PIR was submitted for endorsement to the American Institute for Conservation and its Photographic Materials Group and sent to major institutions with a request to review the form and give permission to be listed at the bottom of the PIR as a "user". For an institution to be listed, it was essential that both curatorial and conservation staff approved, so in all cases Malcolm Daniel, then Curator in Charge of the Department of Photographs at The Metropolitan Museum of Art contacted his curatorial colleagues in sister institutions encouraging their support, while the conservation colleagues were contacted by PIR Committee members. In some institutions it was essential that the registrar or collection managers be on board as well. The institutional and professional organization endorsements have been key to focusing attention on the PIR as a universally accepted document to collect cataloging, historical and technical information to inform the long-term preservation of an artwork. The Board of Directors of the American Institute for Conservation readily offered their support and the PIR Committee will continue to seek endorsement by international conservation organizations.

Original Goals

Several fundamental goals of the PIR are summarized below.

• *To create a concise standardized form seeking generally agreed upon essential information.*

While no document can address all aspects of an artwork, the main goal of the PIR was to create a universal document with generally agreed upon *essential information*. Each institution or collecting agency may need to gather information specific to its organization but the goal of the PIR committee was to eliminate institution-specific questions and to pose questions universally applicable to the cataloging and preservation of photographs. The collaborative review process resulted in a very concise, two page, object specific, check off and short answer document in a writable PDF format. The questions are targeted to elicit very specific answers regarding process and materials and to provide contact information for printers, mounters, framers, studio assistants, even conservators who may be familiar with the artist's work and materials. These were topics all members agreed were crucial to record.

Fig. 4. John Yang (American, born China, Suchow 1933-2009 New York), *[Innisfree Garden, Millbrook, NY],* 1985, printed 1998, Platinum print, Image: 19.5 × 24.5 cm (7 $^{11}/_{16}$ × 9 $^{5}/_{8}$ in.) Sheet: 26 × 34 cm (10 ¼ × 13 $^{3}/_{8}$ in.).
The Metropolitan Museum of Art, Gift of the John Yang Archive, 2012 (2012.482.4).
Photo courtesy of The Metropolitan Museum of Art © The John Yang Archive.

Of interest in the PIR for this work of art by John Yang is the fact that the platinum print was created by the artist for an exhibition some years after the gelatin silver prints of 1985.

• *To create a form that could be used ready-made or as a model for similar forms.*

As stated above, each institution may have particular needs above and beyond what is addressed by the PIR. Therefore, a secondary but equally important goal was to create a form that could be used ready-made or could be adapted to meet the needs of individual collections. To that end the form is not copyrighted and contains a final portion to allow for additional comments. The small print at the end states: *This form is not copyrighted. It may be reproduced, translated, and used freely by artists, galleries, and collecting institutions without requesting further permission. A writable pdf version of this document may be found at: www.conservation-us.org/PIR.* Since the 2009 launch of the PIR a few users report that they have adapted the PIR or extracted particular questions from the PIR in order to provide greater detail to existing documentation. Others do not work in close collaboration with registrars or curators, so have found only the technical aspects to be useful to them while the information on the front page is gathered by institutional colleagues independently. These are both acceptable applications of the PIR, the spirit of which is to prompt information collection and documentation regarding the creation, maintenance and exhibition of an artwork in a flexible manner.

• *The form should be available in many different languages.*

A form that is universally accepted should be available in several languages. Translations of the English PIR were developed almost as soon as the document was launched, and today the questionnaire is available on the web in Spanish, French, Japanese, Greek, German, Dutch, Catalan, and Portuguese, with translations in Chinese, Italian and Finnish underway.

A direct translation from English to other languages is sometimes difficult due to differences in terminology between languages and to regional dialects. The collaborative process, therefore, has been essential when creating translations. In general a volunteer steps forward to chair the initiative, and suggests native speakers from conservation, curatorial and collections management. Often one or two members provide the first translation, after which the committee members review and refine the document until a consensus regarding terminology is reached. For languages spoken over broad regions of the world, committees expand to represent regional differences in vocabularies. For example, the Spanish committee was led by Mirasol Estrada from Mexico, but included colleagues from Mexico, Spain, and Chile. A list of the translation committees is appended at the conclusion of this article. Although the PIR is not copyrighted and can be modified for use, the translations hosted on the AIC website adhere as closely as possible to the content and format of the English PIR.

Some committees cited difficulty with particular terms such as "photograph", "image" and "print". Martin Jürgens worked with the Dutch translation group and stated:

> …we discussed at length the translation of the term **image**, as distinguished in the form from **print**. In English I understand the use of the term image well, and for me it has a broader sense to it: an image can be, in terms of content, anything. A good translation for image doesn't exist in Dutch (as is also the case for German, by the way) so Herman and Michiel suggested using the Dutch term **opname** (equivalent in German is **Aufnahme**), which, however, indicates a photographic original, essentially a **shot**. Their argument was that the form is called the **Photograph** Information Record, and not the **Image** Information Record. My suggestion of using **beeld** (German: **Bild**) wasn't accepted for the same reason. So there does seem to be a sort of contradiction within the title of the form and its content: namely that the title suggests this form is for photographs only whereas the content indicates that this form could also [be] used for other types of images that have been printed. … Oh-oh, so what is a photograph then?? ...

These discussions provide long-term benefits to the profession in the search for consensus and standards, and sometimes open pathways of communication between allied professionals.

• *The form should be endorsed and adopted by professional organizations and major institutions.*

Having the form endorsed by professional conservation organizations and adopted by major institutions was essential to ensure the document's effectiveness. The support of AIC and PMG as well as a listing of all the institutions currently using the PIR gave the project greater momentum and provided a context for the document within a larger community. Additionally, it has helped to stress that the document is supported by a group of allied professionals rather than being the creation of an individual or an institution. Since 2009 a number of additional institutions have asked to be included among those endorsing the form when the next edition is published.

• *That the form be readily available to anyone on the web and that the form be hosted by major professional conservation organizations such as ICOM-CC and AIC.*

The PIR is free and publically available at the American Institute for Conservation website *www.conservation-us.org/PIR.* AIC has been hosting the form since its launch in 2009, managing uploads of new translations as well as providing analytics regarding page hits and session duration. The page on the AIC website where the PIR is hosted has had about 1,800 unique visitors in the 16 months leading up to September 2013. Having the form hosted by a professional organization ensures that the form will be maintained and supported over time. The form can be used by anyone including artists, gallerists, dealers, curators, collection managers and conservators and anyone can add a link to the form on their own webpage. It is hoped that as the PIR becomes more common its web presence will become more abundant. A handful of galleries, educators, photography enthusiasts, conservators, and others currently link to the PIR. This proliferation is something we encourage as it is ideal that the form be widely accessible.

Survey, Feedback and Re-Evaluation

As the PIR headed into its fourth year of activity, the committee sought feedback from users in order to evaluate the real-life application of the document. At the end of 2012, a survey regarding PIR use was designed by Amy Brost, then an intern in Photograph Conservation at The Metropolitan Museum of Art.

The survey consisted of 30 questions divided into three sections: Usage, Content Improvement, and Best Practices. The Usage section attempted to gauge precisely how the PIR was being used: who sent it out, how often, and by what method, how it was returned, how much information it contained, the usefulness of that information, and how the information was subsequently stored. Most questions were multiple choice with space for optional additional comments. The Content Improvement questions were open-ended and designed to give users a chance to comment on each section of the PIR form itself. The Best Practices section contained several open-ended questions to probe users' experiences with implementation and dissemination of the PIR to find out what worked, what didn't, and what creative solutions they may have developed. The survey was launched on October 22, 2012 and closed on January 15, 2013. AIC set it up using SurveyMonkey, the free online survey tool (surveymonkey.com). AIC sent email invitations on three occasions during the survey period to its Photographic Materials Group member list. There were a total of 53 responses, primarily from conservators, but also from a fine art printer, an educator, curatorial colleagues, and collections care professionals.

For the most part the survey resulted in positive feedback with minor suggestions on content and terminology. Terminology questions are raised in the survey and have been brought up in independent correspondence and can be discussed *ad infinitum*. Because the original committee labored over the terminology currently used on the form as discussed above, the current usage is unlikely to change for the next iteration. This topic will continue to be a burning one and changes will doubtless be necessitated in the future.

The most pertinent findings of the survey results are cited below, maintaining the three subject groupings.

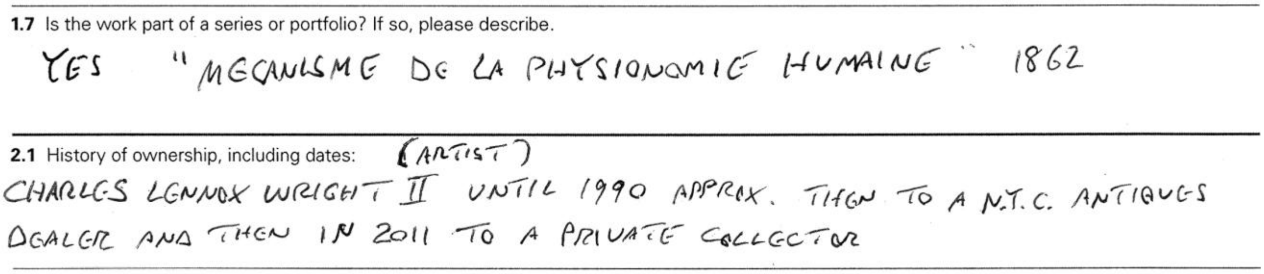
Usage

The majority of the responses to the survey came from conservation professionals, perhaps reflecting the primary origins of the form as well as the means for promulgating the survey via a conservation distribution list. Eleven respondents indicated that their institutions had been sending out the PIR sometimes or nearly always over the last 1-3 years since its publication. Those stating that they do not actively use the PIR cited infrequency of acquisitions, fear of increased administrative burden on artists, galleries, dealers, or internal staff, as well as lack of awareness of the PIR form as key reasons. Some respondents acknowledged the advantages of the PIR over their current practices, and were hopeful about modifying their current institutional practices. The difficulty of instituting new practices was cited as well by extremely large institutions and those where collecting photographs has expanded beyond the traditional curatorial divisions. Several users cited the difficulty of locating the responsibility for the form within the curatorial department when the technical information on the second page was perceived to be of most value to conservation. Regrettably this reflects one of the challenges in the field internationally that curatorial and conservation colleagues sometimes overlook the mutual benefit derived from working together collaboratively.

Of those routinely using the PIR, most send the English version out electronically, receive it back electronically, and then save the file and/or attach it to a collections management database. Most also file a hard copy. A smaller number take additional steps to enter the information into a database by retyping or cutting and pasting text. These text entries are often electronically searchable, whereas the PDF form fields are not. In most cases, staff uses the hard copy for reference. The survey also posed the question of accessibility of the information within institutions. We have found that the majority limits content access to conservation and curatorial staff although the information is theoretically available to researchers upon request. After English, the translations used most frequently appear to be Spanish, French, and the English with Japanese pop-ups.

The present writable PDF format of the PIR is a flaw that diminishes its usefulness. Rapid changes in technology have made it a challenge to create a simple, universally accessible format for the PIR. Many users have commented that the writable PDF format is not universally compatible with all PDF reader software on all platforms, so some users have experienced technical issues when completing the form. Likewise, many users have indicated that the PDF format is not always compatible with the local database system– meaning that the file cannot be uploaded and attached to the catalog system or that the information cannot be searched or tallied along with other information. While the content from the PDF form fields can be exported to Excel and then ingested into a local database, this multi-step process is cumbersome, as is manual data entry. Others have had difficulties with the character limits on the text fields, or scrollbars that appear and force text in the hard copy printout to be truncated. The original design was for a concise form that could be contained by a single sheet of paper, front and back. Attaching additional pages was encouraged as needed. In reality, the survey showed that most users are choosing to work with the form electronically, so it is possible to rethink the design in those terms rather than privileging the two-sided printed page. In addition, as was mentioned above, some users have workarounds for bringing the information into their databases so it will be searchable and accessible, but it is evident that other file formats need to be explored to make the PIR more user-friendly. In order to facilitate the usage of the information contained in the PIR, users must be able to integrate the responses efficiently into their electronic records.

Fig. 5. Adrien Tournachon (French, 1825-1903) and Guillaume-Benjamin-Armand Duchenne de Boulogne (French, 1806-1875) *Electro–Physiologie, Figure 64,* 1854–56, printed 1862, Albumen silver print from glass negative, Image: 29.8 x 22.3 cm (11 ¾ x 8 ¾ in.) Mount: 40.1 x 28.5 cm (15 13/16 x 11 ¼ in.).
The Metropolitan Museum of Art, Purchase, The Buddy Taub Foundation Gift, Dennis A. Roach and Jill Roach, Directors, 2012 (2012.140).


1.7 Is the work part of a series or portfolio? If so, please describe.

YES "MECANISME DE LA PHYSIONOMIE HUMAINE" 1862

2.1 History of ownership, including dates: (ARTIST)

CHARLES LENNOX WRIGHT II UNTIL 1990 APPROX. THEN TO A N.Y.C. ANTIQUES DEALER AND THEN IN 2011 TO A PRIVATE COLLECTOR

Fig. 6. Excerpt from the PIR for *Electro–Physiologie, Figure 64* by Adrien Tournachon and Guillaume-Benjamin-Armand Duchenne de Boulogne. The PIR can be printed out, filled in by hand and mailed to the institution as in this example.

Content Improvement

On the whole, specific suggestions for content improvement were minor, and with rare exceptions, survey responders did not have issues with the wording of the questions in the PIR. Some concerns were related to ongoing debates about terminology in the translated forms. Other suggestions included adding fields for the accession number and object dimensions, and whether or not the print is duplicate, archival or exhibition print as many institutions now acquire multiples of one print. Other users indicated that artist birth and death location information would be useful.

While the survey responders had few specific suggestions for adjustments to the questions on the PIR, a number of responders expressed concern about the overall length and detail of the form. They suggested that the form is too long, that people do not have enough time and/or do not know the information. Of course the limited time factor is universal, and many arts institutions are understaffed making information-gathering challenging. However, even a partially completed PIR will yield information and is to be encouraged. The more the PIR is used, the more it will be evident to galleries and the artists themselves that this type of information is of value and should be collected ideally as early as when the artwork is created or at very least when it enters the gallery. In some distant future one can hope that a completed PIR will be offered without solicitation when an artwork is acquired. In some cases, partially completed forms are appended to databases or added to the artist's file and only completed fully when the occasion arises to make direct contact by phone to collect the needed information in person. In order to further encourage full participation, the responsibility for completion may need to be shifted from one individual to another. For example, if a gallery has incomplete or even incorrect information, the artist's studio must be contacted directly. Contact information of printers and assistants is requested on the PIR in order to enable these direct conversations as needed. Finally, and most dramatically, some institutions use payment for the artwork as an incentive to complete the PIR—without the final version, the check is simply not cut.

A few users suggested changing or eliminating Section 2 (history of ownership, publication and conservation) as the information is too difficult to obtain or dealers do not want to provide it. While it often is difficult to gather reliable information on these topics, the form should retain the flexibility to add this information as it becomes available. For the most part, the artists themselves are generous in providing information regarding publication and exhibition history even if it is not detailed. Other users have preferred to eliminate edition and portfolio information as superfluous or repetitive. However this appears to be the case primarily in situations where conservation and curatorial staff work relatively independently of one another. Since one of the original goals was to create a document seeking generally agreed upon essential information, it is crucial to gather and retain information important to both curatorial and conservation departments whenever possible. The PIR cannot substitute for a condition report but it can be used to condense or expand other questionnaires and should be jointly used by curators, collection managers, conservators, and other relevant staff.

Best Practices

The final section of the survey allowed participants to offer short answer comments regarding successful use of the PIR. As mentioned before, some institutions simply extract and ask questions most useful to their collection or institution. Some users add the questions to the body of an email message to the artist/dealer, and occasionally a phone interview is used to walk the person through the form. Others have added information to the form based on conversations with the artist or gallery. This can be done verbally using the form as a guide and tailoring additional questions as needed. The PIR can also be sent out with other acquisitions-related documents. This way it borrows the momentum of the acquisitions process and does not appear to be an extra step. One user suggested adding a note that it was not mandatory to answer all the questions, so recipients know that any information they can provide is appreciated. Additionally, some departments fill out the basic bibliographic information, if known, before sending out the document. This reduces the amount of blank spaces and makes the form less intimidating. Lastly, experienced PIR users indicate that communicating about the purpose of and need for the document is the best way to ensure good participation. Let the respondent know that they are not being tested or scored and that they do not need to fill out information that they do not know. A partially filled out form is better than nothing at all. Also, explain that the form can be used for multiples or series where the prints are virtually the same. This has helped to relieve the stress level where dozens or hundreds of photographs in a series are acquired.

Some users have developed innovative applications for the PIR. Outside of gallery or institutional applications, some fine arts graduate programs are now encouraging students to use the PIR to record information about their work from the outset and some high-end printers are assisting photographers with filling out the form at the time of production. The PIR has been sent out retroactively, for example sending the form to artists whose work was acquired some years ago and in some instances the PIR has been sent to living relatives or agents of a deceased artist.

Conclusion

There are many benefits of incorporating the PIR into the standard documentation for collections. Simply the act of filling out the form will increase understanding of the work, the artist and any special needs of the artwork for both gallery and institutional staff. This is especially useful in all phases of the life of an artwork including during handling, shipping, storage, conservation treatment, and exhibition. For conservators, the PIR now provides crucial details regarding artists' materials including type of paper used (and why), whether or not the print was toned (and how), and the extent and nature of previous exhibitions – if any. These matters are particularly important with the shift from analog to digital print processes. Information about black-and-white paper types is now of greater interest than it ever was before, due in part to the rarity of these papers and the difficulty of accessing information about them. It is critical to collect what information there is before the generation creating and using these papers is no longer available to consult. Contemporary inkjet and other digitally produced images have undergone a rapid evolution where ink set and paper combinations significantly affect longevity. In addition, the PIR lets artists know that the institution is invested in the long-term care of their work. The questions on the form have prompted many to think about and record information that they may not have considered important in the past.

The results of the survey are now being analyzed with a view to upgrading the current version of the PIR. As format and technology issues continue to be a challenge, other document platforms are being considered instead of the writable PDF format. One of the challenges for the success of the PIR is to spread the word broadly about its great benefits and use, reaching beyond conservation, curatorial and collections management departments to galleries, dealers and the artists themselves. The PIR Committee will work closely with AIC and current PIR users to make the form more accessible to a wider audience. The Committee plans to replicate the great acceptance and success the PIR has had within the preservation community to a wider group of artists, dealers and curators. A series of press releases is planned as well as continued presentations to visiting groups, international conferences and colleges and universities. The announcement and reminders of the form within allied organizations such as the American Alliance of Museums, Association of International Photography Art Dealers, Registrar groups etc. is a goal for the coming years. This parallels efforts in other areas of the field to reach and influence a broader audience.

The creation of the PIR has truly been a collaborative effort involving the time, energy and resources of dozens of people. We would like to thank the original committee members and their institutions, the translation committees for all their hard work and dedication to the project as well as those actively using the PIR and those advocating its use.

Photograph Information Record Committee Members (2007-2009):
Theresa Andrews, San Francisco Museum of Modern Art; Àngels Arribas, Lumen Photographic Conservation; Barbara Brown, Harry Ransom Humanities Research Center; Anne Cartier-Bresson, Atelier de Restauration et Conservation de Photographies; Lee Ann Daffner, Sarah Meister, Whitney Gaylord, Museum of Modern Art; Malcolm Daniel, The Metropolitan Museum of Art; Rachel Danzing, Brooklyn Museum; Mirasol Estrada, Advanced Residency Program, George Eastman House & Image Permanence Institute; Eva Grieten, Art Institute of Chicago; Dana Hemmenway, Library of Congress; Kelley Loftus, Whitney Museum of American Art; Annette Manick, Museum of Fine Arts, Boston; Sylvie Pénichon, Amon Carter Museum; Stephen Pinson, The New York Public Library; Janice Schoepfer, Los Angeles County Museum; Andrea Wise, National Gallery of Australia.

PIR Translation Committees (* indicates the Translation Committee Chair):
Catalan Translation: Pau Maynés,* L.Luís Roqué, Xavier Rossell, Anna Vila-Espuna
Chinese Translation: Hoyu Chang, Hsuan-Yu Chen, Jiuan Jiuan Chen,* Wan-Ping Chen, Yi-Liu (Mei-Chun) Chen, Hsiu Mei Huang, Hsu-Chiao Huang, Jen Jung Ku, Hung-Wen Luo, Fei Wen Tsai
Dutch Translation: Martin Jürgens, Hadassa Koning,* Michiel Kort, Herman Maes, Bill Wei and the fotowerkgroep
Finnish Translation: Elina Heikka, Riitta Koskivirta,* Anna-Kaisa Rastenberger, Laura Sallas
French Translation: Anne Cartier-Bresson, Cécile Bosquier, Marie-Aimée Dubois-Krzynowek, Bertrand Lavédrine, Sylvie Pénichon
German Translation: Martin Jürgens, Klaus Pollmeier,* Marjen Schmidt
Greek Translation: Adia Adamopoulou,* Vassiliki Hatzigeorgiou, Hercules Papaioannou, Aliki Tsirgialou
Italian Translation: Daniele Aliffi, Silvia Berselli, Simona Casarano, Tatiana Cole,* Laura Gasparini, Roberta Piantavigna, Stefania Ruello
Japanese Translation: Toshiaki Koseki, Hanako Murata,* Yoko Shiraiwa
Portuguese Translation: Sandra Baruki, Luisa Casella,* Sabrina Esmeraldo, Miguel Laiginha Loureno, Catarina Mateus, Luis Pavão, Élia Roldão, Ana Saramago
Spanish Translation: Mirasol Estrada,* Claudio Hernández, Rosina Herrera, Vianka Hortuvia Atenas, Alejandra Mendoza, Fernando Osorio Alarcón, Samuel Salgado Tello

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Photograph Information Record

This questionnaire is used internationally to obtain essential information detailing the materials and techniques used in the creation of photographic works and their history. This allows institutions and individuals to better catalogue, interpret, and care for their photographs. Please provide as many details as you can. Extra space is provided at the end for responses that exceed the space allotted.

Contact information for the person completing this form:

Name Date

Address

Email Telephone

Please complete or verify the following information.

Artist name

Nationality Birth date or life dates

1.1 Title of work

1.2 Image date **1.3** Print date

1.4 Is the work editioned? ○ Yes ○ No If yes, this print is number from an edition of plus artist's proofs.

1.5 Is this work editioned in any other size or format? If so, provide details.

1.6 If not editioned, are there other known prints of this image?

1.7 Is the work part of a series or portfolio? If so, please describe.

2.1 History of ownership, including dates:

2.2 Exhibition history **for this print** (indicate length of time and light levels if possible):

2.3 Publication or reproduction history **for this image** (including other prints):

2.4 Conservation history **for this print**. Has the work been examined or received treatment? ○ Yes ○ No

Is documentation or information available? ○ Yes ○ No ○ Attached

3.1 This image derives from ○ film ○ digital capture ○ scanned film ○ other (e.g., paper negative, glass negative)

Provide film type and size, camera type, digital file specifications, or other information as applicable.

3.2 Describe any image manipulation prior to printing.

continued on other side

3.3 This print is a ○ gelatin silver print ○ chromogenic print (C-print, Ektacolor, etc.) ○ inkjet print (Iris, Gyclée, Epson, etc.) ○ silver dye bleach print (Cibachrome, Ilfochrome) ○ other

3.4 If the support/paper is commercially produced, please identify the manufacturer and product name. If produced by hand, please describe the materials and techniques used.

3.5 If this is an inkjet print, please provide ink set information (for example: Epson UltraChrome K3 ink). If the inks are altered or mixed by the artist or printer, please describe.

3.6 This work was printed by ○ the artist ○ the artist's studio ○ a commercial printer ○ other

Provide printer's name and contact information if applicable.

3.7 Please provide any available information regarding printing equipment such as model, chemistry type, etc. (e.g. Light Jet, Lambda, RA4, Epson, Fuji, etc.).

4.1 Once printed, this work has been ○ toned ○ spotted ○ retouched ○ coated ○ treated with other applied media ○ framed ○ laminated (with plastic film) ○ face-mounted (to glazing material) ○ back-mounted (adhered to solid support) ○ lined (adhered to flexible paper or textile support) ○ other

For each procedure checked above, please specify materials, application techniques, mounter's name and contact information as appropriate.

4.2 Are there aspects of presentation (framing, installation details) that are considered integral to the work?

5.1 Are there aspects of the work that are particularly vulnerable and in need of special care?

5.2 If appropriate, please provide contact information for a conservator, assistant, or other individual who is familiar with the work and can be consulted on preservation matters.

5.3 Any other comments or information that you would like to offer regarding the creation and preservation of this work of art would be greatly appreciated.

Additional space for answers to questions above

This form is endorsed by The American Institute for Conservation and its Photographic Materials Group. It is used by The Art Institute of Chicago; Atelier de Restauration et de Conservation des Photographies de la Ville de Paris; George Eastman House, Rochester, New York; High Museum of Art, Atlanta; J. Paul Getty Museum, Los Angeles; Los Angeles County Museum of Art; The Metropolitan Museum of Art, New York; Milwaukee Art Museum; Museum of Fine Arts, Boston; The Museum of Fine Arts, Houston; The Museum of Modern Art, New York; National Gallery of Art, Washington, D.C.; National Gallery of Australia, Canberra; The National Gallery of Canada, Ottawa; The New York Public Library; Philadelphia Museum of Art; Rijksmuseum, Amsterdam; San Francisco Museum of Modern Art; (list in formation).

A writable pdf version of this document may be found at: **www.conservation-us.org/PIR**. This version produced June 2009.

Content Area Photograph Conservation: Teaching Conservation to Non-Native English Speakers

Jessica Keister

Presented at the PMG session of the 2012 AIC Annual Meeting in Albuquerque, New Mexico.

Introduction

Multiple international outreach projects are currently underway, the goals of which are to help train photographic materials conservators and to establish photograph conservation as a profession in nations where it does not yet exist. As conservation is a highly specialized field, a major variable in the success of such projects is the English-language skill of the participants. Techniques for facilitating effective communication between American conservators involved in international teaching initiatives and non-native English speakers can be appropriated and adapted from English as a Second Language (ESL) education specialists.

This paper will discuss one such ongoing international outreach project and the language-based challenges faced by all involved. Advice from an ESL specialist was sought, and several tools and techniques successfully implemented. Even so, dialogues between those involved in outreach projects, ESL educators, and non-native English speaking conservation professionals should continue in order to improve teaching tools/techniques and to help ensure the success of such international projects.

Case Study: Training in Photograph Conservation for the State Hermitage Museum

The Andrew W. Mellon Foundation project to establish photograph conservation at the State Hermitage Museum, in Saint Petersburg, Russia, began in 2010. Prior to this project, an in-depth survey of the Hermitage photograph collections was conducted and a number of needs were identified. One was the lack of dedicated staff to care for these photographs. The Mellon-sponsored and FAIC-managed project aims to rectify these deficiencies by establishing a photograph conservation department at the Hermitage and by providing training in photograph conservation techniques for the new department's staff. American institutions participating in the staff training include the following: the Conservation Center for Art & Historic Artifacts (CCAHA), the University of Delaware, the Metropolitan Museum of Art, the Weissman Preservation Center, the George Eastman House, and Paul Messier LLC (Bogel, 2011).

Four Hermitage staff members were selected by the Hermitage to become the core of the newly established photograph conservation studio. Three of these individuals first visited the Conservation Center for Art & Historic Artifacts in Philadelphia for a week of training in July 2010: it was at this time that CCAHA staff first realized that the language barrier would be a challenge. CCAHA staff involved in the project included all of the photograph conservators, a paper conservator and preservation consultant, a senior conservation technician, and the housing/framing and digital imaging specialists.

All four Hermitage staff would be visiting CCAHA in June 2011, this time for over a week. Based upon the 2010 teaching experience, staff endeavored to address the language obstacles before their arrival.

This was done by seeking the advice of a Kathy Keister, an English as a Second Language (ESL) education specialist. Ms. Keister has been a public school teacher in Pennsylvania for over 35 years, and has been a certified ESL program specialist since 2006. Apart from teaching English, part of an ESL teacher's less obvious tasks involve 'outreach' to other teachers within the school district regarding best practices for teaching ESL students and explaining cultural differences to both the regular classroom teachers and the ESL students. She has worked with students whose native languages include French, Spanish, Urdu, Chinese, Russian, and Vietnamese.

A packet of handouts was prepared for every CCAHA staff member who was going to be working with the Hermitage staff. These handouts included a list of challenges for ESL students within specific subject content areas and tips for communicating with ESL students (see Appendices I and II).

Initial Language Skill Evaluation

Prior to the Russian's first visit, CCAHA was informed that the students had good English language skills. Since CCAHA has regularly and successfully welcomed international interns and fellows, the staff felt confident of their abilities to effectively communicate with the Russian guests. However, the word-of-mouth evaluation provided did not meet the level of language proficiency that was expected.

This mistaken assessment in language skill level is not surprising, as a student's language skills are frequently incorrectly assessed by non-specialists. This is because basic communication skills are very different than technical English, and it was necessary to communicate with the students using technical English in order to teach basic photograph conservation techniques.

BICS versus CALP

ESL specialists differentiate between two different types of language skills - social and academic - which are termed **BICS** and **CALP** - to better discuss the language proficiency of an ESL student. Problems arise when social language skills are mistaken for academic language skills.

BICS is an acronym for the **B**asic **I**nterpersonal **C**ommunication **S**kills required for verbal face-to-face communication. This is "survival English" - how to meet and greet, asking for directions, going to the grocery or doctor, dealing with money, telling time, etc. This language is often context-embedded and occurs in a meaningful social context. Studies have shown that these language skills usually develop within six months to two years after a student arrives in the United States.

CALP is an acronym for **C**ognitive/**A**cademic **L**anguage **P**roficiency. This is the English that is required for any type of academic discourse, and includes listening, speaking, reading, and writing about subject area content material. As a term, 'subject area content material' is straightforward, rather like the subjects listed on a primary school report card: reading, mathematics, and science.

Academic language is not only memorizing vocabulary lists - it includes skills in comparing, classifying, synthesizing, evaluating, and inferring. As a student becomes older and progresses through academia, the language becomes more cognitively demanding. Proficiency in subject content area language usually takes from five to seven years, but can take up to ten.

Being the ESL Student in a Conservation Laboratory

Two conservators who were non-native English speakers were interviewed in regards to their experiences working and learning in English-only conservation laboratories.

Both conservators had begun studying English as teenagers in their native countries, where the classes were large and focused on reading, writing, and grammar, as opposed to listening and speaking. Though they studied English extensively prior to their arrival in the United States, both found that they were not quite as prepared as they had originally thought they were. They found that reading English was much easier than speaking or writing, and both were surprised by the cultural differences proved a stumbling block. Anything involving small talk and cultural references was a challenge.

They agreed that written information – outlines, notes, articles, vocabulary lists – in English is absolutely vital. Using a dictionary to translate written or spoken words is also extremely helpful. Both also agreed that watching and listening to English films or television shows with captions is the most useful way to improve one's understanding of English. One of the conservators did take a formal language class with an ESL instructor, though only for a short time. She stated that it was quite helpful.

The two conservators were in agreement about what their professors or supervisors did to help facilitate their understanding.

- Taking time to explain the meaning of words.
- Providing vocabulary lists.
- Providing detailed slide lists (pre-PowerPoint) which included a description of each slide, important vocabulary, and notes.
- Not slowing their speech down and not slowing the course work down.
- Books with English/French/German translations.
- Hands-on activities and demonstrations.

Successes and Stumbling Blocks

The thoughtful preparations of CCAHA staff involved the use of a number of effective teaching tools and activities, which resulted in the overall success of the training. However, despite these endeavors, there were still several unexpected challenges.

Planning in Advance, Handouts, and a Whiteboard

As much as possible, all activities and lessons were prepared in advance. This allowed for the preparation of extensive, clearly written handouts for everything. Clear typewritten handouts for all activities and lessons were another way to assist in the students. Having new words and unfamiliar phrases provided on a handout enables the students to use a dictionary to look up terms in the future.

An erasable white board was present throughout the Russians' visit. It was used for drawing and writing by both CCAHA staff members and students, as part of an activity or as a tool to help further their understanding of the material.

CCAHA staff also took care to ensure that any printed handwriting was as neat as possible and that all handouts were typewritten. This was more important than initially thought: one of the four visiting Russians could print the letters of the Roman alphabet at an elementary level and may have had significant difficulty with the potential variation of cursive handwriting.

Check List Reports

One of the goals listed for the Hermitage staff in the initial project proposal was the ability to prepare general and in-depth condition reports and proposals for treatment. Considering the necessary language skills required to do this, having each individual prepare a prose report was a daunting task.

Instead of using the standard CCAHA prose report template, checklist-form condition and treatment reports were created. The forms were based upon a checklist condition report developed and used by John McElhone at the National Gallery of Canada. The checklists also incorporated housing and framing sections, listing a variety of attachment methods as well as various matting and storage options.

These checklists were ideal. As the forms did not require forming complete sentences, they put less stress on the students. Conservator Mary Schobert, who worked with the Russian students to prepare their reports and proposals, was able to focus on defining the terminology used in the checklist and working with each student to examine their selected treatment projects. Ideally the students could then take the checklist forms back to the Hermitage and, after translating them into Russian, use them as the standard forms for projects within the new photograph conservation studio at the Hermitage.

Hands-On Activities

A second the goal listed in the initial project proposal was that the selected Hermitage staff become familiar with basics photograph conservation treatment techniques. The typical American student's experience might involve some brief lectures and demonstrations by the teacher before the students progressed to hands-on experimentation. Because of the limited English-language skills of the Hermitage staff, the bulk of a lecture component was omitted and the focus was placed onto demonstration and hands-on activities.

Similar Projects

One of the primary goals in having the Hermitage staff visit CCAHA was to increase their experience in the treatment of paper-based photographic materials. Towards this end, each student selected a project photograph from a group of study collection materials.

Prior to the arrival of the Hermitage staff members, CCAHA photograph conservators had carefully selected the items included within the group. The photographs were a range of processes and ages, but all exhibited the same broad condition issues.

This allowed the students to progress logically through their treatment projects over the course of the week, and ensured that they all learned the same material. They could have lessons and workshops on various conservation techniques together, but there were enough intrinsic differences between the photographs that slight alterations of the treatment approaches would be necessary. It also allowed them to observe how condition issues manifest in different photographic processes.

CCAHA Staffing

The CCAHA conservator working primarily with the Russians was Barbara Lemmen. Having one person as the primary instructor provided continuity, allowing the students to become more comfortable and relaxed than they might have been with a new instructor every day. Ms. Lemmen was assisted everyday by one of the other photograph conservators – the position rotated between Rachel Wetzel and Jessica Keister. The assistant was responsible for assisting Ms. Lemmen with anything required throughout the assigned day, and led a half- or quarter-day workshop. The portion of the day that the wingman was in charge allowed Ms. Lemmen a chance to relax.

Regular Breaks

Regular coffee and tea breaks were scheduled into the day. This allowed for the students to relax and talk to each other in Russian; it is fatiguing spending an entire day intensely focused in a foreign language.

Regular breaks also allowed CCAHA staff to work together to make any last minute alterations or modifications to lesson plans, as well as to informally assess how the day was going, gather and prepare materials, and ask each other for any needed assistance.

The Advantage of a Translator

Because specialized technical language is used in conservation, the presence of a skilled translator would have been beneficial. A Russian-speaking photograph conservator acting as a translator would not have been necessary: any translator with excellent Russian/English skills would have sufficed. The instruction for the Hermitage staff while began with the fundamental foundations of conservation practice, and any explanations made to a translator would also have been required for the students.

It was not practical and it was not ethical to have another student with better language skills translate. First of all, none of the four Hermitage staff were skilled enough to function as a translator. Secondly, acting as a translator took a student away from concentrating on her own project. And finally, and most importantly, having one of the four students translate meant that it was impossible to have a private conversation with a student. This severely limited any interactions with the students, especially when it came to critically evaluating a student’s work.

Differences in Cultural and Educational Backgrounds

Unexpected cultural differences made it extremely difficult to evaluate the students’ level of understanding: were they shy or did they not understand the material? The students also did not appear to have the higher-level scientific background found in conservators who have been trained in Western Europe or North America. The training needed to build upon this foundation of materials, techniques, and ethics, and because of the communication handicap, this basis could not be established with any certainty. It was also difficult connecting with the students beyond a superficial level: trust and empathy are built in informal settings and require time.

Conclusion

It is clear from the experiences of the CCAHA staff that the key to the effectiveness of an international educational outreach project is clear communication between all parties. This includes communication between students and instructors, between individual instructors, and between the supervising agency and all involved at every level of the project.

In the future it would be beneficial to have a series of informal meetings or workshops that focus on strategies for teaching conservation and preservation to non-native English speakers. Such events should involve conservators who have experience with international outreach projects, those who are interested in becoming involved in such initiatives, and with ESL teaching specialists. A second goal of these meetings would be to gather the information on the necessary training and level of competency expected for photograph conservators, and to synthesize these materials, devising a basic curriculum for photograph conservation.

Ideally, this would tie in with the larger international discussion about unifying the curriculum in photograph conservation education. To what standards are students being taught? How is a student’s progress measured and evaluated? If the goal of such projects is to meet the highest contemporary standards of practice, those high standards must be set for teachers as well as students, ensuring that the tools and training given to the students allows them to meet those standards.

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Appendix I:

Challenges for ESL Students within Specific Content Areas

English
In an English class, difficulties include the use of regional dialects and accents, homonyms and synonyms, and an abundance of idioms and figurative language. Idioms such as “he got away with murder” or “it will knock your socks off” may be interpreted literally, and will often cause confusion. It is also important to remember that European students are often taught the pronunciations of British English, as opposed to American English.

Mathematics
In mathematics, the way numbers are written can vary - for example, an American may confuse numbers written by a Frenchwoman, as the style of a ‘one’ and a ‘seven’ are very similar. Also, the placement and function of decimal points and commas can vary, and the stubborn American adherence to illogical units of measurement such as inches and feet can be a significant stumbling block.

Science
Science courses are among the most difficult. The vocabularies are immense and highly specialized, and simple ordinary words may have very different scientific definitions. Passive voice in scientific texts is standard, and cooperative problem-based learning is the prevalent teaching style.

Social Studies
The heavy use of passive voice continues into social studies. ESL students also might not be used to expressing personal opinions or questioning those perceived as authority figures. For them, history might be broken down not into segments on a timeline, but into reigns, regimes, or dynasties.

Appendix II:

Tips for Communicating with ESL Students

- Use every non-verbal means of communication that you can: drawings, gestures, demonstrations, and hands-on activities. Such communication techniques can be highly effective, though it may mean that you end up attempting to mime something like 'suction table.'

- Write everything down or supply as many handouts as possible, so that a student has both visual and auditory input. Use of a large whiteboard or a tablet on an easel is recommended for larger groups so that the whole group could benefit from any words, drawings, and diagrams written.

- For students coming from a non-Roman alphabet background, avoid writing in cursive and stick mainly with printed text. Whenever possible, supply clearly typewritten handouts. Remember that such students are not just learning new words, they are learning new letters as well.

- Don't be offended if your student does not make eye contact with you. It is considered rude in many cultures.

- When speaking, avoid mumbling and speak clearly. Don't dumb things down and don't distort the natural rhythm of the English. Don't speak louder: this just makes people nervous.

- Avoid using the passive voice as much as you can. This is difficult in conservation, as the typical style of report writing can be found at the intersection of passive voice and ambiguity.

- When you have something important to communicate, and especially if critiquing or correcting, speak with the student one-on-one. Don't embarrass her by calling her out in front of the entire group.

- Ask yes and no questions as much as possible. This will allow the student to feel comfortable answering questions without worrying about proper sentence construction.

- Be an active listener: be patient with student's responses, don't jump in immediately to supply words, don't over-correct, and don't embarrass a student by asking her to repeat your corrections.

- Check the student's comprehension frequently, but don't ask, "Do you understand?" unless you have taught that question. This is not a reliable check for understanding, as students will respond yes, even if they don't understand. Anyone who has ever been the foreigner will understand this. Check for understanding through demonstration of skills or through asking multiple choice questions.

Abstract: Evaluation of Ultraviolet Filtration by Glazing and Display Case Materials

Morgan Simms Adams, Steven Weintraub, and Hannelore Roemich

Presented at the poster session of the 2012 AIC Annual Meeting in Albuquerque, New Mexico.

The UV-filtration properties of over 20 samples of currently available glazing and display case materials are evaluated and the results of two methods for measuring UV filtration are compared. Materials examined include samples of glass, acrylic, polycarbonate, and polystyrene sheets in various thicknesses; materials advertised as "UV-filtering" or "museum grade" are compared to similar materials not designated "UV-filtering." The two methods for the evaluation of UV filtration are with a UV-visible spectrophotometer and with an Elsec 764 UV meter. In both cases, a tungsten-halogen source with an enhanced UV output was used as the light source. The spectrophotometer was used in transmission mode, where the unfiltered light source was normalized at 100% transmission. This provided information on wavelength-specific filtration properties of the tested materials. The Elsec 764 UV meter provided output as microwatts/lumen. The samples examined are rated as excellent, moderate, and poor UV filters; comparison of the different types of glazing and display case materials reveals that effective UV filtration is available in polycarbonate, acrylic, and glass sheets.

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19^{th} Century Photography in a Modern Chemistry Lab

Corina E. Rogge and Anikó Bezur

Presented at the poster session of the 2012 AIC Annual Meeting in Albuquerque, New Mexico.

Abstract: College courses focusing on the interface of chemistry and art are an increasingly popular way to introduce non-majors to scientific subjects, but few courses seek to engage science majors in the art world. We recently developed an upper-level laboratory module for chemistry and chemical engineering majors that introduced students to the chemistry and conservation science of 19th century photographic processes. Students learned to visually identify 19th century photographs; made cyanotypes, van Dyke brown prints, gum bichromate prints, and salted paper prints (using negative/positive processes or cliché-verre), and were introduced to sepia, selenium, and gold toning methods. After learning the importance of non-destructive analytical techniques, the students used attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FTIR) to identify organic binders on study collection prints and x-ray fluorescence spectroscopy (XRF) to identify toning or stabilizing materials on salted paper prints and van Dyke brown prints. Students also examined the size and constituents of the image particles using scanning electron microscopy coupled with energy dispersive x-ray spectroscopy (SEM-EDX). The course was well received, because in addition to providing a foundation in new instrumental techniques it also provided students with an introduction to wet-process photography and to the museum and conservation worlds.

Introduction:

Interdisciplinary science courses that seek to attract and engage humanities and art students have become increasingly popular in undergraduate education. Many academic institutions have begun offering courses, mainly through their chemistry departments, that focus on the synthesis of artists' materials and/or the analysis of cultural heritage objects. Dr. Patricia Hill from Millersville University has been a particularly strong proponent of this approach and offers NSF-funded workshops each year for educators interested in integrating art into their science courses (http://www.millersville.edu/chemistry/cheminart.php). These 'science of art' classes are usually introductory courses aimed at broadening the education of non-science majors, and few upper-level undergraduate science courses employ a focus on conservation science. To show that this multi-disciplinary approach provides an exciting context for teaching advanced scientific concepts and experimental practices, we developed an upper level laboratory module on conservation science for chemistry and chemical engineering majors.

Collaborations between the MFAH and Rice University, including an introductory course on the chemistry of art, led to a 2007 Andrew W. Mellon Foundation grant to the Museum of Fine Arts Houston (MFAH), The Menil Collection, and Rice University that funded a conservation science initiative, including the hiring of Dr. Anikó Bezur as research scientist to the museums. Dr. Bezur and Dr. Rogge, then the Wiess Lecturer in Chemistry at Rice, sought to develop a course that would meet the requirements for a 300 level (junior undergraduate) Rice Chemistry laboratory module. Such courses should introduce students to new instrumental techniques, integrate previously learned chemical concepts, and explore new ones, in a ‘capstone’ manner. This course would also engage students in the analysis of museum study collection objects and the reproduction of historic techniques in order to fully understand the materials with which they were working. The chemical complexity of photographs as objects and the important role that scientists played in their development made their study and replication appropriate subject matters. The ready availability of original texts and detailed references that describe the photographic methods simplified the replication process.

The course focused on 19th century photographic processes as the resulting products are prone to degradation reactions and thus their identification is of great importance to conservators. The laboratory module’s schedule – three-hour sessions once a week for eleven weeks – imposed some restrictions on the processes the students would be able to reproduce. Single layer binder-less images such as cyanotypes, salted paper prints and van Dyke brown prints were amenable to the time restrictions and, with the inclusion of gum bichromate prints, presented a sufficiently varied selection in terms of chemistry and analytical challenges. Media that were not reproduced in the laboratory such as gelatin, collodion and albumen prints were represented in the study collection materials the students analyzed.

Students learned to utilize both non-destructive and micro-destructive analytical methods that would actually be used in museum conservation science labs for the characterization of photographs. Binders were identified by micro-destructive microchemical tests and non-destructive attenuated total reflectance Fourier-transform infrared spectroscopy (ATR-FTIR), a technique often overlooked in chemistry labs in favor of transmission FTIR, but commonly used in museums. X-ray fluorescence spectrometry, another non-destructive analytical technique, was used to determine the image and toning materials in photographs. Although increasingly common in cultural heritage institutions, this is a relatively rare method in academic research labs, and the lab module thus presented students with a novel opportunity to learn how to use this technique. Scanning electron microscopy coupled with energy dispersive x-ray analysis (SEM-EDX) was used for the visualization of the paper support and imaging particles and the elemental analysis of individual particles.

Course Outline:

Week 1 (no assigned reading)

Introductions: The instructors introduced themselves and explained the format of the course. It met three hours a week for 11 weeks and was worth 1 credit hour. Prerequisites included general chemistry and organic chemistry, while inorganic chemistry was strongly recommended. Lectures on analytical techniques and photographic methods would be interspersed as appropriate and individual laboratory sessions would focus on analytical techniques, creation of photographs or both. Readings from appropriate texts would be provided as resources, as would a series of handouts describing the chemistry behind each photograph process.

Construction of darkroom boxes: The laboratory took place in a chemistry department that did not have darkroom facilities. In order to prevent fogging of light-sensitive papers each student constructed a darkroom box based on a design suggested by Mark Osterman from the George

Eastman House. A large cardboard box had a window cut out on one side leaving a 2-inch lip (Fig. 1). The bottom of the box was lined with duct tape to make it easier to clean. To provide working light the top of the box had a small window cut into it and a 5x7 inch amber safelight filter taped over it. A length of black polyester fleece was used for the dark cloth.

Fig. 1. A simple cardboard darkroom box.

Introductory lecture: This lecture introduced the students to the history of photography, beginning with Johann Heinrich Schulze's discovery that silver chloride and silver nitrate salts darken upon exposure to light and covering the Daguerreotype, salted paper, calotype, ambrotype, and tintype processes. The differences between printing out and developing out processes were also discussed.

Week 2 (assigned reading: chapters 1-4 of Reilly (1986), handout on history and chemistry of photographic processes)

Visit to the MFAH photograph conservation laboratory: Mr. Toshiaki Koseki, the Carol Crow Conservator of Photographs at the MFAH, provided an introduction to the use of a stereomicroscope for identification of photographic processes. He provided a series of 'known' photographs from his study collection and taught the students how to apply the identification flow chart in Care and Identification of 19th Century Photographic Prints (Fig. 2). The students were then challenged to identify 'unknown' photographs using this method. Surprisingly, the students were quite anxious about this task as it was far outside the realm of their normal scientific experiences, but quickly realized that they could bring their analytical skills to bear and were able to identify many photograph types by the end of the class period.

Fig. 2. Toshiaki Koseki helping students to identify their unknown prints. Photograph courtesy of Karen Willis.

Week 3 (assigned reading: an article on the use of XRF for the analysis of cultural heritage objects (Deming Glinsman 2005))

Introduction to XRF and its application to photograph identification: As none of the students had previously encountered XRF spectrometry, an introductory lecture was given on the theory behind this technique. This was followed by a practical introduction to the Bruker Tracer III-V instrument. The students then used this method to characterize their unknown photographs from week 2 in order to determine if their visual identifications were correct.

Week 4 (assigned reading: article on the chemistry of platinum and palladium prints (Gottlieb 1995), and handouts on cyanotypes and van Dyke brown processes)

Lecture on iron-based photographic processes: This lecture introduced the students to the chemistry behind cyanotype, van Dyke brown, and platinum/palladium processes.

Assembly of contact printing frames: Commercial contact printing frames are prohibitively expensive so we constructed simple ones from wooden frames, latex tubing, Volara and foam-core (Barnier 2000; Rogge 2012).

Cyanotypes: The students made cyanotypes using the traditional iron(III) citrate and potassium ferricyanide recipe (Ware 1996-2004a) and compared them to those created by Dr. Mike Ware's modification of the method that uses iron(III) oxalate and potassium ferricyanide (Ware 1996-2004b). They determined proper exposure time by performing trial exposures with transmission step wedges. They were also introduced to toning processes and used trisodium phosphate or tea to create yellow or brown prints, respectively (Fig. 3).

This provided the first opportunity for the students to witness photochemistry in action. It is well known that exposure to light causes citrate to break down, forming carbon dioxide and acetone: $C_5H_5O_7^{2-}$ + light→ $3CO_2(g) + C_3OH_6(l) + H^+ + e^-$. The electrons produced reduce potassium ferricyanide to ferrocyanide, which in the presence of excess iron(III) forms ferric ferrocyanide, or Prussian blue. The blue color derives from intervalence electron transfer between the two different oxidation states of iron, $Fe^{2+}$and Fe^{3+}, linked by cyanide bridges. However, exposure to light can also cause the temporary photobleaching of Prussian blue to Prussian white, ferrous ferrocyanide. Therefore the initial print density appears to be weak, and only upon reoxidation does the true print density become apparent. These concomitant processes provided an apt illustration of importance of doing test exposures using transmission step wedges in order to optimize the appearance of the final image.

Fig. 3. From left to right: a traditional cyanotype, a Ware method cyanotype and a tea toned traditional cyanotype.

The toning experiments also raised the concept of preventive conservation and the importance of housing materials. Exposure of cyanotypes to weak bases causes the formation of hydrated iron oxides, which are yellow. Some archival storage materials are buffered and contain a base reserve that can cause the same reaction and upon exposing their cyanotypes to base the students immediately understood why buffered materials should not be used for cyanotype housings.

Paper sizing: To investigate the role paper sizing plays in tonality of salted paper prints each student sized a series of papers with arrowroot starch, gelatin, acrylic matte medium or gum Arabic with potassium dichromate.

Week 5 (assigned reading: handout on salted paper prints)

Halide-stabilized and thiosulfate-fixed salted paper prints: The students created halide-stabilized and thiosulfate-fixed salted paper prints using their sized papers. Talbot initially formed light sensitive papers by washing paper in a solution of sodium chloride and then brushing a solution of silver nitrate onto the surface (Schaaf 1996). We chose to use a slightly later adaptation invented by Alfred S. Taylor (and eventually adopted by Talbot), where the 'ammonio-nitrate of silver' (diamine silver(I), $[Ag(NH_3)_2]^+$) is used instead (Ware 1994). This species is a complex ion formed by titration of a silver nitrate solution with ammonium hydroxide. As ammonium hydroxide is added an initial precipitate of neutral Ag_2O forms but as more ammonia is added the equilibrium shifts to favor the formation of the diamine complex. Because this complex ion is charged it is soluble in water and the precipitate re-dissolves. This provided a graphic example of relatively simple chemistry taught in general chemistry classes but applied in a new and novel setting. Another example of the solubility of charged complex ions occurs during the 'fixing' of prints with sodium thiosulfate: $2\ Na_2S_2O_3^{2-}\ (aq) + AgCl\ (s) \rightarrow [Ag(S_2O_3)_2]^{3-}\ (aq) + 2\ NaCl\ (aq)$.

Salted paper prints also provided an ideal format to discuss the importance of equilibrium constants in photography. It is rather surprising to most people that formation of silver halides from metallic silver and halogen gas is strongly thermodynamically favored. Therefore, in the absence of scavenging reactions that remove the halogen formed during exposure of the sensitized paper to light no image would be created. Luckily for photographers, water is capable of reacting with halogens via disproportionation to a hypohalous acid and halide ion: $X_2\ (g) + H_2O\ (l) \rightarrow X^-\ (aq) + HOX\ (aq) + H^+\ (aq)$, where X is a halogen (Ware 1994). The equilibrium constant K for this reaction is 500, 0.01 and 10^{-9} for Cl_2, Br_2 and I_2 (respectively), suggesting that in the absence of other reactions recombination of iodine with Ag to reform AgI is favored. The fact that this reaction is not seen by the students leads to a discussion of what this implies, namely that another reaction removes the HOI or HOBr formed and thus pulls the reaction forward; the reaction is: $3\ HOX\ (aq) \rightarrow 2\ X^-\ (aq) + XO^{3-}\ (aq) + 3\ H^+\ (aq)$.

The production and scavenging of halogens is necessary for image formation, but continued exposure to light after the image has been formed can cause overexposure and loss of image quality. Talbot initially halted exposure by soaking his exposed prints in concentrated solutions of halides. This causes the silver halide crystals to sorb excess halide ions onto their surface. The negatively charged halide ions repel photoelectrons produced upon exposure, preventing reduction of Ag^+ and formation of metallic silver. Halogens can also be scavenged by excess Ag^+: $X_2\ (g) + H_2O\ (l) + Ag^+\ (s) \rightarrow AgX\ (s) + HOX\ (aq) + H^+\ (aq)$ but in the presence of excess halide the reverse of this reaction is favored and a more photostable material results. However, these images are still very vulnerable and can visibly deteriorate over a very short period of time, particularly if the concentration of halide is incorrect. Too little stabilizing halide results in an image that will continue to darken whereas too much iodide can result in loss of the image via the reaction of silver with iodide and oxygen: $4Ag\ (s) + 4I^-\ (s) + O_2\ (g) + 4\ H^+\ (aq) \rightarrow 4\ AgI(s)$

+ 2 H_2O (l). These reactions were observed in some student-made prints, providing a dramatic analog of the deterioration seen in a Talbot print by Rheingold (1993).

Week 6 (no assigned reading)

XRF analysis of salted paper prints: In addition to being able to detect the presence of halide stabilizers as shown in (Rogge 2012), the stabilized prints can also be distinguished from thiosulfate fixed prints due to equal levels of silver being present in the light and dark areas of the halide-stabilized prints (Fig.4).

Week 7 (assigned reading: handout on toning processes)

Toning of thiosulfate-fixed salted paper prints: The students toned their prints using Kodak Professional Sepia II Warm Toner, Kodak Rapid Selenium Toner, Clerc's thiourea gold toner or gold borax toner (James 2008).

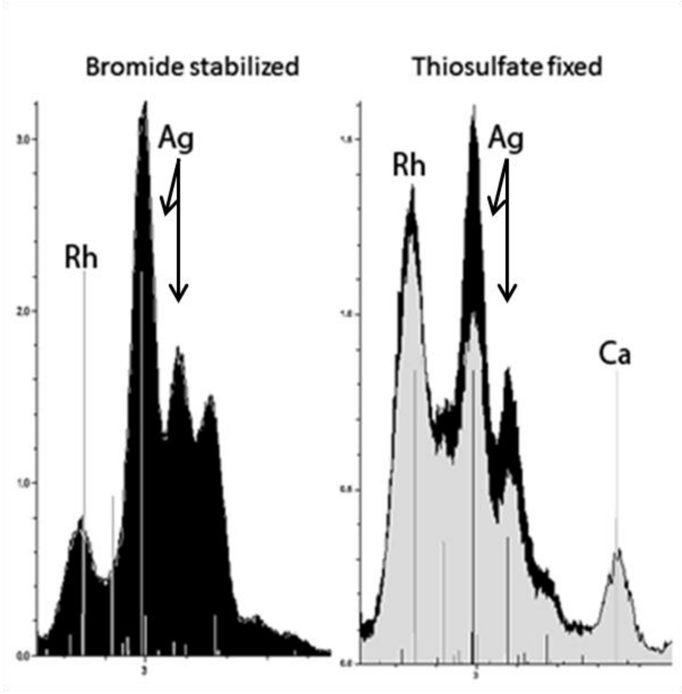

Fig. 4. Comparison of the intensity of the silver peaks in the light (grey) and dark (black) areas of bromide stabilized and thiosulfate fixed prints. The light and dark areas of the halide stabilized prints cannot be distinguished by XRF, whereas there is clearly less silver in the light areas of thiosulfate fixed prints.

Toning provided an excellent opportunity to discuss common degradation reactions, the importance of the electrochemical series, and relative reduction potentials. Toning may be an aesthetic choice by the artists, but also has a decided impact upon the stability of the final print. Silver is a reactive material and is prone to the formation of silver sulfide, Ag_2S, in polluted environments or when the print has been insufficiently washed and thiosulfate remains in the support. Silver sulfide has a lower extinction coefficient than pure silver (Ware 1994) and therefore 'sulfided' prints have reduced image density. However, silver sulfide itself is a very inert material and this stability can be exploited by sepia toning the print, where the silver image material is deliberately converted into silver sulfide. The Kodak Professional Sepia II warm toner used by the students has interesting chemistry where silver is first reduced by potassium ferricyanide (previously encountered in cyanotypes), then converted into silver bromide, and finally reacted with sodium sulfide:

$$4\ Ag\ (s)\ +\ 4\ K_3[Fe^{3+}(CN)_6]\ (aq)\ \rightarrow\ 3\ K_4[Fe^{2+}(CN)_6]\ (aq)\ +\ Ag_4\ [Fe^{2+}(CN)_6]\ (s)$$

$$Ag_4[Fe^{2+}(CN)_6]\ (s)\ +\ 4\ KBr\ (aq)\ \rightarrow\ K_4[Fe^{2+}(CN)_6]\ (aq)\ +\ 4\ AgBr\ (s)$$

$$2\ AgBr\ (s)\ +\ Na_2S\ (aq)\ \rightarrow\ Ag_2S\ (s)\ +\ 2\ NaBr\ (aq)$$

In gold toning, silver image particles are exposed to a solution containing gold(III) ions. Because of the difference in reduction potentials, an electrochemical replacement occurs and some of the silver atoms in the image particles are replaced by gold: $3\ Ag\ (s) + [AuCl_4]^- \rightarrow Au\ (s) + 3\ AgCl(s)$. Because gold has a more positive reduction potential than silver, it is less prone to oxidation reactions and a more stable image results.

XRF analysis of toning materials: As described by Rogge and Bezur (2012), XRF can be used to determine if a print has been toned with selenium or gold. The issue of sulfur (sepia) toning is more complex because the detection of sulfur by XRF could also indicate incomplete removal of the thiosulfate fixer or subsequent exposure to sulfur-containing pollutants and undesired formation of silver sulfide.

Week 8 (assigned reading: Chapter 5 from Derrick, Stulik, and Landry (2000), relevant microchemical tests from Odegaard, Carroll and Zimmt (2005) and a handout on paper sizing)

Identification of binders and paper sizes by ATR FTIR: The students learned how to use the ATR interface of a bench-top FTIR instrument for non-destructive analysis of photographs. Albumen, silver-gelatin and salted paper prints (binderless) were used as examples. The students then analyzed the papers they had sized using the references provided.

Identification of binders and paper sizes by microchemical tests: Utilizing the tests outlined in Odegaard, Carroll and Zimmt (2005) as a reference the students analyzed the papers they had sized as well as the 'unknown' photographs from week 2.

Fig. 5. Gold borax toned van Dyke brown print made from an antique glass plate negative

Week 9 (no assigned reading)

van Dyke brown prints: Coming back to iron-based photography the students made van Dyke brown prints and toned them using the same techniques they had learned for salted paper prints (Fig. 5).

Cliché-verre: The students smoked a glass plate over a candle flame, lightly sprayed it with Krylon workable fixative, and

Fig. 6. Cliché-verre plate (left) and van Dyke brown print made from the plate (right).

then drew on the plate (Fig. 6). Students printed their plates and toned the resulting image with a method of their choosing.

Week 10 (no assigned reading)

Gum-bichromate prints: The students made single color gum bichromate prints using a variety of inorganic pigments from Kremer Pigmente mixed with gum Arabic and potassium dichromate. To determine proper exposure times, they performed test exposures for each pigment mixture (using transmission step wedges) because different pigments accelerate or retard the crosslinking reaction.

This was the only two layer print the students made, and it also introduced the concepts of oxidative crosslinking, metal crosslinking, and the dependence of polymer solubility on molecular weight.

Week 11 (no assigned reading)

Analysis of photographs by SEM-EDX: Sections of cyanotypes (both traditional and Ware method) and thiosulfate-fixed salted paper prints were taken from dark areas and carbon coated. Image particles were located and their sizes measured. This provided graphic evidence for the nanoscale size of the particles and the fibrous nature of the paper.

Conclusions:

The instructors felt that this course successfully introduced the applicability of science to the study of photographs and the museum world while drawing on previous chemical knowledge. The students learned several new techniques that they would not otherwise have been exposed to, and a great deal about photography, a subject that none of them had considered in terms of chemistry before taking the course. The students appreciated the history behind the subject, and the critical role played by scientists in the creation of this type of art gave them a sense of pride and resulted in more investment in the lab. Because the students produced their own images, there was a surprisingly strong drive not only towards understanding and experimentation but also to create more perfect prints. As none of the students had visual arts backgrounds or had done any photography other than simple digital 'snaps', this was unanticipated, and sometimes required the instructors to limit the number of prints created in the interest of time. Student morale was high throughout and one of the students later said that this laboratory module had been his favorite class at Rice.

Based upon these experiences, we feel that the integration of conservation science into chemistry and materials sciences programs should not be limited to the introductory level classes, and that science majors can benefit from the opportunity to learn about more complicated materials and techniques in a more advanced course. 19^{th} century photographic methods proved a convenient topic for these purposes given local museum expertise and instrumentation, and the interest in nanoscale chemistry at Rice, but we expect that other conservation science topics could also be productively explored in advanced laboratory modules. We encourage our colleagues to explore these options and to this end will be happy to make any of our course materials available upon request (email C. Rogge: crogge@mfah.org).

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Earthquakes and their Aftermath: Lessons Learned from the Canterbury Quakes 2010-2011

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Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Abstract

At 4.35am on Saturday 4th September, 2010, the Canterbury district in the South Island of New Zealand experienced a 7.1 magnitude earthquake. The epicentre was located 40km west of Christchurch, near Darfield, and had a focal depth of 10km. It caused widespread damage and was felt over the whole of the South Island, with tremors felt as far away as Auckland in the North Island. No one died during this earthquake but properties were badly damaged including many heritage buildings. On December 26th there was another big aftershock, again with no loss of life. However on the 22nd of February, 2011 at 12.55pm a 6.3 magnitude aftershock centred in Heathcote near the Port of Lyttelton devastated central Christchurch and killed 185 people, mostly in the central city district in relatively modern buildings. The severity of this quake was caused by the fact that it was close to the city and its focal depth was only 5.5km. It was the shallowness of the shake that caused the widespread destruction. Directly after the earthquakes many heritage and cultural institutions were unable to be accessed, adding further stress and concern to museum professionals already coping with extreme distress over the fate of family, friends and homes. Communication networks broke down, along with power, water and sewage facilities. After assisting in the salvage of cultural and heritage collections over the next year in the Canterbury region it became evident that something was not right in the state of Canterbury heritage recovery efforts.

The research undertaken at the Getty Institute was based on these experiences. This study aimed to investigate preventive methods relating to disaster preparedness systems that could be achieved with limited time on a limited budget. The production of a disaster plan can be very time consuming and costly in funds and person power. Therefore the research investigated aspects that related to this topic by reviewing the current literature, which is prolific and excellent, and also looked further afield into other professions to see if there are any alternative processes that can be used effectively in cultural and heritage institutions. The aim was not to reinvent the wheel but use what was there already to assist in the production of a set of processes that could enable museums, art galleries, archives and libraries to produce a realistic set of procedures to use in the event of disaster.

Methods used to investigate these problems involved:

- interviewing known experts in the field, if available, and people that had experienced wide scale destruction in and around their museums in the United States. From these interviews it was hoped to glean information to pass on via workshops, lectures and possible publications in New Zealand and the Pacific region.

- researching related peer-reviewed books, journals and articles in the Getty Library and on the internet.

A template was produced relating to a set of questions for the interviewees in an attempt to produce a standard that was neutral and effective and fair for all. Before leaving for the Getty research took place in and around the Canterbury region to ascertain what did and did not work during the recovery of collections after the earthquakes. This had a significant impact on the questions and what research would take place once at the Getty.

1. Introduction

New Zealand is known as "the shaky isles" because earthquakes are not uncommon. However Wellington, in the North Island, was the city considered to be most at risk, not the Canterbury region. This unknown system of faults near Christchurch that generated the catastrophic 2010 and 2011 earthquakes came as a surprise to earthquake experts around the country and overseas. Although the epicentre, of the most destructive earthquake, was in Heathcote, near Lyttelton, the energy waves travelled along the hills causing most damage to areas in the central business district of Christchurch 10km away.

Fig. 1 New Zealand.

The amount of damage was dependent on the type of ground upon which the buildings were sitting. Soils such as sand and silt, or reclaimed land caused much more displacement due to liquefaction. Liquefaction was, in fact, a huge issue and occurred where there was water, sand and silt present. Much of Christchurch is a low lying former wetland and liquefaction was widespread across the region. Ground shaking during an earthquake can cause some soils to liquefy. These soils behave more like a liquid than a solid during an earthquake, and silt, sand and water form a mud-like material that is invasive and destructive. Once the water dissipates it leaves a fine grey dust that is abrasive and potentially dangerous to people and objects.


Fig. 2 Dried liquefaction.

After being extensively involved in the salvage of heritage collections throughout the series of earthquakes it became apparent that cultural heritage institutions were not prepared. Having formed the Canterbury Disaster Salvage Team in 1987, and held annual workshops stressing the importance of preparation and awareness of possible threats to collections, it was horrifying to discover how ill-prepared the smaller cultural institutions in particular were, despite regular training. The issues related to the small amount of time or money to develop their training or plans beforehand. They were well aware that the preparation of a disaster recovery plan is the most effective method for ensuring the safety of their collections but were unable to progress with this for various reasons, principally lack of funds or personnel to do the work. Unfortunately there is no one-size-fits-all solution and coming up with a template or plan for all is not effective due to the difference in the size, location and makeup of the institutions in the region.

Fig. 3 Damage after February 22, 2011.

My research also looked at new ways of using risk assessment and disaster planning that incorporates fresh processes of managing any potential disaster. I was particularly interested in pursuing a line of research into effective processes and procedures that can be used to minimise the effects of a catastrophic disaster, not necessarily from the museum sphere alone but in areas such as engineering, project management, and emergency first responders etc, such as FEMA, to discover methods that can be applied in the cultural heritage sector. A key to the success of minimising damage in a disaster scenario seems to be preparation. My project was aimed at discovering processes to help smaller institutions in New Zealand and elsewhere in the world to find cost-effective preventive measures that lessen the amount of damage in major disasters such as earthquake. As mentioned before, the components pursued at the Getty included interviewing experts in the field, and researching relevant articles using the extensive library there. By far the most interesting aspect was the interviews that were candid, sad and gave the study a human factor that was not originally envisaged.

Fig. 4 Damage to wooden structures.

2. Review of Problems

Specific problems arising after the three significant quakes in September 2010, February and June 2011 in terms of the salvaging collections included;

- *Lack of any meaningful communication and a splintering of networks both within and outside of cultural and heritage institutions.*

  Only one large museum in the Canterbury region was in a position to reach out to help the wider museum community during and after the earthquakes. The Air Force Museum of New Zealand, under the directorship of Therese Angelo, was sterling in its efforts in helping other heritage agencies. The Air Force Museum also worked to find funding partners to enable part of their planned new building to be used as a temporary recovery centre for the smaller heritage organisations that had lost their buildings. This centre is now up and running and assisting many museums and cultural institutions with collection-related services.

Fig. 5 Triage session on Lyttelton Museum's collection at the Recovery Centre Air Force Museum

- *Lack of administrative power on a regional level.*
  The declaration of a national emergency by the New Zealand Government made it very hard for external cultural and heritage institutions in the rest of New Zealand and the world to gain access and to help as much as they wanted to.

- *Procedural manuals and disaster plans when they existed appear to be ignored or did not work.*

2.1 Questions asked as part of the Getty research included:

- Why is disaster planning so difficult for museums to achieve and keep updated?
- What sorts of procedures would make life easier for them to achieve a good level of disaster preparedness?
- Is there something wrong with the current thinking where it may be too difficult to achieve any form of disaster proficiency in museums and galleries?

2.2 Methods used to address these problems included:

- *Interviews* - interviewing known experts in the field and people that have experienced destruction in and around their museums in the United States and from this, gleaning information to pass on via workshops and lectures.
- *Research* - researching related peer-reviewed articles in the Getty Library and on the internet.

The interviews revolved around four topics; storage, display, people and buildings. Questions were asked regarding what worked and what did not in relation to these topics. Aligned to this I read and attempted to digest as much as possible in the three month period. The interviews developed into a riveting and intriguing series of related experiences that in many cases mirrored each other and yet were completely different. Leading to the inevitable, and obvious you might say, conclusion that it is the culture and the actions of the society in which the museums exist that decide how effective recovery and salvage can be in the event of a catastrophic event. Despite any preventive measures if the will is not there at the national and senior levels then it appears any efforts on successful reconstruction will be limited.

3. Research to date

After three months studying at the Getty it was obvious that some very good disaster preparedness programmes are being undertaken, particularly in California. After sitting in on a workshop at the Gene Autry Museum run by Julie Page of the California Preservation Program (CPP) and Western States & Territories Preservation Assistance Service (WESTPAS), it was evident that disaster preparedness was considered to be a vital component of collection management in heritage institutions.

CPP is funded by the California State Library (calpreservation.org) through the Institute of Museum and Library Services and WESTPAS is funded by National Endowment for the Humanities to serve 14 Western states and Territories (westpas.org). Another excellent initiative has been instigated by the Foundation of the American Institute for Conservation Historic and Artistic Works (FAIC) - AIC - CERT. AIC-CERT (American Institute for Conservation Collections Emergency Response Team) and was set up in 2007 to produce an effective disaster salvage response for cultural institutions during emergencies and disasters. This is achieved by coordinating recovery of collections by liaising with first responders, state agencies and the public. FAIC also received funding from the Institute for Museum and Library Services to train museum staff in disaster recovery of collections producing very effective workshops for this purpose. These systems and processes that were being put in place that would definitely help cultural and heritage organisations deal with future disasters.

The interviews with professionals from the Getty Institute, Los Angeles, San Francisco and New Orleans showed how so much can be learnt from those that have experienced catastrophic disaster. There were many mixed thoughts on the use of disaster plans from the positive to the extremely negative, but almost all felt that prevention of damage by the use of safe storage and display was essential. Training in disaster preparedness was also considered vital for all cultural and heritage professionals. Many also felt that should disaster plans be produced then all staff of the organisation should be included in its preparation and not a small minority. For example one cultural heritage organisation in Canterbury produced a visually pleasing facilities plan for itself but failed to add anything relating to how the public would be dealt with by the staff in the event of a city-wide emergency. It was only when it was publically disseminated that the education department of the same institution noted the omission. If the education department had been involved from the outset this would not have occurred.

Fig. 6 Fire and Flood Workshop run by the Canterbury Disaster Team.

Training in disaster prevention can never compare to an actual experience of one. However it will make the participants aware of issues, problems and how to proceed should a similar event affect their collections. There needs to be a will from senior managers to allow their staff to train in these types of workshops and to actively encourage the production of relevant materials, communication links and systems that will safeguard their staff, public and collections.

4. Conclusion

For cultural heritage professionals in New Zealand, this event has proved to be a salutary lesson on what to expect should the very worst happen. Future disaster planning should take into account not just the normal disaster scenarios but also ones that were not immediately apparent, such as a museum being taken over by Civil Defence teams and government granting extended powers that have a severe impact on the safety of cultural heritage collections. In the future it is suggested that there should be some consideration of a network between heritage and cultural institutions to share and work together to protect each other in the event of disaster. DISACT in Canberra, Australia is a very good example of how museums, galleries, libraries and archives are coming together to help save their joint heritage from damage in the event of disaster. They have produced a letter of intent to help each other. As quoted from the DISACT website:

*DISACT ('**Dis**aster **ACT**') was established by cultural and scientific collecting institutions in Canberra to improve disaster preparedness and provide local mutual assistance in the event of emergencies affecting public collections. DISACT sponsors disaster recovery training, conducts quarterly DISACT Network meetings and has a website resource. Participants include the Australian War Memorial, National Archives of Australia, National Gallery of Australia, National Library of Australia, National Museum of Australia, Screen Sound Australia and a range of other agencies. (*http://www.cpbr.gov.au/disact/)

5. Acknowledgements

I would like to thank the Getty for the opportunity to undertake this scholarship and to all my interviewees for being so candid and helpful. It has been a pleasure to have a committed period of time to study and reflect upon a topic that has always interested me. The research is progressing.

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Abstract: Analysis and Comparison of Recent Large-Scale Emergencies Involving the Recovery of Photographs

Andrew Robb

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Over the past two decades, large numbers of photographs damaged by floods and tsunamis have been recovered successfully by freezing photographs as an initial, short-term measure, and then using a variety of drying approaches, such as air-drying, ethanol baths, and freeze-drying to complete the recovery of the photographs. Recently reported incidents (Dresden 2002, Peterborough 2004, Hawaii 2004, District of Columbia 2007, and Ofunato 2011) provide useful case studies for the response and recovery of photographs affected by disasters.

The circumstances of each incident (quantity of damaged material, degree of damage, time available for initial recovery, and resources available) shaped the response and recovery methods used in each situation.

An assessment tool is proposed that quantifies the scale of the incident and the needs of the incident. Scale is determined by two factors: quantity and damage. Needs are determined by two factors: time until stabilization begins and resources available. Each of these factors is assigned a number from zero to three and added together resulting in a *Scale* score and a *Needs* score; each totaling from one to six. The *Scale* and *Needs* scores are multiplied together to create an *Incident* score from one to thirty-six.

This incident model can be used to assess and compare incidents. The model can also be used as an assessment tool that during initial response and recovery efforts to better allocate limited resources and understand the incident as it unfolds.

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Result!!!
Christchurch Earthquakes Test Canterbury Museum's Quake-Proofing

Sasha Stollman

Presented as a poster at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

This poster describes recent unprecedented seismic activity in New Zealand's South Island, highlighting building strengthening efforts and collection installation techniques which contributed to the survival of the majority of the decorative arts objects on exhibition in Canterbury Museum's Mountfort Gallery.

The Canterbury region of New Zealand's South Island has been in recovery mode ever since the magnitude 7.1 earthquake struck at 4.35am on 4 September 2010. Thousands more followed over the next couple of years, including the far more destructive M6.3 on 22 February 2011.

Canterbury regional heritage institutions have long been anticipating significant activity from the 650 kilometer Alpine fault, and had been preparing accordingly. However the astonishing forces behind the previously unknown shallow fault network directly under the Canterbury Plains had not been anticipated and the term 'earthquake' had not been perceived as an ongoing series of events.

Fig. 1 Canterbury Museum's Mountfort Gallery Ceramics Bay following the 22 February 2011 earthquake. Photograph © Sasha Stollman.

Canterbury Museum, established in Christchurch, New Zealand in 1867 by German geologist Julius von Haast, designed in Gothic Revival style by architect Benjamin Mountfort, is the oldest purpose-built museum still in use in New Zealand. The original building, a single room typical of Victorian museums, has come to be known as the Mountfort Gallery and currently exhibits an extensive European Decorative Arts collection.

When Canterbury Museum's archaeologist Michael Trotter became Director in 1983, the 19^{th} century buildings were in dire need of significant maintenance, and to be brought up to current earthquake standards. Following extensive engineering surveys and research into the buildings' original fabrication, the Canterbury Museum Trust Board developed a strengthening program to address several key structural failings. Consent for building works was hard-won as the proposal appeared heavy-handed. Impressively however, these buildings were some of the few 19^{th} century examples to survive the 2010-11 earthquakes.

In 1995, Sasha Stollman was appointed by Michael Trotter to establish the Museum's first Conservation Laboratory and develop the preventive conservation approach for over 2 million collection items. The Mountfort Gallery of European Decorative Arts, opening in 1997, was the first Museum exhibition to be prepared and installed with a Conservator on staff. The range of earthquake mitigating methodologies incorporated provided a rewarding opportunity to document successes and failures following the 2010-11 seismic activity. Notably, amongst 200+ ceramic objects, only the tallest vessel sustained a hairline crack at the narrowest point of the base. The rest of the monumental ceramics were successfully protected by form-fit brass mounts, and the smaller ceramics were stabilized using Rhoplex N-580 acrylic emulsion sticky dots.

Following this unprecedented series of devastating earthquakes, the Canterbury Museum undertook an organizational review resulting in the disestablishment of half the staff, mostly collection-related positions, including the one conservator. Contract conservation was considered more cost effective. Regretfully the golden opportunity to examine the immediate post-quake condition of the collection stores to document successes and failures did not eventuate prior to Sasha's departure from the Museum in September 2012.

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

The Fouad Debbas Collection (Lebanon) in the Core of a Regional Emergency Preparedness Strategy

Yasmine Chemali

Presented as a poster at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

The Fouad Debbas Collection is one of the most important photographic collections in the Middle East. It contains more than 40,000 images from Lebanon, Syria, Palestine, Turkey, and Egypt, dating from the beginning of photography in the 1860's until the mid-20th century.

The collection includes albumen prints in portfolios or mounted in albums, postcards classified by publishers and subject matter, glass plates and magic lantern slides, stereoscopic views, negatives, cartes de visites, and cabinet cards, as well as maps, books, and a notably famous manuscript from 1853/5-1860/2 written and illustrated by the Countess de Perthuis.

The mission of the Fouad Debbas Collection is to ensure accessibility and visibility to the images as an open-source for research and knowledge, while securing an optimum storage environment for the photographs themselves.

Teatime scene with the Saalmüller family in Brummana, Lebanon, gelatin silver bromide glass plate negative, The Fouad Debbas Collection©.

Located in Beirut, the collection is stored in a facility specially equipped for its needs in terms of housing (acid-free enclosures and envelops), storage (adequate shelving system), lighting (UV filters), climate (air conditioning, dehumidifiers and water-leak detectors), and security (controlled access, fire extinguisher and smoke detector).

Collections in Lebanon and neighboring regions face many risks, including the humid climate of the country damaging vulnerable archives and collections, the "Damocles sword" of a new regional armed conflict, the lack of governmental support, and the absence of emergency preparedness programs. Also problematic is the way that the Arab people have become used to recovering from disasters, especially in a country that suffered a 15-year civil war and faces many other threats to national security.

The idea of developing a common strategy for emergency actions is a result facing of those risks. Lebanese institutions do not have emergency preparedness strategies and cooperation between institutions does not exist. Confusion about the future course of action at the very moment of a disaster should be avoided, and having an emergency plan in place would save a considerable amount of time. Bringing together photographic collections to work together in listing affiliated professionals, training volunteers, involving civil protection partners, establishing priorities in collections, and setting up a kit of supplies and tools, as well as looking for a secured location: all those endeavors are part of a common strategy at the regional level that is presented and detailed in this paper.

In March 2012 the first meeting of the Modern Heritage Observatory (MoHO) took place in Beirut. Partners in this initiative are the Heinrich Böll Foundation, the Arab Image Foundation (AIF), Irab Association for Arabic Music (IRAB), the Arab Centre for Architecture (ACA), and the Cinémathèque of Tanger. It aims to advocate for the preservation of modern cultural heritage in the Middle East and North Africa, with an emphasis on photography, music, architecture, video, and film. The project partners have come together to mobilize for joint action to impact policies and legal frameworks, and to generate political commitment towards modern cultural heritage. Through the creation of a network between professional bodies from the region, the project seeks an exchange of experience and expertise, and the elaboration of strategies for joint advocacy actions. The Modern Heritage Observatory provides an ideal framework in which to develop a common strategy for an emergency preparedness plan through its regional meetings, trainings, and workshops.

Step 1: How to assess risks and decide priorities for your collections.

The situation in Lebanon is complex and paradoxical: on one hand Lebanese are used to dealing with emergency situations, but on the other hand they do not seem very concerned by the idea of preparing for risks or disasters. There is a feeling of *wait and see* about what will happen. In this context, this is quite hard to plan an emergency response with Lebanese people. This is why one of the first steps of an emergency preparedness strategy is to assess real risks that threaten collections in order to make the appropriate decisions. Putting pressure on cultural institutions by shocking them with the possibility of a threat is a good way to awaken them to the necessity of emergency planning.

Risk assessment can take the form of a survey conducted by each institution, with questions such as: What weather conditions or sources of natural disaster are associated with the geographical location of your institution? What are the potential sources of disasters (airport, railroad, oil refinery) near your institution? What could be internal causes (structural collapses, unstable materials in the collection, theft and vandalism) of damage? Once the survey is completed, each institution should also analyze its own collection and storage room(s). The feasibility of a common disaster preparedness strategy for the Middle East region will not be guaranteed unless it targets collections of approximately the same size, which are constituted of the same type of artifacts.

According to Stefan Michalski, a senior conservation scientist at the Canadian Conservation Institute (CCI), there are nine agents of deterioration that can cause damage or loss to collections. These are as follows: 1 - direct physical force, 2 - thieves, vandals, and displacers, 3 - fire, 4 - water, 5 - pests, 6 - contaminants, 7 - incorrect temperature, 8 - incorrect relative humidity, and 9 - dissociation. This list was developed by CCI and is available online at www.cci-icc.gc.ca (Michalski, 2004, pp.51-90). To this list, it seems crucial to add one more agent: 10 - armed conflict.

In order to better understand better the risks faced by collections, the creation of one or several scenarios for each deterioration agent is essential. This permits the different risks to be scored, and for institutions to see where their priorities lie.

The Magnitude of Risk is then the sum of four components. According to approach outlined by ICCROM and CCI, for each specific risk assessed, a list of questions arises:

A. How soon? is the rate or probability of damage.

B. How much damage to each affected artifact? describes the proportional loss of value.

C. How much of the collection is affected? represents the fraction of collection at risk.

D. How important are the affected artifacts? concerns the value of artifacts at risk.

A. How soon?
4: about once every year /in about 1 year
3: about once in 10 years/ in about 10 years
2: about once in 100 years/in about 100 years
1: about once in 1000 years/in about 1000 years

B. How much damage?
4 : total or almost total loss of artifact (100%, $^1/_1$)
3: significant but limited damage to each artifact (10%, $^1/_{10}$)
2: moderate or reversible damage to each artifact (1%, $^1/_{100}$)
1: just observable damage to the artifact (0.1%, $^1/_{1000}$)

C. How much is affected?
5: all or most of the collection (100%, $^1/_1$)
4: a large fraction of the collection (10%, $^1/_{10}$)
3: a small fraction of the collection (1%, $^1/_{100}$)
2: one artifact (0.1%, $^1/_{1000}$)
1: even less than one artifact (0.01%, $^1/_{10,000}$)

D. How important are the artifacts?
3: much higher than average significance (100x the average)
2: higher than the average significance (10x the average)
1: average significance for this collection
0: lower than average value for this collection ($^1/_{10}$ the average)

The Fouad Debbas Collection has accomplished this exercise and the results according to each scenario clearly highlight the major risks to the collection (see below).

Deterioration Agent 1: Physical Forces. This deterioration agent is not currently a priority for the collection. However, Lebanon is located on fault line (see IRIN 2009 and UISF 2009) and could have an earth tremor. In the storage room most of the artifacts are paper-material, housed in boxes. Seismic tremors could most probably negatively affect some of the glass plate negatives or more vulnerable materials. Results: A:2, B:1, C:2, D:1. Total (Magnitude of Risk): **6**.

Deterioration Agent 2: Fire. If a short circuit happens in the Debbas showroom (where a business in light fixtures is located) a fire could travel up to collection storage on an upper floor. There is currently no fire suppression system such as an FM200 in the collection storage room. Results: A:2, B:4, C:5, D:2. Total (Magnitude of Risk): **13**.

Deterioration Agent 3: Thieves, Vandals and Displacers. This deterioration agent is not a priority for the collection. However, the following scenario is possible: during a public exhibition a visitor is offended by the caption "Beirut, Syria" as it is often noted on historic postcards and albumen prints. The visitor would "correct the error" by erasing "Syria" and writing "Lebanon" instead, but the frame would still provide protection for the photograph. Results: A:3, B:1, C:1, D:1. Total (Magnitude of Risk): **6**.

Deterioration Agent 4: Water. A drainage malfunction from a dehumidifier in the collection room could produce a leak during the weekend. Four water leak detectors are installed in the storage room and the collection manager is immediately alerted thanks to the building management system (BMS). Results: A:2, B:2, C:1, D:1. Total (Magnitude of Risk): **6**.

Deterioration Agent 5: Infestation and Pollutants. This deterioration agent is not currently a priority for the Fouad Debbas Collection. However ,the air is very polluted in Beirut (see Baaklini 2012 and Bard 2012). The Debbas building is also not a dedicated museum space but an office building with a cafeteria. A fly could get into the building through an office window and travel to the collection room: flyspecks could later be found but those would be on the storage enclosures and not on the artifacts themselves. Results: A:1, B:1, C:1, D:0. Total (Magnitude of Risk): **3**.

Deterioration Agent 6: Light. Ultraviolet (UV) light filters cover all lights in the storage room and in the adjacent corridor as well. Nevertheless, one photograph could be exposed to UV light while being handled in the digitization lab. Results: A:3, B:1, C:1, D:1. Total (Magnitude of Risk): **6**.

Deterioration Agents 7 & 8: Incorrect Relative Humidity (RH) and Temperature. The Fouad Debbas Collection has made great effort concerning climate control and maintaining a good environment for its photographs and archives. However, due to the humid climate of Beirut and to the HVAC system chosen (air conditioning and dehumidifiers), the collection is threatened by some fluctuations of RH and/or temperature during power cuts, which are frequent occurances in Lebanon. Results: A:3, B:2, C:2, D:0. Total (Magnitude of Risk): **7**.

Deterioration Agent 9: Dissociation. This deterioration agent is not a priority for the collection, as materials are currently stored in one room only and have a good classification system. However, the listing and inventory of all photographs and archives are not 100% reliable, and there is sometimes no correlation between what is written on the inventory and what is found in the storage room. This deterioration agent was added to Michalski's list because we believe that this can be a recurring problem for private collections or institutions which are not museums. Results: A:2, B:2, C:1, D:0. Total (Magnitude of Risk): **5**.

The tenth deterioration agent, armed conflict, could be considered as a hazard or "source of danger" in various societies (Michalski, 2004, p.52) but reflects the reality for Lebanese institutions. The Fouad Debbas Collection formulated two scenarios in order to illustrate two different risks that have a high probability of occuring.

1. During a conflict, the army requisitions the Debbas building, equipment, and vital supplies. The staff is unable to enter the collection room due to restrictions on movement imposed onto the civilian population. Electricity is cut off and the risk of attack reaches its climax. The building could be devastated. Results: A:3, B:3, C:3, D:3. Total (Magnitude of Risk): **12**.

2. Tires being burnt block the highway behind the building. A dark thick smoke is entering the building: noxious particles are everywhere and infiltrate the collection room. Results: A:4, B:2, C:3, D:1. Total (Magnitude of Risk): **10**.

The result of the risk analysis within the Fouad Debbas Collection is that the primary concern is for three major deterioration agents: fire, incorrect RH and temperature, and armed conflict. Calculating the Magnitude of Risk is an efficient tool to trigger awareness for preservation and risk management (see table below).

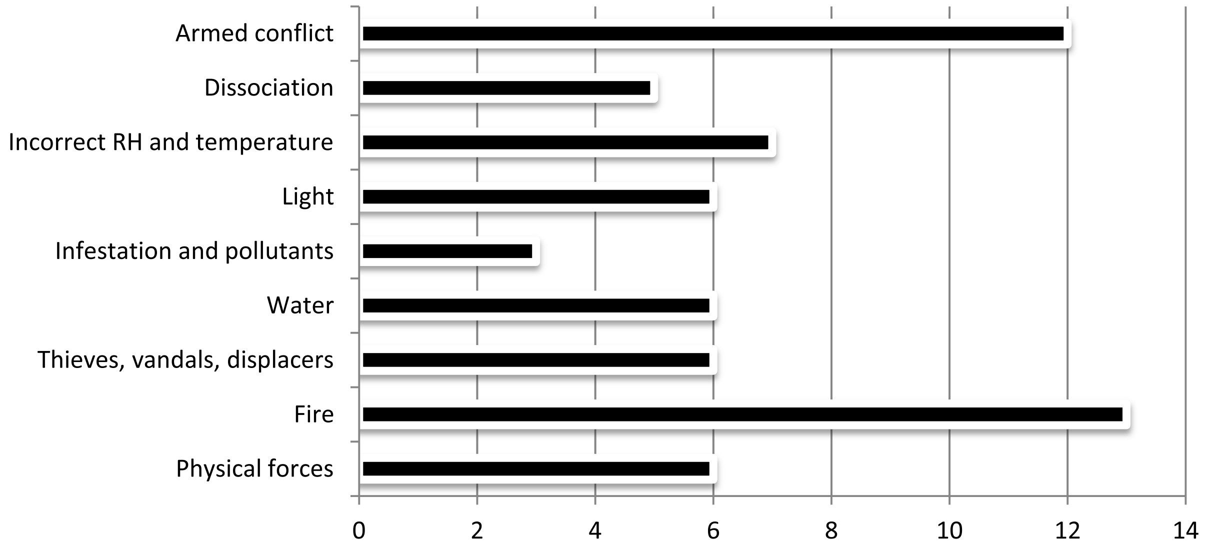

Table 1. Comparison of the magnitudes of risk for the various agents of deterioration.

Magnitude of Risk Due to the Specific Risk Assessed	
14-16	***Catastrophic priority***: total loss is possible in a few years or less. These scores arise typically from very high fire or flood probabilities, earthquake, bombing, and fortunately, are rare.
11-13	***Extreme priority***: significant damage or loss to a significant portion of the collection is possible in a few years. These scores typically arise with very high rates of significant deterioration from bright light, UV, or damp.
9-10	***Urgent priority***: significant but limited damage of the collection is possible in a few years. These scores typically arise from security problems and in institutions where preventive conservation is not a priority.
7-8	***Moderate priority***: moderate damage to some artifacts is possible in a few years, or significant damage or loss is possible after many decades. These scores apply to the ongoing improvements even conscientious museums must make after addressing all of the higher risk issues.
4-6	***Low priority***: small damage to some artifacts is possible after many decades.
1-3	***Museum maintenance***

These surveys and methods are some tools used to assess risks and decide priorities; but they are useless if the inventory of the collection is not complete, if the storage conditions are unknown, and if condition reporting for artifacts is not done.

Step 2: Why knowing the collections is crucial.

Having a clear inventory and retaining records and all information relating to the collection will benefit any for future actions. Such documents will help in case of emergency recovery. Physical characteristics such as size, weight, or vulnerability should be reported in a database as well as the object's location in the storage or exhibition spaces. In case of an emergency, knowing where artifacts are located will increase their accessibility. Signs or color codes should be used for each priority level, and a file constructed for each object. For example, establishing the location(s) of the *priority items* and marking storage boxes with stickers that reflect this priority can be a good method to of saving time when a disaster occurs. Again, priority markers indications should never be evident to a visitor, but known within with institution.

Guidelines for condition reporting should also be established. In order to get an accurate evaluation of the general condition of the Fouad Debbas Collection, the decision was made to examine in detail 10% of the collection: unmounted and mounted photographs, cabinet cards, stereos, postcards, etc. A general assessment (counting of items per album, portfolio, or box) of the collection was first done. Afterwards a representative 10% of photos were chosen for the more in-depth examination. Over the next few months, a large number of condition reports were completed. In order to be precise as possible, four levels of condition were described. The results for the selected samples were obtained and extrapolated for the whole collection. From those extrapolated percentages and the type and extent of deterioration encountered, decisions were made as to collection priorities in case of an emergency.

Ideally, determining why one album is more important than another should not be an obligation nor a choice, but at the very moment of a disaster collections managers should know that some artifacts are less valuable than others. Impartially evaluating collections is not an easy task, but is still necessary. Listing artifacts according to their value can be an option, using scores from 0 to 3. In this system 0 would be for a photograph or other item that can be found in every collection, while 3 would be for a unique piece, a very important artifact in the history of art, technology, or science. Level 2 would describe meaningful artifacts but which exist in other collections and 1 for artifacts that are a somewhat superior to an item classified as 0. No classification should be definitive, and the list should be revised and updated according to the evolution of the art market value, new discoveries relating to the object such as a signature or stamp, new acquisitions by the institution, and/or new publications. And importantly, this list should stay confidential to the public.

Step 3: Identify partners and conduct trainings.

The common emergency preparedness strategy presented here is line with recent initiatives supported by the Prince Claus Fund for Culture and development and the International Centre for the Study and Preservation and Restoration of Cultural Property (ICCROM). From December 3-15, 2012, the Prince Claus Fund supported cultural heritage rescue training in Lebanon (ICCROM 2013). For twelve days, archaeologists, architects, military, and humanitarian volunteers learned to recover cultural heritage through lectures and a hands-on recovery workshop, which simulated an actual disaster scenario. The training, called “Lebanese for Lebanon,” was initiated by Anna Dal Maso, a participant of ICCROM’s International Course on First Aid to Cultural Heritage in Times of Conflict:. Joanne Farchakh Bajjaly of the non-governmental organization (NGO) Biladi was also an important partner in the “Lebanese for Lebanon” training. Biladi is dedicated to promoting cultural and natural heritage to youths. Its main mission is to re-establish the link between young people and their heritage, which can serve as a tool for establishing dialogues in conflict situations.

Along the same line, the Modern Heritage Observatory (MoHO) strategy for emergency response should target partners from different backgrounds which share the same concern towards cultural heritage. Civil protection partners should support the strategy: police are needed for the maintenance of public security and order, the fire service for rescue and general damage protection, and technical services for ensuring that infrastructures such as electricity, water, and gas suppliers, as well as transport and IT systems, are operational.

In Lebanon, where there is a clear lack of governmental support the role of NGOs is crucial. Wherever there is an emergency in the country, the Lebanese Red Cross (LRC) intervenes. Established in 1945, following the years of civil war, this humanitarian organization has reoriented its services to address postwar requirements. Led by volunteers, the LRC provides relief to victims of natural and man-made disasters, and helps people prevent, prepare for, and respond to emergencies. Save Beirut Heritage (SBH) is a cultural heritage organization based in Beirut. Created in 2010 by activists as a Facebook group highlighting and vocalizing the dangers facing Beirut's ancient sites and traditional buildings, SBH aims to preserve Lebanese architectural heritage, especially in Beirut. The organization, which is equipped with a 24-hour hotline, lobbies the Ministry of Culture and other decision-makers through petitions and public demonstrations.

Not to be forgotten, an emergency response project needs many trained volunteers, in addition to the current MoHO members, who can assist in protecting an emergency site and the artifacts. The situation of the Fouad Debbas Collection is not unique: this private collection does not have enough staff to form the sufficient and available team necessary to deal with the collection in case of a disaster. For each partner institution, specific roles should be identified as described in Heritage Preservation's *Field Guide to Emergency Response, A Vital Tool for Cultural Institution* (2006).

Once partners are identified, trainings, workshops, and regular hands-on drills should be developed. These would be held within the MoHO partner-institutions, which include the Fouad Debbas Collection, the Arab Image Foundation, the American University of Beirut, the Arab Center for Architecture, the Institute for Palestine Studies, the Foundation for Arab Music Archiving, and Research and Fondation Liban-Cinema. The teaching component aspect of this common emergency preparedness plan is essential because participants should immediately know how to react when an emergency occurs. This teaching can take the form of group discussions, regular hands-on drills or role-plays. They should include topics such as: how to handle valuable artifacts stuck in mud, how to act with civil protection forces. Teaching materials should be available in Arabic: the Arab Image Foundation has already translated Heritage Preservation's Emergency Response and Salvage Wheel as well as a number of videos and presentation by experts from ICCROM and the US Committee of the Blue Shield (a non-profit organization dedicated to the protection of cultural heritage during armed conflicts.

Summary

In this region, we cannot afford to sit and wait until disasters come along. We need to prepare for an emergency situation by creating some useful materials such as a toolkit containing supplies and equipment, report forms in order to assess damages, evacuation plans for people and artifacts as well as for collection archives and documentation, and to identify an accessible and clearly designated storeroom to host the damaged collections once evacuated. The principle function of a disaster supplies toolkit is to contain first-aid sanitary materials, personal protection equipment, basic stationery, and packaging material for evacuation purposes. In case of a disaster, partner-institution can help one another by renting its toolkit, whole or in part. But why renting? Because each institution should have, at all times, an emergency toolkit available, fully stocked, and ready to use at any moment.

This paper is presented here as a work in progress. It is not a proper emergency model plan for an institution, but a strategy to gather our forces in the Lebanese region, and to encourage collaboration and dialogue between collecting institutions, civil forces, NGOs, and product/service suppliers.

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

The Glass Plate Negative Project at the Heritage Conservation Centre

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Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Abstract

This article discusses the glass plate negative preservation project undertaken by the Paper Conservation team at the Heritage Conservation Centre (HCC), Singapore in early 2012. This historically significant collection of early landscape and portrait photography in Singapore belongs to the National Heritage Board (NHB) and numbers approximately 1,700 plates dating from the late 19th and early 20th century.

During an initial condition survey, most of the plates were found to have accretions, surface dirt, old labels, fingerprints, and breaks. Storage was generally inappropriate with different types and sizes of plates stacked in piles. Following the survey, in order to prioritize treatment needs, the plates were divided into three treatment categories: no treatment, minimal treatment, and extensive treatment.

Minimal conservation treatment, primarily surface cleaning, was first carried out on the plates in order to stabilise them. Plates requiring no treatment and minimally treated plates were then individually wrapped in four flap folders and housed vertically in archival quality storage boxes. Each box contained about twenty plates, sorted according to type and size. Extensive treatments including glass repair, emulsion consolidation, and extensive surface cleaning was conducted by trained conservators as time and resources permitted.

The conservation and re-housing of these plates not only ensures long term preservation, but also facilitates their retrieval for research purposes. The experienced gained by this project has also allowed HCC to better promote safe handling and researcher access to collections of this type.

Historical Background

The history of photography in Singapore dates to the mid-19th century with the establishment of many European commercial photography studios, Sachtler & Company and G.R. Lambert & Company being prominent. As they documented the early landscape and people of Singapore, the negatives inevitably became part of Singapore's material culture, being particularly significant as they also capture the photographer's intent. The glass plate negative collection of the NHB is comprised of items from G.R. Lambert & Co. (figs. 1, 2) and numerous other early studios.

The first repository for the collection was the National Museum of Singapore, though there is little information on how the negative came to be there. Established in 1887, the National Museum is the earliest museum in Singapore. The plates were stored un-accessioned in the museum, though some had generic numbers applied with pressure sensitive tape. The collection was later moved to HCC, which is a centralized storage facility for NHB collections. It is purpose-built, providing climate control storage, collection management and conservation services.


Fig. 1. 'A Nonya' - an original gelatin dry plate by G.R Lambert & Co. *(left)*.
Fig. 2. The negative's positive image *(right)*.
Courtesy of the National Heritage Board, Singapore.

Objectives

This project began with a preliminary survey carried out in 2011 by the HCC Paper Section. From the survey, it was found out that the plates were not housed in proper conditions. Most of the early housing methods and materials were in need of improvement (figs. 3, 4) as they had resulted in damage to the plates. In addition, this collection had never been surveyed or treated by trained photograph conservators. This project presented a good opportunity for HCC to examine and preserve this historical collection, while building a more in-depth understanding of it. Following the preliminary survey, a detailed, randomized survey was carried for the first 100 plates, which eventually lead to the conceptualization and implimentation of this project.

Fig. 3. Glass plate negatives were stored inside the document drawers at HCC archival storage.

Fig. 4. Assorted plate formats were stacked inside each box.

Survey and Treatment Categorizations

During the survey (fig. 5), three main standard formats were noted in the collection, 3¼ x 4¼ in. (quarter plate), 4¾ x 6½ in. (half plate) and 6½ x 8½ in. (whole plate). The half plate collection in NHB belongs to the English format, smaller than the American half plate (5 x 7 inches). The majority of the negatives are half plates, comprising approximately 60% of the entire collection. Collodion wet plates and gelatin dry plates were both found in the collection. Both negatives utilized glass as the primary support and were widely used in the 19th century, dating from circa 1851 and 1878, respectively.

The collection was assessed according to its condition and further categorized according to treatment needs. Three categories were assigned: Category 1 (Cat. 1) - no treatment, Category 2 (Cat. 2) - minor treatment, and Category 3 (Cat. 3) - moderate to major treatment (see table 1). This categorization process was important as it helped to estimate the amount of time and funds required for the entire project. From the 2011 survey, approximately 90% of the plates were identified as requiring some form of conservation treatment, and the whole collection needed re-housing. In early 2012, the negatives were sent to the lab for treatment.

Fig. 5. A randomized survey was carried out in early 2012.

Table 1. Descriptions of Treatment Categorizations

Treatment Category	Condition Definitions	Treatment Needed	Estimated Distribution
Cat. 1	• Generally stable • Minor finger marks or stains	• No treatment required	3%
Cat. 2	• Dirt, accretion and stains on the glass side • Dried mould spots on the glass side	• Required minor treatment such as cleaning and tape removal	90%
Cat. 3	• Plate breakages • Severe accretion and staining on glass and/or emulsion side • Flaking of emulsion layer	• Required moderate to major treatment • Major cleaning on the glass and/or emulsion side • Glass repair • Accretion removal on both sides • Emulsion consolidation	7%

Conservation Treatment

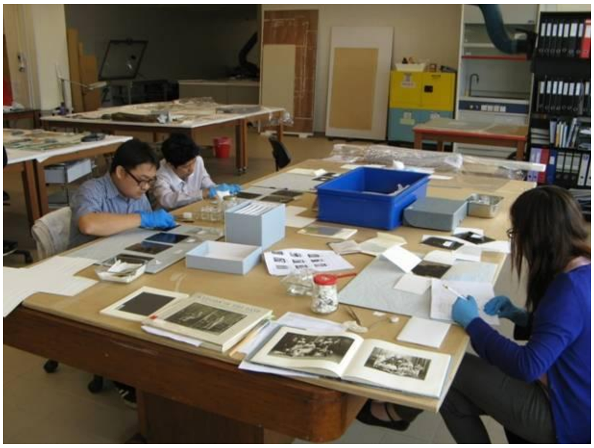
Information about each plate including subject description, type of plate, previous generic numbers, and inscriptions found on the plates had been recorded during the survey. In collaboration with HCC Collection Management Team, the plates were assigned new numbers that were pencilled on the top edge of each four-flap folder during the rehousing.

Cat. 1 - No Treatment Required

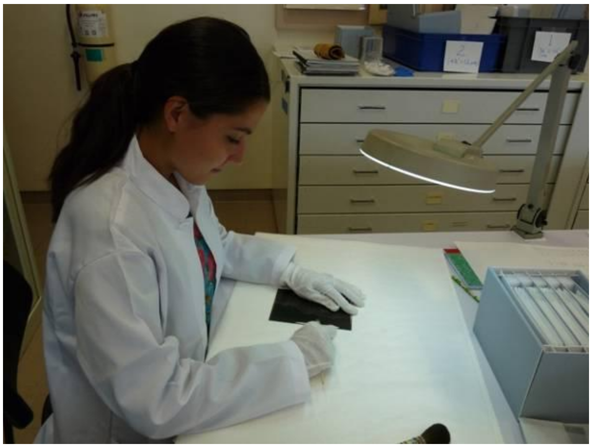
The treatment project for the collection began in early 2012. The plates were brought to the lab in small batches, and the team proceeded to treat and re-housing them (figs. 6, 7). Because the Cat. 1 materials were stable, only re-housing was required. The negatives were individually wrapped in four-flap folders and housed vertically in storage boxes.

Cat. 2 – Treatment

Most of the glass plates were categorised as Cat. 2, and the treatments carried out for this categorization involved mainly the glass sides of the negatives. These Cat. 2 materials were considered structurally stable; however, they exhibited dirt, accretions, and finger marks which necessitated surface cleaning. Pressure sensitive tape labels having no historic value were removed mechanically (fig. 10). Swabs dampened with water/ethanol solutions (50:50 or 70:30, depending on the requirements of each object) were used for reducing stains or tape residues. Whatman lens tissue, which has a smooth surface and does not leave fibres behind, was used to gently wipe off any residual marks. HCC conservators were assisted with these Cat. 2 treatments by two interns, Ms Alison Bryan and Ms Emily Hick, during their internship programs with the HCC (figs. 8, 9), during which Ms Bryan and Ms Hick worked under the supervision of the HCC paper conservators.




Figs. 6, 7. The Paper Section team working together on the project.




Figs. 8, 9. HCC interns, Ms Alison Bryan and Ms Emily Hick carrying out glass plate negative Category 2 treatments.

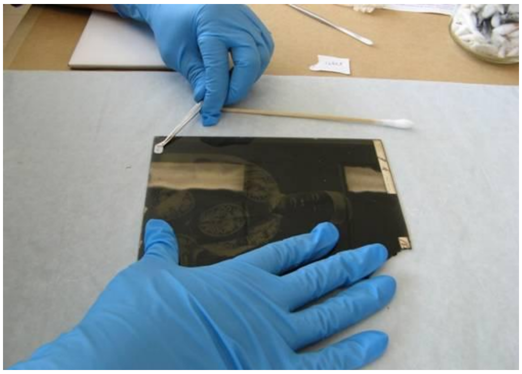


Fig. 10. Pressure sensitive labels were removed during the treatment process.

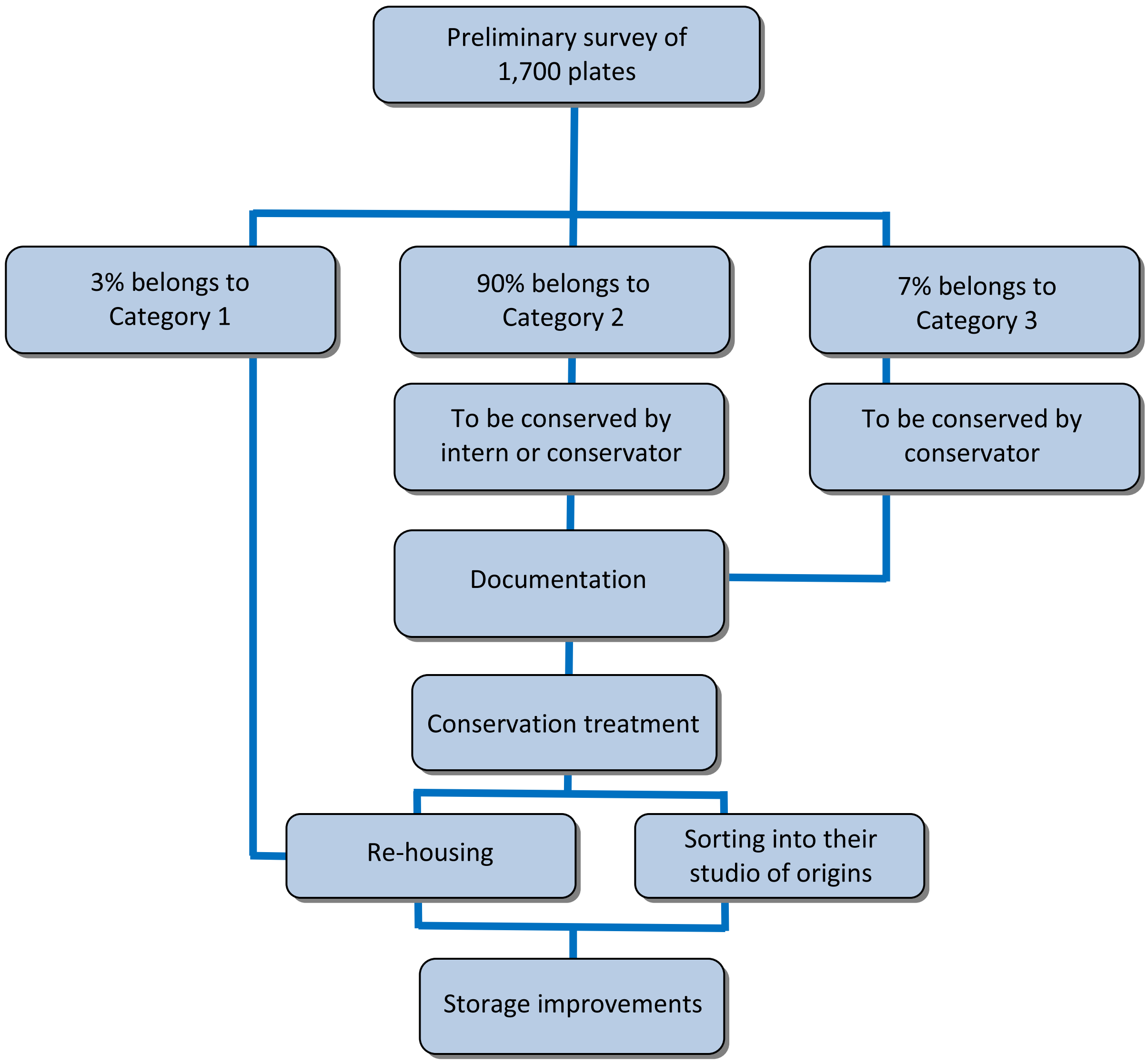


Fig. 11. The glass plate negative project strategy.

Cat. 3 – Treatment

The plates identified as Cat. 3 were treated only by the paper conservators as the treatments required a higher level of technical competency, as outlined within the project strategy (fig.11). Due to the complexity and time consuming nature of these treatments, conservators began working with Cat. 3 objects only at the later stage of the project. These objects will continue to be treated over the course of the next several years.

The condition of Cat. 3 plates was varied. Most suffered from one or more of the following: severe accretions on the emulsion side, paper accretions/residue overall, dried mould stains, plate breakage, and emulsion lifting or flaking as seen in figures 12 and 13. In order to address these issues, treatment of the emulsion surface was required. Extra care was taken as the emulsion can be very sensitive to moisture, especially if the emulsion had degraded. They were surface cleaned with a soft bristled squirrel hair brush, minimizing the risk of scratching. Pressure sensitive labels adhered to the emulsion sides were removed mechanically. Depending on the amount of tape residue, a swab lightly dampened in a water/ethanol (90:10) solution was used to gently remove the label. This was only done when the emulsion layer had no damage or presented no risk of flaking.

Fig.12. Emulsion flaking and loss on a wet collodion plate. Courtesy of the National Heritage Board, Singapore.

Fig.13. Broken glass plate negative. Courtesy of the National Heritage Board, Singapore.

For the treatment of the broken glass plate negatives, the team adopted the repair method developed by Katherine Whitman (Whitman and Wiegandt 2007). The broken shards of glass are aligned and adhered vertically with the aid of *lightline* as recommended. A slight modification was made to Whitman's method by using button-size magnets on opposite sides of the plates to hold them together during alignment and adhesion, instead of wax, which was recommended. The decision to use magnets was taken as most of plates that are broken are not severely shattered. This method was first encountered and experimented with during an internship the author undertook at the Canadian Conservation Institute (CCI) in 2010 (fig. 14). Silicon release Mylar is placed between the magnets and the plate to prevent the magnets from adhering to the plate if excess repair adhesive is present. After the treatment, the plates are placed in sink mats in order to minimize direct handling, potentially dislodging the shards.

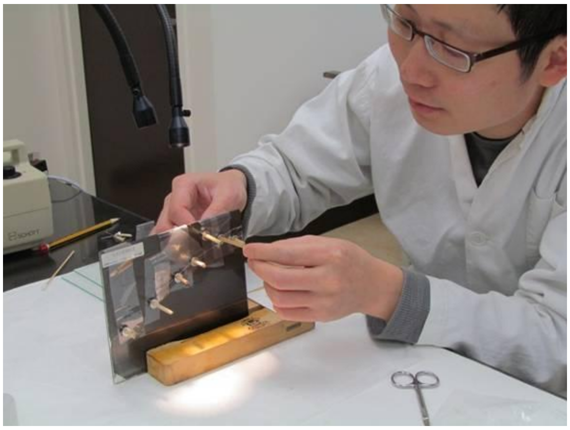


Fig. 14. The author repairs a glass plate negative during an internship program at the Canadian Conservation Institute.

Plates with Edge Losses

Plates that were found to have moderate cracks or edge losses required immediate attention in order to reduce the chances of further damage occurring. Museum quality mat board was used as rigid secondary supports beneath the plates in the four-flap folders. For plates with larger losses, which could be further damaged, another piece of mat board was cut and added as an 'in-fill,' providing additional support during storage. By tracing the shape of the losses with a fine tip pen and Mylar sheet overlay, an appropriately-sized 'in-fill' was cut (figs.15, 16). The 'in-fill' was then adhered to the secondary support mat board with 3M #415 double sided tape. It was found that 4-ply mat board was matched the thickness of most of the glass plates. The negatives were then placed together with the secondary support board and 'in-fill' (figs. 17, 18) in a 4 flap folder in order to minimize further damages when handled.

Fig. 15. The plate was placed over the board and was aligned on left and right sides.

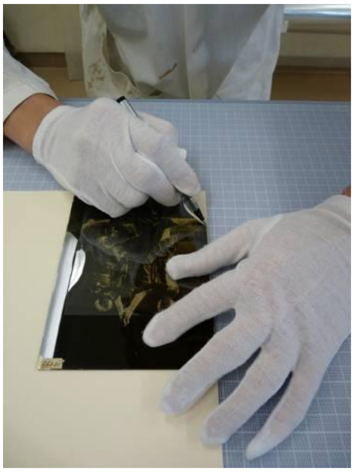
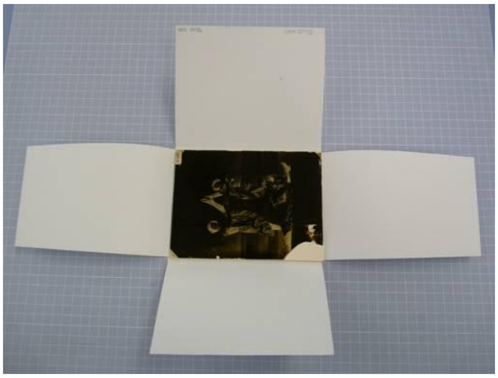


Fig. 16. Fine tip pen and Mylar sheet was used to trace the loss area.



Figs. 17, 18. The plate was placed on the backing board and fitted into the 'in-fill' board *(left)* before storing into the four flap folder *(right)*.

Storage System Improvements

During the survey, it was observed that all the different-sized plate formats were stacked horizontally on top of each other. This storage method was inappropriate as it placed significant pressure to the plates, particularly those at the bottom of the stacks, and also compromised safe handling. In order to improve this storage system, the conservation team decided to adopt a vertical storage system, helping to achieve the project objectives of easy object retrieval while promoting safe handling of the collection.

The specifications of the storage materials were carefully considered. All storage materials had to meet the criteria for conservation standards - being free from harmful components and any off gassing chemicals that could cause oxidation of the image silver or staining and deterioration of the gelatin. There were initial challenges with the procurement of standard size enclosures and storage boxes that best fit the plates. The glass plate negative vertical storage boxes and four flap paper enclosures offered by the supplier were found to be slightly larger than NHB's glass plates. Though customizing the boxes would have been the ideal solution, the team decided to go ahead and purchase the standard size boxes in consideration of time constraints and cost effectiveness, especially as the survey was still ongoing. Bond paper and glass plate negative boxes were selected and purchased from Talas conservation supplies in New York. Bond paper, which was used to make the four flap folders, was selected because of its smooth surface, which will not cause further abrasion or lifting of the negatives' emulsion. When considering what size storage boxes to purchase, the team took into account safe handling practices. Having too many plates in each box would result in very heavy boxes, putting the negatives at risk when accessed.

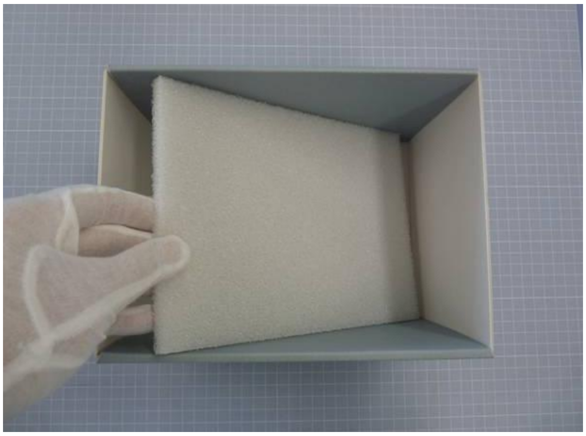


Fig 19. Ethaform was added to the base of the box.

Fig 20. After assembling the partitions, the sides were filled with Ethafoam strips.

HCC interns and temporary staff assisted in cutting the four flap folders and completing necessary box modifications. Templates of the standard-size glass plate negative four flap folders were created by using 8-ply mat board to facilitate the cutting process. Each folder was individually cut and folded to conform to the plate's size, ensuring the plates would be housed snugly within the folder. Medium density Ethafoam (*DOW* natural polyethylene foam) was used as a filler material inside of the boxes in order to minimize any movement of the plates while housed within the box (figs. 19, 20). Ethafoam was selected as it met the required conservation standards. Moreover, it could be purchased from a local supplier and pre-cut to the required dimensions. The base of the box was also filled with the same Ethafoam. With this extra Ethafoam base, the plates were slightly elevated inside of the box, facilitating the handling of individual plates as seen in figure 21.

Twenty plates, each individually wrapped in four flap folders, are housed in each box, with their individual negative numbers labelled on the outside the box (fig. 22 and 23). The light weight of the box allows HCC staff to safely handle the collection, especially when retrieving boxes from upper shelves. Finally, the boxes were stored on powder-coated metal shelfs as seen in figure 24.

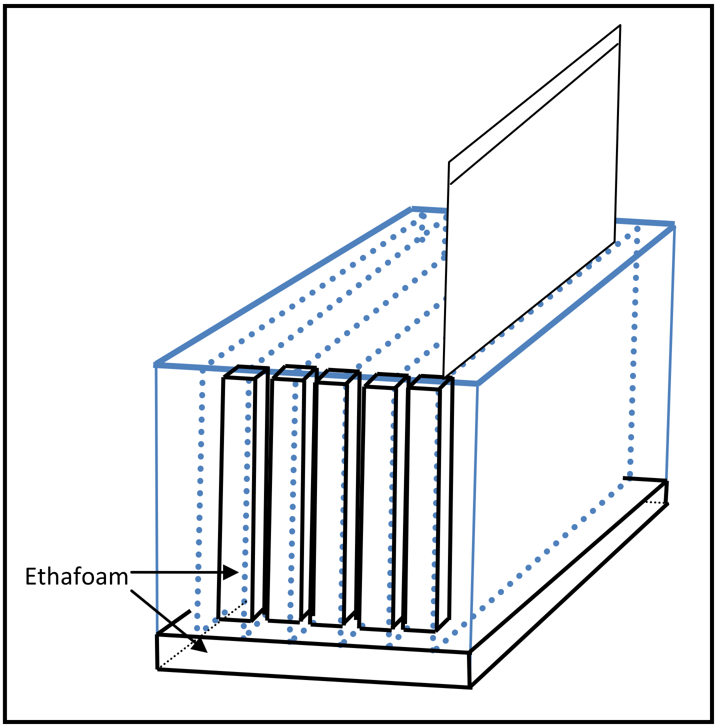


Fig. 21. Diagram showing the interior of the vertical storage box

Fig. 22. After assembling the box, twenty glass plate negatives could be stored inside.

Fig. 23. The glass plate negative numbers were labelled on the outside of the storage box.

Fig. 24. The new storage box is kept inside the powder-coated metal shelf.

Sorting into Studios of Origin

In order to improve the collection retrieval system, the plates were identified and classified whenever possible by the studio of origin. Those plates which have been identified as belonging to one particular studio were separated and housed together. One subset of negatives that the conservation team managed to identify during the project was negatives produced by the studio of G.R. Lambert & Co.

In the past for exhibition or archival purposes, prints had been made from some of the original G.R. Lambert & Co. glass plates. These gelatin silver prints were subsequently accessioned and recorded into the NHB MuseumPlus database system. The MuseumPlus system manages and organizes collections through an online interface, which can be accessed among all NHB museums. Because of this prior history, a list of the images made by G.R. Lambert & Co. was extracted from this system and used as a reference in order to sort the negatives. Besides utilising the database information, some publications also provided assistance in the sorting process. The separation of the G.R. Lambert & Co. collection and the eventual inclusion of this information within the MuseumPlus database will greatly enhance the resources available to researchers.

Conclusion

The treatment and rehousing of the glass plate negatives at HCC has presented an opportunity for the conservation team to closely examine and preserve the entire glass plate negative collection at NHB. Most of the collection fell within treatment Category 2, which required only minor cleaning as well as rehousing. For the most part these treatments were carried out by interns under the supervision of HCC conservators, while the moderate and major treatments of Category 3 items, including lifting emulsion, removal of accretions on emulsion surfaces, and glass plate repair were carried out by HCC conservators. Having a number of interns in this project working with Category 2 materials enabled the HCC conservators to concentrate on the more in-depth treatments required for Category 3 glass plates. With the HCC's ongoing workload of conservation support to the NHB museums, the glass plate negative project is expected to be ongoing for the next few years: about 20% of the collection will be treated and rehoused by 2013. Nonetheless, it is a significant learning opportunity for HCC staff and when the project has finished, the collection will become much more accessible to the researcher.

Acknowledgements

I would like to express my gratitude to the National Heritage Board for their generous support and funding; the Paper Section team and my fellow colleagues at the Heritage Conservation Centre for providing their endless support towards this project and review of this article; PMG-AIC for awarding me a travel honorarium; Mr. Greg Hill (Canadian Conservation Institute) for his valuable advice on the glass plate negative project and review of this article; and HCC interns Ms Alison Bryan (Yale University, US) and Ms Emily Hick (Northumbria University, UK) for their assistance with this project.

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A Novel Non-Adhesive Housing Mat for the Display and Storage of Broken Glass Plates

Ibrahim Abdel-Fattah

Presented as a poster at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

A novel non-adhesive and high-quality storage and display enclosure was developed for two broken photographic glass plates (both negative and positive). The housing mat was created in the following way:

First, using a sample of the cardboard in water, the pH of the cardboard was measured with pH indicator strips.

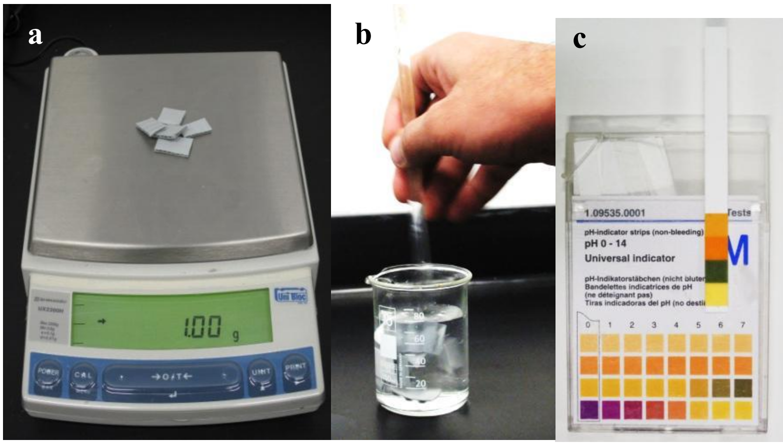

Fig. 1. Measuring the pH of the cardboard a) weighing 1 gm. of the cardboard, b) stirring the card board in the water for 45 minutes, c) measuring the pH with pH strips. The result was about 7.

The dimensions of the broken sections were accurately measured. The measurements were then used to cut an archival card board to exactly fit the broken parts.

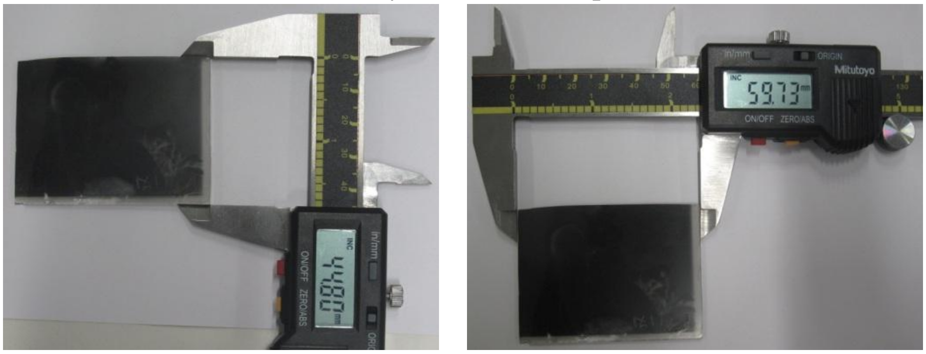

Fig. 2. Measuring the broken glass plate (length, width, and thickness).

Two more archival cardboards were cut with opening slightly smaller than the plates, to work as window mats. This enables the plates to be studied from both sides. This was especially desirable for the negative, so that it could be clearly seen with transmitted light.

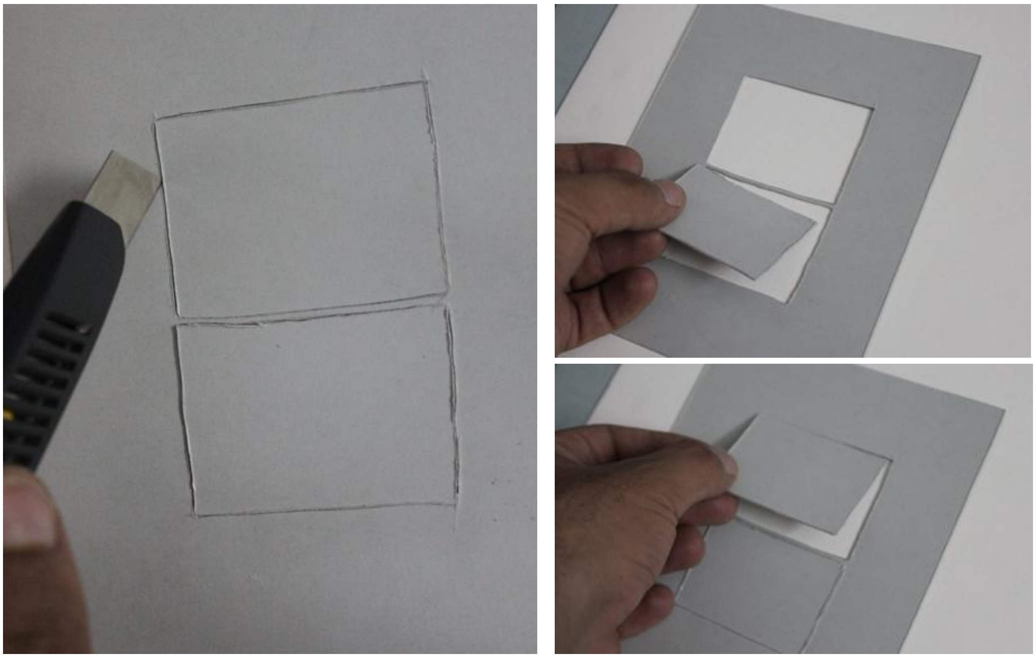

Fig. 3. Cutting the cardboard to fit the parts of the broken plate.

Those three layers of cardboard were adhered together with archival adhesive tape at the top, so that the package could be opened if necessary.

Before taping everything together, a layer of thin, white acid-free paper was inserted between the glass plate and the bottom window. The paper extended slightly beyond the edges of the object, enabling lifting of the glass without touching it, avoiding fingerprints even on the glass side.

Finally, two sheets of transparent acrylic glazing (Perspex) were placed over the housing to protect the plates from dust and pollutants, and to avoid fingerprints and scratching.

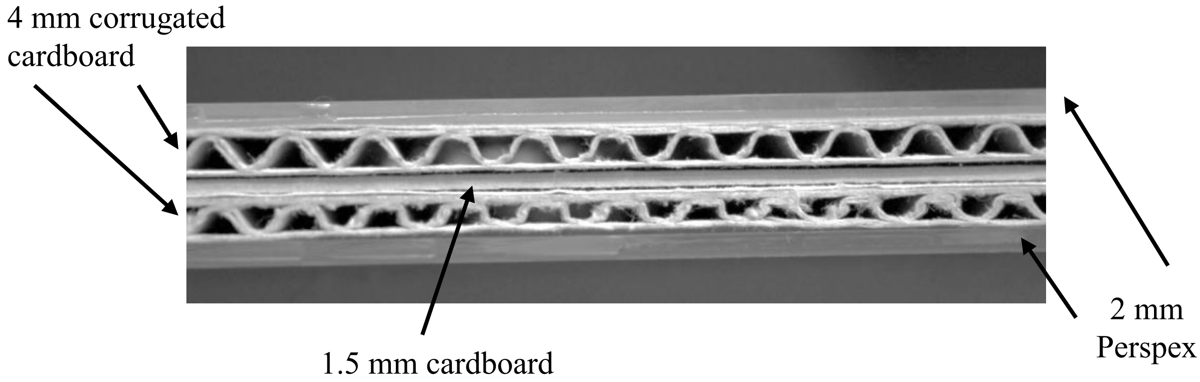

Fig. 4. All the three layers of cardboard used to hold the plate.

Fig. 5. The fragments of the negative are placed into the custom-cut window mat. The emulsion layer is towards the back of the housing to help preserve the image.

Fig. 6. The extensions of the thin, white acid-free paper can be used to remove the glass fragments from the housing. This makes for easy and secure removal of the fragment when needed.

To secure the housing system, two locks were created using the same transparent acrylic material (Perspex). The lower lock was modified to function as a stand, so the plates could be displayed vertically. The lock could be removed easily for horizontal storage.

Fig. 7. The broken glass plate after matting a, b) front, and c) back.

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Abstract: Preservation of Historic Glass Plate Negatives in Low Budget Conditions

Amir R. M. Miyandabi, Rebecca Main, James Elwing, and Michael Myers

Presented at the poster session of the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Purpose:
To find solutions to the consolidation and recovery of images on damaged glass plate negatives. These solutions could then be applied in regional museums with low budgets throughout New South Wales Australia

Principal findings:
Tests were conducted on large 19^{th} century glass plate negatives from the Freeman Brothers' studio in the Powerhouse Museum. The principal findings were:

1. Practicality of use of diluted gelatine solutions in re-adhering fragmented and detached silver gelatine emulsion layer to glass plates
2. Practicality of use of Klucel J solution in reducing the desiccation of emulsion caused by storage in very dry environment.
3. Importance of the combination of digitization methods with hands on approach with regards to achieving optimum preservation results
4. Calculation of time and resources required for the suggested conservation approach for optimum use of available resources

Conclusions:
The project concludes that while digitization is a useful method for preservation of glass plates, the process would be incomplete without proper hands on preservation measures as well as proper storage plans. A proper preservation of the actual photographic material –here glass plates - would add to value, reliability and of course the authenticity of the collection to be digitized. In this regard what is required is to have reliable metrics for proper estimation of the time and resources required for the project. As well it is important to use available and also compatible materials with regards to the object and the project itself.

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Abstract: Digitization of the Enemark Panoramic Nitrate Negatives

Jennifer Lloyd

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

This paper will discuss the planning involved in the project to digitize 500 nitrate panoramic negatives, including the pilot project and the creation of the 'panorail', and the steps involved in moving the items from the Nitrate store offsite to conservation for flattening and then the digitization work area.

The Enemark collection (http://nla.gov.au/nla.cat-vn3044614) consists of around 500 nitrate negatives which vary in length from 1000mm to 2700mm. The negatives were taken by Mr. John H. Enemark and Ms Anne M Enemark during the period 1917 – 1946. The images were taken around Sydney and NSW country areas (including Canberra) using a professional Cirkut camera.

This collection was chosen as a project by the National Library of Australia for the 2012/2013 fiscal year and involves the unrolling, digitizing and cataloguing of each negative in the collection.

The negatives are currently stored in small cardboard boxes, rolled with several negatives in each roll. The roll has a diameter of approximately 40mm. Each roll is unrolled, flattened and then delivered to the digitization section.

In order to digitize the collection a special piece of equipment has been designed (called the 'panorail') which allows the negative to be placed between two sheets of optical glass. The glass sits on a frame that allows the sandwiched negative to be moved beneath the camera. This allows the operator to move the long negative past the camera without having to change any settings on the camera and more importantly without having to handle the negative. The images are then 'stitched' together with software to create one image.

The collection can be viewed online at http://nla.gov.au/nla.cat-vn3044614.

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Abstract: The Preservation Challenges of Historic Scientific Photographs

Brenda Bernier

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Since the dawn of photography, scientists have used photographs to document the natural world and human behavior and culture. As a research institution, Harvard University has embraced photographic technology from the start, generating and collecting massive quantities of scientific photographs in the fields of geology, botany, astronomy, engineering, physics, medicine, archaeology, and ethnology. Often the use of a collection may differ significantly from the original purpose for which it was created, by advancing increasingly refined scientific theories, supporting research in unrelated fields, or being appreciated for purely aesthetic reasons.

Collections of scientific photographs can pose numerous preservation challenges. These photographs were often extensively handled when first produced, then as scientific needs changed, were left untouched for decades, frequently in poor environments. Some types of photographs, such as solar spectra, astronomical plates and seismograms, depend on image accuracy to a degree that makes digitization complicated. Annotations on crumbling enclosures can sometimes provide the only meaningful context to the image. Collections are often large, containing tens of thousands or hundreds of thousands of photographs generated for scientific analyses, and timetables allotted for the preservation of these materials often become compressed, as contemporary researchers clamor for access.

This paper will present an overview of historic scientific photographs at Harvard and ways in which their changing use over time has generated increased interest, as well as new preservation challenges. Three collections will be emphasized: the Gardner Collection landscapes that recorded geological data (Cabot Science Library), 17,000 glass plate negatives of patients taken for Dr. Jean-Martin Charcot, the father of modern neurology (Countway Library of Medicine), and three decades of seismograms that had suffered rodent infestation (Department of Earth and Planetary Sciences). The highlighted case studies will illustrate how unusual treatment, rehousing, digitization, and project management challenges were tackled.

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Preservation of Photographic Images for Future Generations: New Opportunities for Prints and Photo Books with a Conservator's Perspective

Joseph E. LaBarca

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand

Abstract

Upon discovering the 120 year old object in their grandparents' attic, most people today would be hard-pressed to play back a recording made on a wax cylinder of the late 1800s. What will people do just 50 years from now with an optical disk or magnetic hard drive? Over time, we have recorded our memories in many ways: letters, post cards, photographs, movies, audio and video recordings are a few examples. In earlier days, interpreting those recordings was independent of the technology used to create them – you could hold and view a hard copy document in your hand. How will future generations deal with those post cards, letters to the family, and photographs that have now been replaced by "Word documents", email, and digital images on the computer? Professional and mass-portrait labs are beginning to recognize the importance of hard copy images, and the value they can provide to the end consumer. However, the end consumer in particular needs to become aware of long-term storage issues that relate to the preservation of the data behind digital photographic images. Longer-term issues beyond routine backup and migration of data need to be considered, and preservation via human-readable hardcopy images is a key option. As conservators we need to be aware that hard copy photographic images using various imaging technologies will continue to be present in the future, especially if the photographic market is successful in its efforts to expand printing of digital images. Conservators can also be a part of the educational process to help spread the word on the importance of preserving photographic images. This can be done both by publically showcasing restored works from the past as well as using images from the past to promote the value of hard copy photographs into the future.

Introduction

As our world of photographs becomes more and more digital, there is an ever-growing concern over long-term storage and the preservation of these images, especially as it relates to the general public. While the photographic printing industry is certainly aware of this concern, the general public is not. Earlier papers by this author on the subject of long-term preservation (LaBarca 2007, 2010) have dealt with digital photographic images and the use of film as a technology-independent storage medium while a more recent paper (LaBarca 2011) focused on documents of all kinds, including digital files of letters, emails, as well as photographs. The focus of this paper is long term preservation of the "best of the best" of consumers' photo images through hard copy output products from the photo printing industry and to make conservators aware of, and supportive to, industry efforts to preserve digital images through printing. The goal of this paper is to reinforce to conservators the issues surrounding the long-term preservation of digital photographic images with the hope that conservators can help spread the word on the importance of hard copy photographic images, both from the past and into the future. Ultimately, this will help insure that the next generation of photographic conservators actually have hard copy photographs to conserve.

Current State

As personal computers, notebook/"tablet" computers, and smartphones continue to grow in use, digital imaging, email, and social media become more and more popular as the primary mode of documenting our lives. This creates an ever-growing concern over long-term storage and the preservation of these memories and documents. While some, perhaps many, of these files do not need to be preserved for the long term, some do. Unfortunately, consumers often do not recognize the importance of many of their images; for example, it may not be until a photograph is "rediscovered" 20 to 30 years later that people realize how valuable it is. In the digital world, without proper attention now, digital documents of all kinds will simply not be available 100, 50, or perhaps even 30 years in the future.

Despite efforts by photo industry trade organizations, the average consumer continues to be generally unaware that there is an underlying risk associated with information storage on computer hard drives, digital devices, optical media, or even storage "in the cloud". In many cases, because it is digital, the consumer actually feels that the information and images are safely preserved. Museums, conservators, and archivists, on the other hand recognize the problem of digital image storage. Relative to preservation strategies for large institutions, research and other published works are available on the topic (Gschwind et al 2004, Kriegsman and Mandell 2004, Miyata 2004). These strategies, however, are based on shorter-term storage with an associated longer-term migration plan. While some risk is mitigated, much remains.

Key Issue: Formats

Most people today would be hard-pressed to play back a recording made on a wax cylinder of the late 1800s. What will people 100 years from now do with an optical disk or magnetic hard drive? Wax cylinders were replaced by gramophone disk recordings in the early 1900s, (what we call "phonograph records" or simply "records"). They were a more robust and longer-lived technology, but eventually even records were replaced by new technology – CDs. Now CDs are being superseded by flash media in compressed MP3 format, and the whole concept of iTunes® and "cloud storage" could eventually replace device storage media all together. The eventual replacement of technology is inevitable. Just as one would have difficulty finding the equipment to play a wax cylinder from the late 1800s, or the equipment (turntable and stylus) to play back a 78-RPM record made in the mid 1920s, so too are people having difficulty finding the equipment to render a letter or document recorded on a 5.25-inch floppy disk just 30 years ago. Why would we think it will be any different in another 30-50 years when our children and grandchildren want to render a photographic image recorded on an optical or magnetic disk?

Digital technology adds several additional layers of complexities. Consider a 5.25-inch disk. To render a digitally stored image presents four distinct hurdles: 1) media format, as mentioned; 2) interfacing to a modern computer; 3) file format; 4) data integrity.

Media format: because the 5.25-inch media format has been superseded by three successive generations (3.5 inch magnetic, optical CD and optical DVD), finding a 5.25 inch disk drive may be very difficult.

Interface format: with the advent and proliferation of the Universal Serial Bus (USB) interface in the mid and late 1990s connecting an older 5.25-inch drive will pose problems. Most drives will have an external serial or parallel connection and, connecting to modern computers will not be possible. Some drives may be found, however, with a USB connection. If the drive is an internal drive it likely has an Integrated Drive Electronics (IDE) architecture which can still be found in many recent computers.

File format: file formats change. For example, early word processors from various companies (Wang®, Multimate®, Wordperfect®, etc.) each had unique file formats. As Microsoft Word became a defacto industry standard, MS Word provided some capability to translate from those formats. Today, however, due to the age of these formats, this capability is not included in recent MS Word versions. An internet search, however, can provide software or companies that do provide translator software (for a charge) to an early version of Word, which can then be retranslated by current versions. In the early days of digital photography Microsoft created a proprietary ".MIX" file format for its "Photo Draw" and "Picture It!" software, both used for consumer photo archives, which was later abandoned without any means of doing batch conversions. Images stored in this file format are essentially lost forever.

Data integrity: is the digital data still there and readable or not? Passing this final hurdle will depend on media quality and storage conditions. Today there is a plethora of low quality, very inexpensive optical media with highly doubtful long-term storage capability. There are also high quality optical media with claimed longevity of 300 years (for CDs, 100 years for DVDs). Even if the media last that long, the likelihood of passing the first three hurdles after 300 years, or even 100 years, is highly doubtful.

Format Hurdles: An Example

Consider the discovery of a 5.25 magnetic floppy disk from 1985 containing family history information. In this example we'll make it easy: the disk was in a labeled jacket containing the file name, and we also know it was created with Multimate® word processing software. Given the relatively low storage capacities and the fact that 5.25-inch floppy disks were stored in a jacket, a human readable hard copy print out of an index of the contents of the disk were often included inside the jacket. This enables us to more easily locate a document and perhaps know its file type. None-the-less, the four hurdles remain. Not only does this example illustrate the physical format and computer interface challenges, it also illustrates the file format challenge. Not all ".doc" files are the same, nor can they be read interchangeably. Even within a company like Microsoft their Office software products evolve. Long term MS Office file formats like DOC, PPT, and XLS have recently been updated to DOCX, etc. The "X" files cannot be read by earlier versions of Office software without add-in updates. Clearly, file format is a very serious concern for long-term preservation.

Finally, it also needs to be noted that the huge challenges of restoring the information in this example occurred with the passage of only 25 years. Imagine the challenges facing a consumer finding digital family photographs after two or three generations.

Technology Always Advances

For both physical and software formats, change is driven by ever-advancing technology. Consumers began "burning" CDs when laser writing technology became inexpensive enough to drive the price of CD writers down. Then the same thing happened with DVD writers. While consumers are now burning DVDs, there is a new, incompatible DVD format from the entertainment industry, with the Blue-ray DVD format having won out over the HD DVD format. How long a particular format persists depends on many factors, including economics. An additional risk factor is the breadth of usage of a particular format, which can have both positive and negative consequences on the risk of obsolescence. CDs have been well established for many years by the music industry and could therefore be considered a long-surviving, low-risk format. However, unanticipated technology changes occur that can increase risk and shorten longevity. Music CDs are now under direct challenge from flash memory in MP3 players and smartphones. Will there be a full-scale format change? Eventually there will be. Consider VHS tape. It also became well established and actually rendered the Beta format obsolete. In 1990 it would have seemed likely that VHS was sufficiently well established by virtue of the motion picture industry that it would be at low risk for a format change. Today, of course, VHS has become obsolete by DVD technology, driven by the same industry. So risk is always present and usually cannot be predicted far in advance of a format change.

Just as media format changes are hard to predict, technology advances around file structure and format will inevitably change as well, and these improvements eventually render older technology obsolete. DVDs offered many significant improvements over VHS tape. Flash memory in MP3 players offers many advantages over mechanically driven CD players. Technology of file formats and structures continues to advance as well. With this in mind, why would we expect today's popular photo encoding format (JPEG) to endure? JPEG2000 already offers many improvements in compression over JPEG. The Windows Media Photo file format, later renamed HDPhoto, was announced in 2006 and shipped with the Windows VISTA operating system. With some fine tuning by the JPEG committee, HDPhoto has become JPEG XR and in mid-2009 became a published ISO standard (ISO/IEC 29199-2). With its improved compression algorithms, improvements in color reproduction accuracy, and support for High Dynamic Range (HDR) imaging, it is only a matter of time before camera manufacturers begin to abandon JPEG. Will JPEG file formats be readable in 2033? 2033 is only 20 years away.

Historic Perspectives

In the days of photographic film, it was pretty much a given that a hard copy print would be made. In the world of digital photography and display devices this is not the case. Digital photography has enabled the capture of multitudes more images than with film. Industry estimates indicate that nearly 380 billion images were captured in 2012 (Zeev 2013). While many, if not most, of these images do not need to be preserved, some do. For those images, long-term storage of the digital information is tentative at best, especially when it is up to the end consumer to manage the files.

Many studies are available on the long-term storage of digital information (Wilson 2005). The work has been driven largely by libraries, museums, and governmental institutions, and addresses the threats associated with computer-dependent systems. There is recognition of the need for ongoing data migration as hardware, software, file formats, and operating systems evolve. Because the quantity of information for these large institutions is huge, high-capacity systems are needed. Alternatives to these types of rapid access, computer-dependent systems have been studied where the ability to have rapid access is reduced in exchange for a reduction in the need for data migration. Examples that have been discussed in the literature make use of photographic film as the preservation medium (Normand et al 2005).

The use of film for preservation is not new, as it has been done extensively in the motion picture and document industries for many years. Polyester-based, black-and-white silver separation films enabled the creation of separate red, green, and blue records of color motion pictures that could last over 200 years in controlled, room-temperature storage. The viability of this process has been demonstrated repeatedly in recent years with successful restorations of many classic films. With their ongoing transition to digital (both capture and projection) there is still a recognition by the industry of the importance of film as a technology independent medium for long-term storage and preservation. Today an additional option to silver separation film is available with a new offering from Eastman Kodak Company – KODAK Color Asset Protection Film 2332. The importance of a systems approach to preservation in the motion picture industry was emphasized at the 2013 IS&T Archiving Conference in Washington DC (Fitzgerald and Rutter 2013).

Black-and-white microfilm provides stability up to and beyond 500 years at room temperature with good storage efficiency. Compression of documents in the order of 25 to 45 times is possible. New hybrid document imaging systems enable the use of film with scannable metadata for enablement of automated search and retrieval functions (Hofmann et al 2005). For additional information on film usage in this application, where longevity estimates of 100-500 and more years are possible, see the technical papers referenced earlier. In addition, methods and a patent on film for preservation schemes are available in the literature (Willaims 1996, Williams and Burns 2004, Burns et al 2005).

Preservation of photographs in the home has historically centered on hard copy prints in albums, scrapbooks, and shoeboxes. In photography, there has been significant growth in digitally generated scrapbooks, photo albums and photo books in the last several years, and growth of these products is expected to continue. A hard copy print is human readable and therefore requires no system architecture to be put into use. Longevity of various photographic print media will be discussed later in this paper.

As consumer imaging continues its rapid advance to the digital world, preservation remains erratic or non-existent. There has been little to no thought by consumers for long-term preservation of their images. It seems they are taking for granted the automatic, "built-in" preservation that came with the traditional analog negative and resulting print that was available for many decades. Today, digital files of all documents, including images, tend to be loosely organized on hard drives, CDs, DVDs and social media sites. But, often, there is no organization and little to no awareness of the vulnerability to loss of the image from the format and integrity issues mentioned earlier. All of these impacts result in the need for continual long-term migration of the digital data of an ever-growing digital image collection. Unfortunately, consumers in general are totally unaware of this need.

Long Term Archiving

As mentioned above, archiving of digital files requires an ongoing commitment to manage records to keep them intact and ahead of any type of time-dependent changes. Considering that consumers want at least some of their images to last for many generations, if not a lifetime or more, this requires a very long-term commitment. Migration cycles need to be short because of the rapid and ongoing advancement of the computer and associated systems and the short life cycle of the media. So how do we preserve for the long term, for many generations?

TIP: Technology Independent Preservation

Technology independent preservation takes a long-term perspective and eliminates the need for short-cycle migration of digital information. The digital information (images, documents, email) is rendered to a hard copy, human readable output. Once done, a computer (today or in the future) is no longer needed to access and use the information. Once the document is rendered, elimination of the dependency on the computer has a positive impact on migration cycle time and allows for a preservation system that needs infrequent attention other than maintaining proper environmental storage conditions. The migration cycle is dependent only on the long-term stability of the output media. The key is to move from a digital storage format to a human-readable format using media that are very stable. This is echoed by industry analyst InfoTrends, which, in their publication "Road Map 2013: Photo Printing Trends", believe that "…strong growth in printing will take place because it is the best way to insure that important photos will be easily accessible and viewable well into the future".

Preservation by Consumers Today

The first and simplest way is to make hard copy prints of the most valuable images, and media of various technologies exist today to provide over 100 years of storage life at room-temperature conditions. Printing is easily accomplished at home using photographic-quality 4 × 6 or page-sized printers, at retail locations using self-service kiosks or a retailer-operated digital minilab, or online. Online options are best for larger volumes of images. Many online sources are available providing prints, photo books, and photo albums and include many high quality professional labs or consumer oriented image sharing sites. The first page or so of a Goolge® search on "professional photographic printing" provides many sources of high quality printing. With all of the long-term concerns that have already been discussed, printing of the consumer's "best of the best" images is the simplest and most reliable means of storage for multiple generations.

Digital storage, however, does have its merits including access and sorting capabilities. Online storage is becoming ever more prevalent at reasonable costs and photo sharing sites such as Snapfish, or SmugMug are popular and provide storage of the full, high resolution file. So are social media sites such as Facebook ® although many sites do not store the full resolution file. Significant compression is often done resulting in a significant loss of quality if a print were to be made from this compressed file. In addition, the consumer needs to be aware that some companies sponsoring these sites have gone bankrupt and shut the sites down with little or no notice, resulting in a total loss of the stored files. A second, self-managed option for digital storage is to use multiple magnetic hard drives with redundant backup. This option requires a disciplined approach and gets complicated as the collection of images grows in size. RAID (redundant array of independent disks) systems provide automatic redundant backup and storage and require minimal attention by the consumer. Another, higher complexity and less desirable storage option is to routinely move images to optical media such as CDs or DVDs. One critical concern in this option, in addition to the media format, file format and data integrity concerns applicable to all digital storage as discussed above, is the media longevity. While CD and DVD optical media is available with advertised longevity of 100 years and higher, there is a large amount of anecdotal evidence that low-cost CD media lasts for two years or less. Any short-term plan by the end consumer to use optical media should center on high-quality, higher-cost media only. An additional storage option to consider are the many services today that will automatically backup files and store them "in the cloud" for a nominal service fee. As mentioned before, the long-term viability of the service provider is a potential concern here as well. Additionally, cloud storage does not address the inevitable long-term changes in file formats.

Stability of Materials Used for Preservation

A key issue for conservators as hard copy "photographs" move from traditional black and white and color silver halide materials to the wider range of digital technologies is identification. These newer digital output technologies include thermal dye transfer (often mistakenly called "dye sub"), electrophotographic/toner technologies (including both dry and liquid toners), and inkjet materials. Inkjet materials contain the widest range of component types including swellable and porous media and dye-based and pigment-based inks. An excellent resource for conservators to aid in the identification of print materials is the Digital Print Preservation Portal (DP3) from the Image Permanence Institute at Rochester Institute of Technology. The DP3 website includes information on identification of various output technologies as well as degradation pathways and illustrations.

The section below provides longevity information on various technologies used for hard copy output. A reflection medium has the advantage of being excellent for human readability but has variable longevity, which depends on the output technology chosen making careful choice by the consumer very important. Regardless, a hardcopy print is a human-readable, technology-independent record of the digital file.

Table 1 below discusses the longevity of various reflection technologies and provides specific examples and longevity information for Kodak media (ISO 18909:2005, Bugner et al 2004). Longevity of similar technology materials from other manufacturers may or may not be as stable so careful comparison, using common test methods and interpretations, is called for. With one noted exception, the lifetime estimates in these tables use a new endpoint criterion that is more conservative than that typically used for consumer images (Oldfield and Segur 2004, Oldfield and Twist 2004). Because the application is for long-term storage, these predictions are based on dark keeping applications, and they include the effects of heat, humidity, and atmospheric pollutants, but they do not include effects of light.

Media Type	**Media Name**	**Estimated Longevity**	**Comments**
Thermal Dye Diffusion Transfer	*Kodak Professional Ektatherm XtraLife* media	80–100 years for 5% dye loss[2]	Virtually no sensitivity to humidity or ozone
Inkjet/Porous Media	*Kodak Ultra* Premium photo paper	50 to over 75 years	Using high-quality pigmented inks
Silver Halide	*Kodak Professional Endura* papers	Over 150 years	Virtually no sensitivity to humidity or ozone; greatest longevity of any silver halide paper
Electrophotographic	*Kodak* NexPress Digital Production Color Presses with *Kodak Professional Endura* EP-D paper	Over 100 years[3]	Virtually no sensitivity to ozone; physical damage can occur in high humidity environments so storage conditions need to be carefully controlled

Table 1. Stability of reflection media for long-term storage applications.[1]

[1] Using much tighter dye loss criteria of 15%; room-temperature storage conditions of 23ºC and 50% RH and pollutant-free air; lower storage temperatures can provide significantly longer longevity.
[2] Time for 15% dye loss has not been determined due to the extremely high thermal stability; actual time will be well beyond 100 years.
[3] Estimated based on longevity of the various components; testing on current products in progress.

Table 1 clearly shows there is a wide range of high quality reflection printing technologies that can be used for long-term preservation. Properly stored, hard copy prints are certainly usable for long-term preservation of the consumer's "best of the best" images. The photographic industry needs to encourage people to make prints as preservation records of their images so future generations will easily be able to find and enjoy these records of people's lives without dependence on a possibly obsolete digital technology from a generation or more prior.

Image Permanence Standards

As mentioned previously, a preservation strategy requires good information on media dark stability. This includes more than just thermal stability, which had been sufficient for printing technologies using silver halide materials. For the newer technologies such as inkjet, standardized stability information should include gas pollutants and humidity as well. The ISO technical committee on photography (TC42) has recently published three new standards on measuring image degradation due to heat, atmospheric pollutants and humidity (ISO 18941:2011, ISO 18946:2011, ISO 18936:2012,) and a similar standard for degradation due to light is close to being published. Work is also underway on measurements of durability of photo books. Protocols for predicting life estimates are also needed, however, and these must include all four of the environmental factors (heat, humidity, pollutants, and light), and they need to be relevant to the specific application and end user. As mentioned in Table 1, tighter degradation criteria are needed for the application of preservation compared to normal consumer home and display predictions. The longevity estimates included here are 50% tighter (allowing for only half the colorant loss) than those generally in use for consumer/home longevity predictions, which can be found in the ISO Image-life parameters table of illustrative endpoint criteria contained in the silver halide stability standard (ISO 18909:2005). These tighter criteria would yield a net change that would be considered close to a just-noticeable difference (JND). For this application of long-term preservation, that level of change is about the maximum tolerable.

A Call to Action

With digital now in the mainstream for imaging, much more education is needed to make the general public/consumer aware of the risks of image loss from not having a preservation plan. Memories preservation is important, and consumers have done this historically through photo albums and scrap books. The initiative that was announced in 2007 and supported for several years by the International Imaging Industry Association (I3A) on consumer photo preservation was a start to creating this awareness among retailers and consumers (I3A 2006). The "SaveMyMemories.org" website, also launched in 2007, received positive response initially and during its first couple of years, but is no longer available. There needs to be further promotion to a broader audience, especially the consumer, and these efforts need support from the entire photographic industry. At the image creation end this includes imaging manufacturers, including camera and output media suppliers, as well as the photo fulfillment industry. At the image preservation end this includes conservators. Photographers and their associated printing labs, along with online photo fulfillment sites, mass portrait and school finishing labs, have the closest connection to the end consumer and therefore have the best chance of driving this message home. Conservators can help spread the message by publically highlighting historical preservation they have done in the past and promoting the importance of these works to future generations. Creating the awareness at the consumer level will help create the demand and stimulate the business for various high-volume photo fulfillment systems to address the consumers' need for image preservation and maintain a stream of important images for conservators of the future to maintain and restore.

Conclusions: Path Forward – Reaching the Consumer

This paper has described the risks associated with storage of digital data and why those risks are so high. We have also presented a solution using high quality hard copy output to create a long-term solution that will last for multiple generations. Additionally, this paper has reviewed both traditional (silver halide), and newer (inkjet, thermal) media for storage as hardcopy prints. Electrophotographic media, such as that used for on-line generation of photo albums, photo books, and scrapbooks is also included and is especially important given the growth in these products. A simple solution, however, does not help if the consumer is not even aware that the risks are present.

Educating the consumer is the near-term issue that needs to be solved and a broad, far-reaching effort is needed. To make consumers aware immediately, digital camera manufacturers should take a lead role by providing educational information when a camera is sold. The photo fulfillment industry can reinforce this message to further educate the consumer while simultaneously growing revenue from photo output products. Educational outreach by conservators will be helpful in highlighting the importance of hard copy images from the past and emphasizing that this will still be important with today's images 30, 50, or more years into the future. Finally, a goal of Pixel Preservation International, in conjunction with industry sponsorship, is to reach out to the general public to educate, through examples such as those included in this paper, on the need for technology independent storage.

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Abstract: Actions for Preserving Digital Photographs

Millard Wesley Long Schisler

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

We have been discussing the problem of preserving digital information, which includes the enormous amounts of digital photographs, for over 10 years. Much has been said and written about this topic. Unesco is preparing for the event this year in Vancouver, *The Memory of the World in the Digital Age: Digitizaton and Preservation*. In the preparation of this upcoming event they state that "*despite the adoption of the UNESCO Charter on the Preservation of the Digital Heritage in 2003, there is still insufficient awareness of the risks of loss of digital heritage*". The problem resides not only in the lack of awareness, but also the lack of implementation of preservation actions of those that are aware.

The challenges of preserving digital photographs for long term access are straightforward and simple on one hand, but complex when trying to implement because they involve changes in the way we do things, and the creation of new workflows, expenses and activities in our personal and institutional lives, already cluttered with the daily activities of survival. Many photographers that do try to achieve the preservation of their own work talk about the amount of time and energy put into this effort, and lack of certainty in their actions.

My presentation will be divided in three parts. The first part will give a brief outline of what the *digital dilemma* means today for digital photography. The second part will be an evaluation of some cases studies I have been working on, from NGOs, Museums, photographers and people from different social groups. The third part will talk about actions that are necessary for us to move forward. This last part is where we need to concentrate our energy!

Millard Wesley Long Schisler
Rede Memorial
São Paulo, Brazil

Conservation of New Photographic Art: Direct Printing and Textile Artifacts

Pablo Ruiz García

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

1. Introduction

The conservation of photography is a young science: thirty or forty years of professional development it is not a long time. Nevertheless, in such a short period of time it is possible to see how much the profession has changed, and to see how contemporary artifacts made by photographic means now have nothing to do with the photographic objects with which photograph conservators originally worked.

When I started in this profession I was working mainly with nineteenth century photographs. As time passed, most of my work was with photographs of the twentieth century, dating from as late as the 1970s. About five years ago, I took a leap to face the problems that affect contemporary photographs, those dating from the last decade of the 20th-century to the present day. I suddenly had to deal with the developments in photographic art production systems which occurred over the last two years. These technologies open new challenges for the future. This is what this paper is all about: photographic artifacts are being created today that will challenge conservators in the years ahead.

Today's conservators are familiar with inkjet and lightjet (digitally made chromogenic prints) on cellulose supports, using known installation and exhibition systems.

Fig. 1. Inkjet photographs by Nadav Kander, on exhibit at the Andalucian Center for Photography, Andalusia, Spain.

In recent years I have encountered other photographic objects with more unusual physical characteristics.

These include digital prints where the primary support has become the substrate: this is usually done to ensure consistency of an artwork, especially with large format photographs. Artists may also print their works on various fabrics, use surface coatings, and present them in different and innovative ways.

Fig. 2. Photomontage (digital textile print) installed in a gallery space.

Searching for information on these new materials and techniques has led me to work with one of the most important printing laboratories in Spain, Clorofila Digital. Clorofila Digital has been making lots of contemporary artworks with a number of these new types of printing systems. I am currently working with their research department, studying, analyzing, and increasing my understanding the new digital printing systems and their possibilities. I am also helping them to develop their quality control system.

Fig. 3. Clorofila Digital’s showroom. Image by Oscar Polanco, 2012.

2. Technologies for New Photographic Art Production

Direct printing can be done on a number of unusual substrates. The fashion industry has made excellent use of this. For example, it is possible to see a range of jewelry objects made with directly printed photographic elements and assembled with silver, gold and platinum components (Fig. 4). The photographic images are printed directly on glass, the primary support. Another similar artifact is an image printed onto white ostrich feather, with silver components (Fig. 5). It is also made by direct printing of the image.

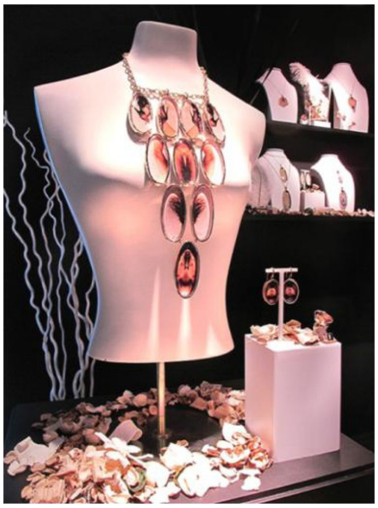

Fig. 4. Jewelry by Saioa Aldaya, photographs by Daniel Dicenta.

Fig. 5. A white ostrich feather *(left)* and a direct printed photograph on a similar ostrich feather *(right)*. Jewelry by Saioa Aldaya, photograph on feather by Rafael Rodulfo.

Many artists are presenting their artworks as light boxes, which can be made using several different technologies. For example, when viewing the light boxes in Figure 6 from a normal distance, they look quite similar. However, they were made using very different photographic technology. The light box pictured on the left is a chromogenic print, printed with lightjet technology, and attached to the verso of a translucent plastic support using a silicone adhesive.

The object pictured at the right of Figure 6 is direct printed onto an acrylic substrate. The image is made up of inks which are cured with ultraviolet (UV) light: these types of inks are also known as photo-polymerization inks. The image layer is on the exterior of the light box. It does not require the use of an adhesive, but also has no protective varnish or glazing.

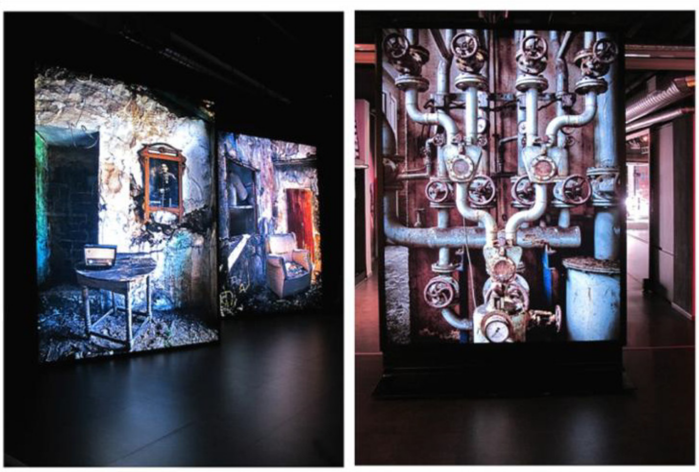

Fig.6. Light boxes: a chromogenic prints *(left)* and a direct print *(right)*, both adhered to translucent acrylic supports. Unknown photographers.

Fig. 7. Textile printed light boxes illuminated with light-emitting diode (LED) light sources installed in the Clorofila Digital showroom. Unknown Photographers.

Light boxes can be constructed in yet other ways. For example, the light boxes pictured in Figure 7 are printed onto fabric and stretched on round supports with diameters of 1.5 meters. The images are printed by dye sublimation onto a proprietary fabric support known as Backlit, which is manufactured by Fisher Textiles, Inc. They are illuminated with light-emitting diode (LED) light sources.

Fig. 8. Vertical, cylindrical, textile printed, free-standing light boxes by Ricardo Cisneros.

Yet another variation of the light box presentation style is pictured in Figure 8. The fabric elements with printed images are wrapped around vertical acrylic cylinders. The tubes are free-standing, and are illuminated from within.

3. Industrial Printing Contribution to Photographic Art

The technologies of direct printing on various substrates and printing on textile supports did not originate within the arts community. These techniques for creating digital prints were developed by the graphics printing industry (photomechanical or industrial printing) and later appropriated by photographic artists. Both technologies, direct printing and textile printing (inkjet-applied dye sublimation printing), became possible with advances in industrial printing, in combination with the development of inkjet technology, made over the past 20 years.

Fig. 9. Plastic bottle lids with commercial labels direct printed on top.

Direct printing was developed for printing text and graphics on plastic-coated electrical wires. After the improvement of the UV-curing systems, these inks were used to silkscreen posters, product labels, and commercial packaging. Inkjet printing with these inks became possible with reducing the viscosity of the ink and after subsequent improvements to the injector's capabilities.

Textile printing is the result of the evolution of large-scale textile printing systems in conjunction with technologies developed for dye-sublimation printing on transfer paper. After the initial printing onto the temporary support, a hot press is used to transfer the images onto a final support. The direct digital textile printing technology sometimes used in contemporary photography originated in the 1990s as an alternative to silkscreen technology. Later developments in dye sublimation inks and printers now permit images to be printed directly onto the fabrics.


Fig. 10. A textile printed curtain *(left)* and a direct printed ceramic wall *(right)*. Unknown photographers.

The use of textile supports has necessarily led to the use of large printers, allowing for the creation of extremely large objects. Because of the extreme sizes possible, this printing is done roll-to-roll: the unprinted material is initially rolled and after printing, is re-rolled for storage and space-saving purposes. This is mainly used for commercial advertising materials, such as flags, banners, signs, etc… Artworks produced in this way are 'low production' or 'print-on-demand' pieces.

4. Technical Aspects

The structure of these photographic objects is different depending on which printing technology is used. Both direct printing and textile printing, however, do have some technical aspects in common: the use of inkjet technology and unusual supports, as well as having images formed by applying energy in some form.

Inkjet technology involves transforming a digital image into a series of electrical pulses. These pulses them control the deposition of ink droplet onto a given support material. This is now fairly common and established printing technology. In addition to the possibility of printing on uncommon supports, the inks, once deposited on the supports, are designed to form an image by bonding with the support. This is done with energy, most commonly through heat and/or light.

Both technologies essentially function as follows:

ink + support + energy = digitally printed object

The differences between the two processes begin at the moment when the ink droplets arrive at the support material. The form of energy applied to the inks is different, and the resulting image materials have correspondingly different structures and appearances.

Fig.11. UV radiation causing the photo-polymerization of direct printing inks: the UV light source is passing over the applied ink, causing it to cure.

Direct printing uses energy in the form of UV light to cure the inks on top of the support material. Textile printing uses thermal energy, or heat, to form an image within the fibers of the (textile) support.

In direct printing, a high-UV light source passes over the applied ink, forming cross-links within binder and curing the ink. Once the ink is cured, the image is fixed onto *the surface* of the support. This is a chemical photo-polymerization reaction induced by light energy reacting with a photoinitiator compound in the ink. This is similar to what occurs in 19th century colloidal photographic processes such as gum dichromate and carbon printing.

The image formation of textile printing involves two separate steps. The first step is printing the image onto the textile surface. At this point the image is weak, and the colors are not saturated. To complete the image formation, as a second step, the printed fabric passes through a calender (rotary heat press). As the printed fabric passes through the heated press, the ink sublimates and forms an image *within* the fibers of the support.

What is occurring as the fabric passes through the calender is that the dye bonds to the fibers, increasing the saturation of the colors and the sharpness of the printed image. The printed fabric is then re-rolled to keep it safe and to save space.

Both technologies rely on the advanced development of inkjet printing, new machines to deliver the ink and create the print, specific media (the various substrates used to print), and special-purpose inks.

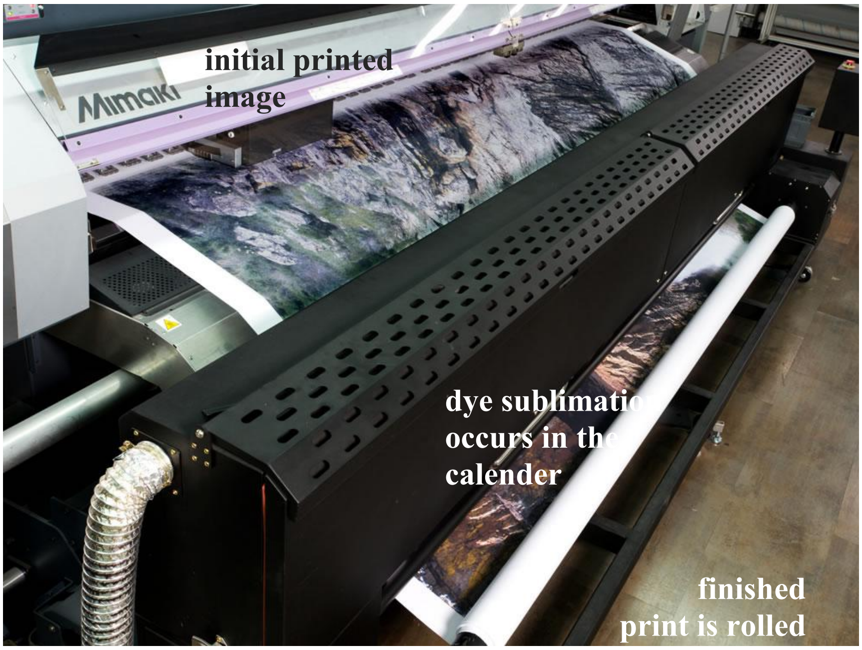

Fig. 12. Thermal energy causing the ink sublimation in textile printing.

Fig. 13. A photographic artwork combining both direct printing and textile printing. Installation made for CasaDecor 2011. Unknown photographer.

5. Process Identification

Direct printing and textile printing have advantages and limitations in terms of life expectancy, preservation needs, and scope of restoration options, if required. However, in order to realize these parameters, it is first necessary to properly identify the printing process used. The easiest way to identify the printing process used would be to focus on their physical characteristics through a detailed visual assessment.

This can be done by relating both technologies to the continuous tone of a chromogenic photograph. As photograph conservators are aware, under magnification both traditional and lightjet chromogenic prints exhibit gradations of continuous tone (Fig. 14). This continuous tone contrasts with the regular or irregular halftone screen patterns produced by direct printing. At a normal viewing distance the image appears to be continuous tone, but upon closer study, perhaps under magnification, the nature of the non-continuous tone pattern will become visible (Fig. 15).

Fig. 14. A lightjet chromogenic print, overall *(left)* and detail images *(center and right)*. The continuous tone of the image is evident upon closer examination.

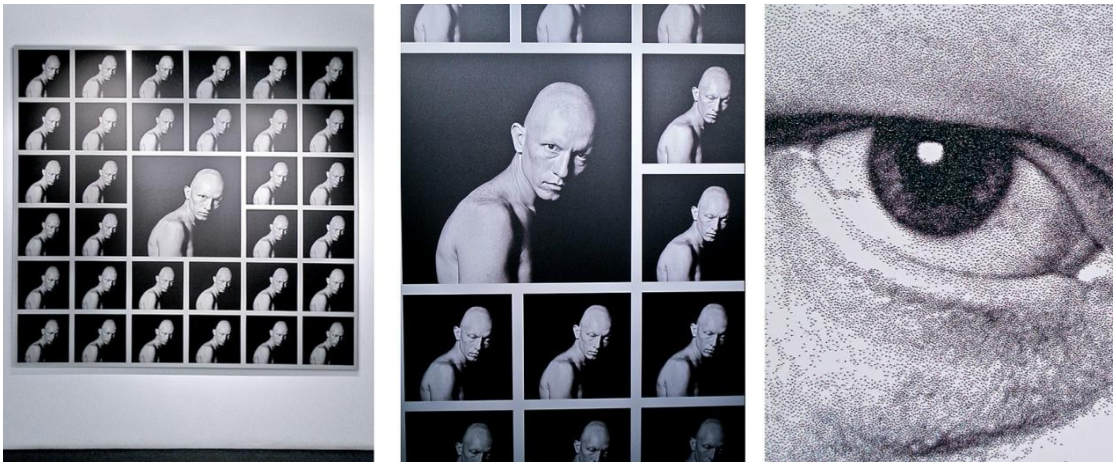

Fig. 15. A direct printed image on a Dibond support, overall *(left)* and detail images *(center and right)*. The digital halftone screen patterns produced by the inkjet printer are visible upon closer examination.

The technology used to direct print older artworks were less advanced than what is currently used: the size of the ink drops was larger than the standard ink drop size is today. Smaller drop size results in higher quality images. This could necessitate examination using a microscope when determining if an unknown print has continuous tone or a digital halftone screen pattern. The current standard for the drop size in direct printing is 1.6 picoliters.

Textile printing can also be contrasted with the continuous tone of a chromogenic print. Again, at a normal viewing distance the image appears to be continuous tone. Upon closer examination the woven surface texture of the fabric support become readily evident. Under magnification, it is possible to see how the ink has penetrated the fibers of the support. During the thermal sublimation process the ink moves into and expands within the fibers, obscuring any digital halftone screen pattern and creating the illusion of continuous tone. There is a slight decrease in the sharpness of an image when compared with chromogenic printing, but the printing technique provides overall good image quality.

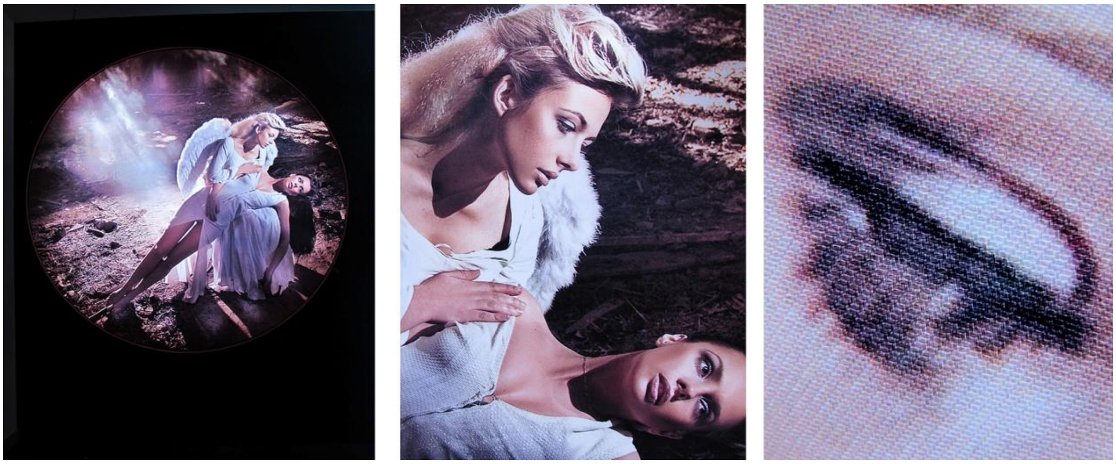

Fig. 16. A textile printed image, overall *(left)* and detail images *(center and right)*. The weave of the fabric is readily visible, and the printing technique gives the illusion of continuous tone.

Other physical characteristics can assist in identifying direct printed and textile printed artifacts. For example, in direct printing the inks forming the image sit on the surface of the support. Because it does not significantly penetrate the support, it is easier to observe the digital halftone screen pattern, especially in areas of low image density. In areas of high image density, the heavy amount of ink applied forms a continuous film on the surface of the support, creating a higher surface gloss in these areas (Fig 17).

Fig. 17. A direct printed image, overall *(left)* and detail (*right)*. High image density areas exhibit have high surface gloss and continuous ink film *(right)*.

Identification of textile prints is more straightforward because of the nature of the support material. The objects may also exhibit a matte surface gloss, almost having the appearance of satin in areas of high image density. Often the support fabrics are polyester, and the edges are cut with heat. This local melting and cooling of the plastic (polyester) fabric gives the object distinct hard plastic edges. These objects may also have a variety of attachments, such as sewn edges and fastening mechanisms such as grommets.

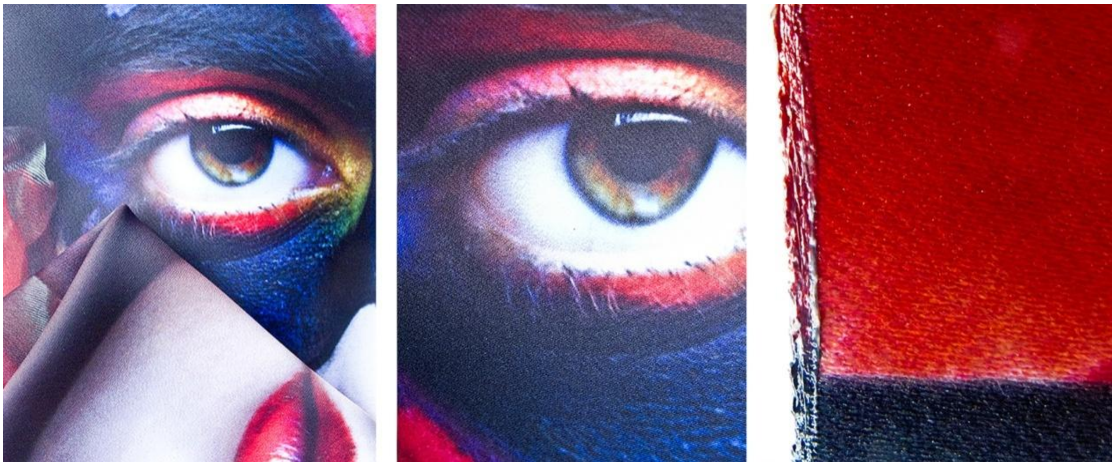

Fig. 18. A textile printed image: the flexible folded support *(left)*, matte surface gloss *(center)*, and melted plastic edge *(right)*.

It is possible to confuse textile printing (inkjet-applied dye sublimation printing) with other types of digital printing on fabric supports such as those made through dye diffusion thermal transfer printing techniques. However, the image created using those techniques remains on the surface of the fabric: it is not formed within the fibers.

Both direct prints and textile prints are often exhibited without any protective surface coating (laminates or varnishes) or housings (mats, frames, glazing).

Physical Characteristics		
	Direct Printing	**Textile Printing**
Support	any kind of media	synthetic fabrics
Image	UV-curable inks	sublimation inks
External Fastenings	rare, depending on the support	more common, including stitching, melted edges, grommets

6. Structural Components

6.1 Supports

As the UV-cureable inks can be used on a variety of supports (stone, iron, plastics, wood, steel, ceramic, etc.) broad statements as to the physical durability and chemical stability of these substrates are not possible: there are too many variables to take into consideration.

However, the most common supports used in direct printing are Dibond (a genericized trademarked term for an aluminum/polyethylene/aluminum composite material, first manufactured by 3A Composites) and Plexiglas (the tradename for a transparent thermoplastic glass alternative, poly(methyl methacrylate), first manufactured by the Rohm and Haas Company).

Fig. 19. The same image direct printed onto a Dibond support *(left)* and a Plexiglas support *(right)*.

Fig. 20. The same image textile printed onto fabric supports with different, distinct weave structures.

The supports used in textile printing can vary, not significantly in chemical composition but in the weave structure and/or any sewn or attached elements. The chemical composition of the fabrics must contain, in some proportion, synthetic polymers. Though most are polyester, fabrics may include a certain percentage of cotton fibers (to provide different physical qualities regarding the hand or draping of the fabric) or polyamide fibers (to increase the strength and elasticity of the fabric). The intent of these fiber mixtures is to fabrics that are flexible, and able to withstand high stresses without tearing.

No matter the composition, all textile supports are waterproofed and treated with fire-retardant chemicals. These treatments give them greater resistance to biological contamination than conventional fabrics. They may also have surface coatings that assist in the creation of higher quality images.

6.2 Image forming substances

Direct printing inks consist of four basic components: 1) a photoinitiator, 2) acrylic resins, 3) colorants (pigments or dyes), and 4) other fluid modifiers and additives (Fig. 21).

As stated previously, the photoinitiator is activated upon exposure to a source of UV radiation between 200 and 400 nm. This activation begins the polymerization of the ink. The resins in UV-curable, or photo-polymerization, inks consist of acrylic oligomers and monomers. The large oligomers do not participate in any cross-linking reaction: it is the smaller monomers that polymerize upon activation of the photoinitiator component. The monomers also function as a plasticizer to the larger oligomer molecules. For a graphical representation of this, please see Figure 22.

The additive and fluid modifiers added to the ink serve to increase or decrease the viscosity of the ink during the printing process, and to adjust physical properties of the cured ink film such as flexibility and resistance to abrasion. The colorants present within both direct printing inks and textile printing inks will be discussed in Section 6.3.

As these inks do not contain volatile organic compounds (VOCs), they are known as "100 percent solid inks" (Maitland 2005, 287). With correct curing of the ink, all of the components are a part of the final ink film: all that remains is a layer of acrylic polymer containing the colorant, binding it to the support material.

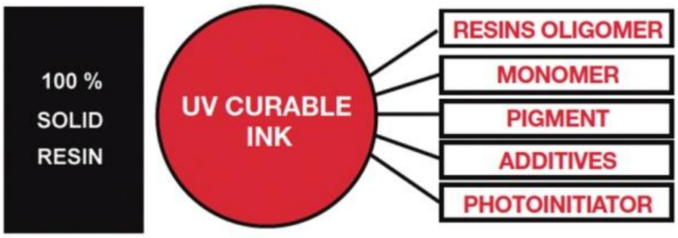

Fig. 21. A graphic representation of direct printing ink composition.

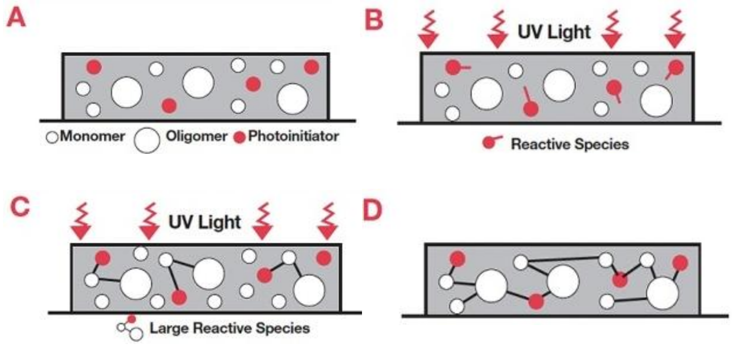

Fig. 22. The uncured ink film *(A)*: the ink is exposed to UV light and the initiator is activated *(B)*: the monomers begin to polymerize *(C)*: the cured and cross-linked ink film *(D)*.

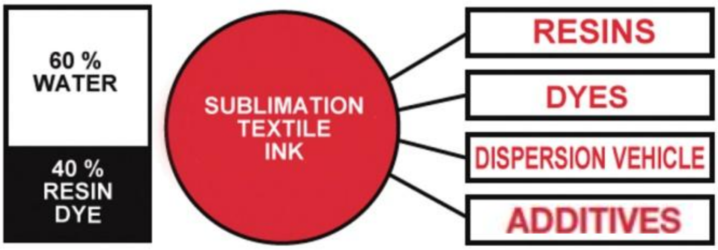

Fig. 23. A graphic representation of textile printing ink composition.

The inks utilized in textile printing are of a very different composition: they consist of solid particles (waxes and/or resins) dispersed in an aqueous solution (Fig. 23). During the heating process, the solids move into the textile fibers, redepositing as solids. These inks are designed to bond with synthetic polymers: the fibers are not colored with a physically-bound ink, the ink becomes part of the fibers themselves (Fig. 24.).

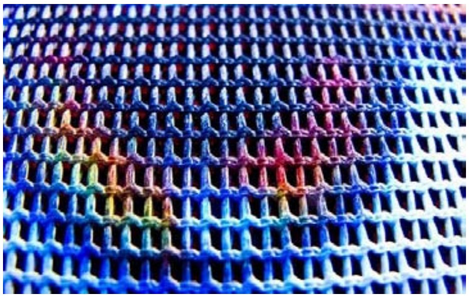

Fig. 24. Textile printed image: the ink is formed within the fabric's fibers.

6.3 Colorants

The colorants used in digital printing are either dyes or pigments, with pigments being the more stable, long-lasting option as a colorant. Permanence is of significant interested to digital print ink/equipment/paper manufacturers such as Epson, Agfa, and Minolta.

Information located by the author indicates that the inks used for direct digital printing utilize pigments as the colorants. No accurate information regarding the dyes used in textile printing was found. What is known is that textiles printed with this technology and used in the fashion industry can be washed and ironed. Therefore, it may be assumed that the inks can withstand a range of temperatures and relative humidities.

Fig. 25. Ruiz Galán fashion designs at Madrid Fashion Week 2012. Image by Oscar Polanco, 2012.

The need to conduct more extensive ageing and lightfastness testing is plain. However, further analysis and understanding of the composition of these contemporary photographic objects can be complicated by the proprietary nature of many of the products. Manufacturers are not always willing to divulge trade secrets.

7. Conclusions

The information on the stability of the products offered by these companies is often vague. In its product information, Agfa states that accelerated weathering tests with Anuvia UV-curable inks applied to various substrates indicate that the outdoor durability of the inks is "more than 2 years - probably even more than 3 years under Western European, outdoor conditions" (Agfa-Gevaert 2013).

Fig. 26. Photographs printed onto ceramic and acrylic supports, installed within a bathroom. Image by Oscar Polanco, 2012.

It is easy to forget that the ink is not the only thing to consider when thinking about the long-term stability of an artwork. On must remember that that the stability of the substrate, paper, fabric, ceramic, glass, etc, is also an important factor. For instance, empirical experience suggests that a direct printed image on a ceramic support is still in excellent condition after five years of outdoor exhibition in Spain. No doubt the use of a ceramic support lends a certain degree of long-term stability to such an object.

Fig. 27. *En algún lugar, ninguna parte: Proyectos no ejecutados de Le Corbusier* by Dionisio Gonzalez, exhibited by Solo Objects at ARCOMadrid 2013 (International Contemporary Art Fair). Photographs printed by the Clorofila Digital laboratory. Image by Oscar Polanco, 2012.

In order to more fully understand the life expectancy for these types of digital artifacts, it is necessary to continue to research the materials and printing techniques. Until our understanding develops, a conservative preventive conservation approach to these objects may be the best course of action.

To assist in answering many of these questions, the author is currently working to develop a research project in collaboration with the restoration laboratory at the Universidad Complutense in Madrid. If funding in secured, the intention of the project is to analyze the materials used in direct and textile printing, with the ultimate goal of increasing our understanding of these new photographic artworks.

8. Acknowledgements

The author would like to thank Clorofila Digital for their cooperation in the ongoing research into digital printing processes, and for the use of images of their galleries, equipment, and artworks within this paper. Thanks also to Oscar Polanco for the use of his images. The author would also like to thank Jessica Keister for her assistance in preparing the English version of this paper.

Unless otherwise noted, all images are by Pablo Ruiz García, 2011/2012.

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Transparent Things through which the Past Shines: Conservation of Holograms in the Collection of the National Gallery of Australia

Andrea Wise

Presented at the PMG session of the 2012 AIC&ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand

Abstract

The National Gallery of Australia (NGA) holds a varied collection of new media, including holograms by artists such as Robyn Beeche, Shu-Min Lin, Paula Dawson and Margaret Benyon. Few artists see the making of a hologram as an integral part of their practice. Paula Dawson and Margaret Benyon are exceptions. Both are pioneers in the area having made and used holograms for many years. While their subject matter and intent are quite different, both artists are attracted by the technical complexities of the media and both use holograms to blur the boundaries between reality and illusion. The theory of holography was established by Dennis Gabor in 1948, with the realisation of light generated holographic images occurring with the invention of lasers in the 1960's. Over the years holograms have evolved, reflecting similar trends to those in photography, incorporating digital technology with applications in science, industry, medicine and art. Until recently the recording materials used most frequently for high quality, large holograms were silver halides due to their light sensitivity and commercial availability. Since the advent of digital imaging these materials have become more or less obsolete. New developments in colour holography have contributed to an entire exhibition created in holographic images being substituted for the fragile originals in 2011. Little is written on hologram preservation and most of that which exists is based on guidelines for photographic preservation. This paper will provide a brief outline of hologram history and development together with an overview of the materials and techniques of a selection of holographic works in the NGA collection and consider some of the implications for the Conservator.

Introduction

Holograms are now commonplace, a familiar feature on credit cards, used on passports, found in magazines and advertising; mass produced and turned out in their millions these commercial holograms are at the opposite end of the spectrum to the unique art holograms on display in galleries and museums around the world. Salvador Dali famously claimed to be the first artist to work with holography in his 1972 New York exhibition. This was not strictly true as there had been two previous exhibitions dedicated to holographic art in the US in 1968 and 1970, highlighting the enthusiasm with which the medium was taken up by artists, almost immediately after the invention of lasers. In fact New York was home to the world's first museum dedicated to holography, which opened in 1976. This collection was transferred to the Massachusetts Institute of Technology (MIT) when the museum closed due to financial pressures in 1992.

By their very nature holographic works are exacting; the challenge for the artist is to maintain their creativity without sacrificing technical excellence. The holograms in the NGA collection are created using a variety of materials and techniques and take different forms. For example the large work (3657mm x 3657mm) by Shu-Min Lin, *Glass Ceiling*, (1997-2001) comprises 12 reflection holograms and 132 granite tiles on which visitors are invited to walk. It was made by a professional holographer on behalf of the artist, and is illuminated with a complex system of lighting held in an overhead grid. Another artist collaborating closely with a professional holographer is Robyn Beeche. She was one of the few women working as a catwalk photographer in the 1970s and 80s with designers such as Vivienne Westwood and Zandra Rhodes. She created groundbreaking images in polaroid, lenticular and holographic format. Beeche's holograms were made by professional holographer, Edwina Orr at Richmond Studios in London; there are three in the NGA's collection, all in excellent condition. These are a rare holographic process which uses a form of colour mixing to achieve a black and white effect. (Orr, 2012). While a number of high profile artists, such as Bruce Naumann, Robert Rauschenberg, Richard Hamilton and James Turrell have exhibited holograms, the physical works are usually made by technicians. There are few artists who see the making of a hologram as an integral part of their practice. Paula Dawson and Margaret Benyon are exceptions. Both are regarded as pioneers in the area, having made and exhibited holograms for many years.

History and development of holograms

The history and development of holograms, together with the rapid advances in hologram technology during the twentieth century, have resulted in a number of different hologram categories, which are already well documented (Bjelkhagen, 1995; Holophile, 2012; Wikipedia, 2012). This paper will deal simply with a generic definition of the two broad groups into which the examples of works taken from the NGA collection fall: *laser transmission* holograms and *reflection* holograms. The Nobel Prize-winning physicist Dennis Gabor made the first holograms (initially called *interferograms*) in the 1940s, announcing his theories and achievements in 1948. But holography had to wait until the invention of the laser in 1960 for its first practical applications, and it was not until 1962 that Yuri Denisyuk made recordings of three-dimensional objects (curved mirrors) in the Soviet Union. The results of these experiments were unsurprisingly named the *Denisyuk, single beam* or *reflection* hologram. Another famous early holographic image was made in the US a little later, 1962–64, by Emmett Leith and Juris Upatnieks. Known as *Train and bird*, it was classed as a *transmission* hologram.

Prior to the invention of the laser there were no light sources of a truly coherent nature – coherent being light comprised of a single wave length, which derives from a single point and is monochromatic. These fixed lasers produce a continuous light wave, whereas pulsed lasers, also developed during the 1960s, emitted powerful bursts of light that made it possible to create holograms of live subjects. Colour holography began with Stephen Benton's white light transmission holography developed at the Polaroid Research Laboratories in 1968. When these *rainbow* holograms are illuminated with a white light, different colours reconstruct different parts of the image at a slightly different angle. As a result the whole image can be seen but its colour varies in a vertical direction, similar to diffraction from a grating.

What is a hologram?

The word hologram comes from the Greek – *hólos* (whole) and *gramma* or *grafē* (message or writing). As Margaret Benyon discusses in her work, one of the most fascinating things about a hologram is that if you break off a piece the whole image is encapsulated in that fragment. She demonstrated this by exhibiting holographic jigsaws with straight rather than interlocking edges. These relied on the ingenuity of the viewer to piece them together using the appropriate angle of the image as the guide for reassembly. Early holograms are reminiscent of the first photographs; each is unique providing an image recorded in an emulsion on a photographic plate or film. Recalling the fixed poses of early photography, these holograms required absolute stillness, both in their method and from their subjects. Fine grain, silver halide, gelatin photographic emulsions and dichromated gelatin emulsions were commonly used. These were subject to a variety of processing techniques, which invariably included chemical bleaching – a vital step, since it ensures high diffraction efficiency and, therefore, brightness. A hologram is usually made in low light or a different colour light to that of the laser.

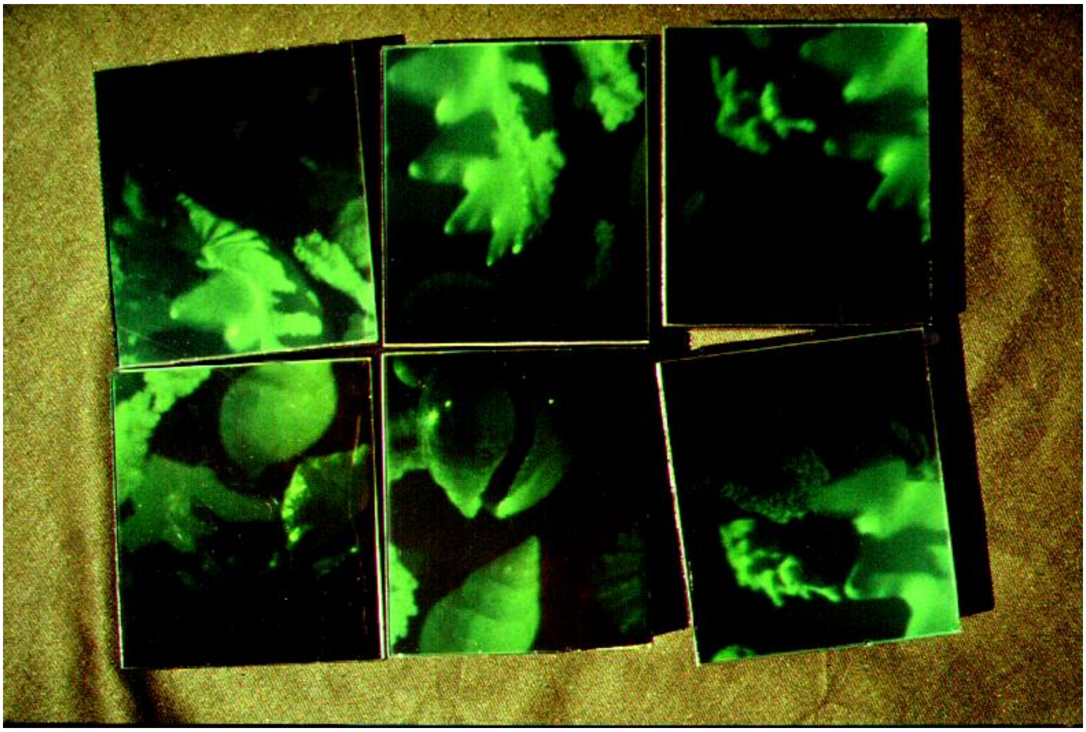

Fig. 1. Margaret Benyon, *hologram 'jigsaw'*, © Margaret Benyon.

To make a hologram, a laser is used for illumination with the single beam being divided in two using a beam splitter. One laser beam illuminates the subject; the subject diffracts this light, which then reaches the sensitised emulsion in scattered form. The other part of the laser beam is the reference beam and falls directly onto the plate or film. The light waves of these two sets of laser beams interfere as they recombine and this interference pattern is recorded on the emulsion layer. Development methods are similar to traditional photographic processing. Once developed, with a reflection hologram an image will be apparent; but in a transmission hologram only a series of soft wavy lines is visible on the plate. This bears no resemblance to the original subject and is not visible as an image but would be comparable to the compression of sound onto a CD. This holographic image is only decoded when a laser, of exactly the same intensity and at the precise angle to that used when it was made, is directed to illuminate it.

No lens is involved in recording either image, although a lens may be used to diverge the laser beam. Mirrors are used to manipulate the laser beams appropriately. This is a first generation, master hologram where the image is always virtual. Like a photograph printed from a negative, at this point another holographic image can be made or modified through transfer. A reflection hologram is made by placing the sensitised plate or film in front of the subject and illuminating the subject through this. A transmission hologram is made by placing the plate or film immediately behind the subject. Holograms can be made on a wide range of substrates, most commonly glass and film (tri-acetate or polyester) or film laminated to glass, but foil, metal and hard plastic are also used.

Making a hologram

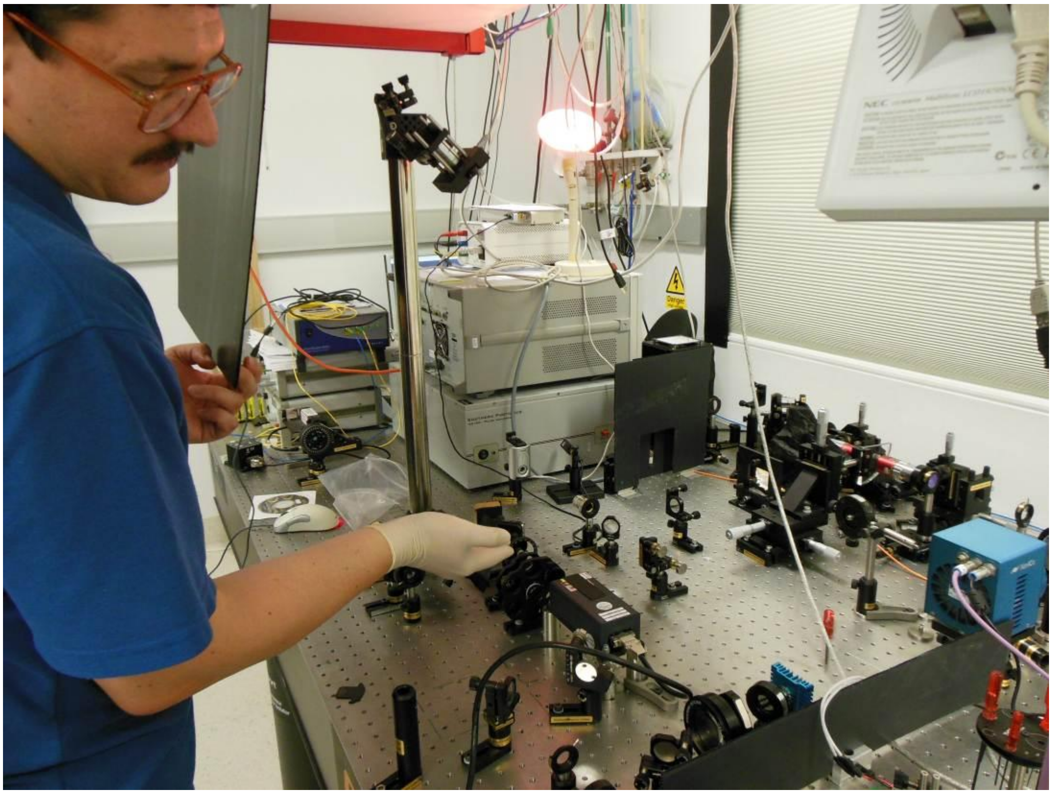

Fig. 2. Dr Alex Minovich, Research Fellow, Nonlinear Physics Centre, Australian National University, checking the equipment used to make a hologram.

To further understand the process, physicist and research fellow at the Australian National University (ANU), Alex Minovitch, was consulted; and with Alex's assistance, two simple Denisyuk reflectance holograms were made. A fixed green laser was directed through a series of filters and an attenuator in order to reduce the intensity of the beam to the correct level. The laser was reflected by means of a mirror to a microscope objective to diverge the beam onto the subject (a shell). The laser was checked throughout the process using a computer to ensure that it remained cohesive. Paper was placed in front of the plate holder to ensure that the laser was directed correctly. The appropriate low light level for the process was achieved using a traditional red, dark room light. A commercially prepared glass holographic plate was inserted into the holder and placed in front of the subject and exposed to the laser beam for 5 seconds. Once exposed the plate was developed and fixed according to the manufacturer's instructions. This was 2 minutes agitation in the developer, during which time the plate darkened, then a 20 second wash in water, followed by bleaching (and fixing) until the plate became clear; this took less than a minute and was followed by another 20 second wash in water. The plate was then allowed to dry. The chemical bleaching ensures brightness.

Display

Holograms are displayed in either transmission or reflectance states. Transmission holograms, illuminated using a laser, where the laser reconstructs the original image, must have the light source opposite the viewer and thus also opposite the original light source. This means that extreme care has to be taken to avoid having the laser reach the viewer's eyes. This can involve having a specialist such as a physicist on hand to advise. Transmission hologram display was previously complicated by the expensive, fragile, high powered lasers that were required. Lasers are now ubiquitous; small, relatively robust and mass produced at low cost. Reflection holograms are illuminated using a white light source on the same side as the viewer. In addition to considering the nature and intensity of this light source, its height, angle and divergence from the work are also critical. In positioning the hologram on display, correct viewing distance and height, again, may make the difference between seeing the image clearly and not seeing it at all. Most holograms benefit from display in darker-than-usual gallery spaces; this cannot be created by adjusting the lighting on the object, which is a fixed requirement, but conditions can be modified by the introduction of screens, curtains and lowered or absent ambient lighting.

Permanence and deterioration of holograms

Holograms are complex objects. There are a number of factors that could affect their permanence and should be taken into consideration prior to any conservation treatment. Although there is a plethora of literature about the history, development, manufacture and application of holograms there is little written on hologram preservation and much of it is based on guidelines for photographs. Holograms do have many physical similarities to photographs and so comparable considerations can apply. Until fairly recently, the recording materials used most frequently for large, high-quality holograms were silver halides because of their light sensitivity and their commercial availability. Early holograms were prepared individually but, once the technology became more widespread, commercially prepared products became available through the large photographic companies. Since the advent of digital imaging these materials have become more or less obsolete.

The type of support, the emulsion, the nature of the light-sensitive material, and development and processing will all contribute to the quality and permanence of the final work. As holograms are also routinely bleached as part of the processing, this should be taken into account when considering their longevity. Writers described deterioration in holograms as early as 1986, undertaking testing that relied on similar parameters established in testing for photographic deterioration. Accelerated ageing indicated that there was a change in silver particle morphology and that hologram deterioration was largely catalysed by residual processing chemicals, accentuated by the small developed grain size in the image silver, resulting in a loss of resolution. (Brown and Jacobson, 1986). From this information it could also be anticipated that holograms will react to environmental pollutants in much the same way as black-and-white silver gelatin photographs. Deterioration that can be expected in holograms includes mould, bloom, delamination and cracking in the emulsion layer, changes in the image colour and total image loss; this final point relates in particular to product defects in batches of holographic film. (Orr, 2012).

Consideration needs to be given to whether or not the hologram should or could be taken apart. Holograms are sometimes displayed on a single support layer with the emulsion exposed. The exposed emulsion will then be subject to mechanical and environmental damage, but remains available for interventive treatment such as surface cleaning or consolidation of the gelatin layer. There is much concern amongst holographic artists regarding the potential swelling of the gelatin layer in high RH, which can encourage mould growth and may cause distortion, interference and colour changes in the image. For reflection holograms, colour change is a common problem, particularly a shift from red to blue; while yellow images can change from a gold hue to green. It has been suggested that this colour change is closely related to the thickness of the gelatin layer; swelling can cause a red shift and shrinkage a blue shift. It has been noted that this colour shift can be corrected simply by returning the hologram to optimum RH. (Orr, 2012). However, it has been suggested, that long term exposure to light can also cause this shift from red to blue, and that this change can be irreversible, as a result of permanent shrinkage of the gelatin in the emulsion layer. (Orr, 2012) While on display, holograms require continuous and intense lighting, outside the normal parameters of gallery conditions. In addition to light, heat can also contribute to deterioration, particularly when combined with chemical residues in the emulsion, which can cause instability and result in darkening of the image. (Bjelkhagen, 1995). Heat is particularly a problem for holograms with a black backing, so lighting of negligible heat as well as UV emission should be chosen.

This might explain the preference in the literature for holograms to be sealed in some way after production. At its simplest level this might mean putting the work into a frame behind glazing, but a wide variety of techniques are recommended for this purpose and the conservator should expect to encounter these. Recommendations include covering holograms on glass with another glass sheet – sometimes this is just placed on top, but it can be adhered with a variety of materials, with references in the literature including optical or UV-cured cements, epoxy, silicone, Canada balsam, commercial lacquers and plastic sprays. Improved resolution by reducing interference and matching the refractive indices of the various layers was a consideration. One of the best methods for achieving this was to adhere the still wet, swollen emulsion of the hologram to another cover layer; in the case of a transmission hologram on glass, this would be another layer of glass. In a similar way, holograms on film might be laminated with another plastic film or to glass. (Bjelkhagen, 1995). Reflection holograms often have one side blackened; easily done by placing black card, self-adhesive black vinyl or similar behind the film or plate. However, it was routine to include black paint on the emulsion side or the back of the support or even to use chemical blackening. Proprietary formula paints, or screen-printing inks, matching the refractive index of the emulsion layer were commonly recommended. Oil paints were to be avoided as it was recognised that these might penetrate the emulsion layer or off-gas chemicals such as peroxides, which would have a deleterious effect on the hologram. (Bjelkhagen, 1995). It has been suggested that darkening in the image, overall or in isolated areas, can result from chemical contamination related to these mounting processes. (Orr, 2012).

Paula Dawson

Australian artist, Paula Dawson is interested in movement, time and memory and it was involvement with her seminal work in the NGA collection, *There's no place like home,* that initiated this investigation into holograms. Her early work was conceptual, combining painting and dance; she trained in classical ballet. Dawson became interested in interference patterns, initially derived from 'sculptural' explosions, carried out using real dynamite, and these experiments led her directly into work with holograms.

Fig. 3. Paula Dawson, *There's no place like home,* 1979-80, laser transmission hologram on glass, National Gallery of Australia, © Paula Dawson.

There's no place like home is a laser transmission hologram. It represents the cluttered interior of a suburban home. The hologram requires a mock room to be built for exhibition, appearing as a window, which the viewer can choose to either look through or walk behind to experience the reality of the empty room. The title refers to the 1939 movie *The Wizard of Oz,* in which Dorothy clicks the heels of her ruby slippers and wishes herself home. It has been observed that, '*There's no place like home* blurs the boundaries between illusion and reality, just as Dorothy's trip down the Yellow Brick Road happily melded the world of dreams and the people of real life into a Technicolour land of magic.' (Gellatly, 1999). While an enduring fascination with time is central to this work, it also alludes to Dawson's interest in mnemonic memory. The generic objects of the interior (already outdated when the work was made) are there as visual aids to evoke individual recollections; as she says, 'Memory is a soft and seductive thing.' (Davis and Ramsey, 2010).

The work was completed when Dawson was artist in residence at the Laboratoire d'Optique de l'Université de Franche-Comte in Besançon, France, in 1979–80. At the time it was the largest hologram ever made (1500mm x 950mm x 80mm). Lack of other practicing holographers led her to be creative with the technical process and to find different contexts in which to place her art; collaborating with a wide range of scientists and technicians over the course of her career, incorporating new holographic methods and materials as they evolved. Dawson has remained as completely engaged with the technical aspects of her work as she is with the artistic concerns, believing this to be integral to the creative process, writing, 'The sensitivity and dexterity of the holographer's hands are vital…the holographer's craft shares the flexibility and immediacy of physical manipulation with the techniques of the painter, rather than those of other *technology* artists…' (Davis and Ramsey, 2010).

There's no place like home has exceptional resolution and spatial representation. It comprises two sheets of glass, one of which is coated with emulsion and contains the holographic image, while the other sheet is a cover. The two sheets of glass are adhered at the edges with wide black plastic self-adhesive tape. No image is visible, only fine interference lines, similar to moiré patterns, which makes it a little disconcerting to condition report. When the work was called for loan in 2010 it had already been in storage for more than ten years. This is not uncommon for holograms, particularly transmission holograms, as the cost and complications of installation usually condemn them to infrequent display. Unfortunately the foam in the specially designed aluminium crate supplied by the artist had deteriorated dramatically. The work was photographed and documented at this point and the foam and resulting sticky residue successfully removed mechanically. The exterior of the glass on both sides was then carefully surface cleaned with 50:50 ethanol and water, and lint-free cloth, taking care to avoid the very edges and the black tape.

Cleaning made closer examination possible. It was found that three distinct types of deposit could be seen under magnification in between the two layers of glass. These included a whitish bloom with features similar to mould growth, an efflorescence that appeared more particulate, and some small roundish areas, which looked as if fluid was trapped between the layers. As the lead time for the loan was fairly short and our familiarity with this complex work was limited, it was decided to leave it intact for the short term. The magnified deposits appeared largely amorphous in structure and in theory, therefore, should not interfere with the transmission of the image. The major concern was whether or not the work would be viewable once installed in the exhibition – particularly given its significance to the artist and its important place in her body of work. Although a laser is essential for display, the work was acquired without this provision, as at the time, lasers were fairly large, complex, easily damaged, expensive pieces of equipment. So it was not possible to test the image prior to installation. Fortunately, the artist was able to provide accurate installation details, including the intensity of the laser and the exact angle of illumination.

Working together with the artist and physicists from Macquarie University the hologram was safely installed and successfully lit. Problems of potential deterioration and proposed treatment were discussed. The artist opposed the idea of taking the hologram apart. She believed that she had used optical cement between the layers of glass and was not convinced that the sheets could be successfully separated. She was, however, happy to be consulted on any future investigations that took place.

Margaret Benyon

The British artist Margaret Benyon, the first woman to use holography in art practice, spent an extended period in Australia during the late 1970s, making a number of Australian-themed holograms; returning to live here in 2005. Benyon made her holograms during the period 1960–2009. Thirteen are in the National Collection, acquired over a thirty-year period between 1979 and 2012, and include *Hot air*, a significant early laser transmission hologram made in 1970 and acquired in 1979.

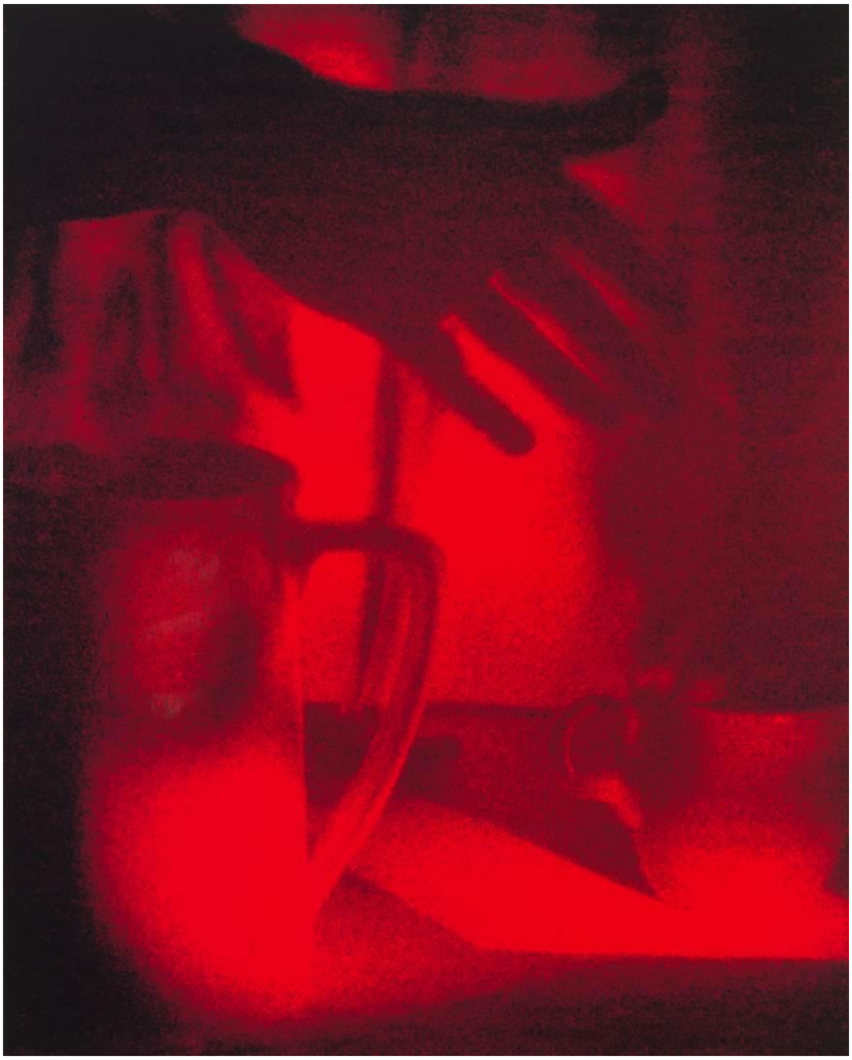

Fig. 4. Margaret Benyon *Hot Air,* 1970, laser transmission hologram on glass, National Gallery of Australia, © Margaret Benyon.

Margaret Benyon trained as a painter and while at the Slade School of Art in London in the early sixties experimented with the Op Art being popularised at the time. Concerned with the representation of three-dimensions on a two-dimensional canvas, she read about holography in a newspaper article in 1967 and was attracted as much as by the technical challenges as the creative solutions it might offer. Working in the medium at this early stage of its development, while exciting, meant that Benyon had to lead the way as both an artist and a technician. Like Dawson, she is fascinated by the merging of reality and illusion, writing, 'We are like Alice, on the other side of the mirror. The hologram serves to remind us that notions such as left and right are one-dimensional and are determined by an arbitrary act of choice.' (Benyon, 2009). She regards making a hologram in much the same way as any creative process; '…it is possible to work through a number of stages. There is the choice of fabrication of objects to be holographed, through test plates to final exposure and even further manipulation of the piece, either in the way it is shown or combined with other media.' (Benyon, 2009).

The other twelve works by Benyon in the collection are reflection holograms, either Denisyuk, single-frame holograms, or multi-frame holograms. They include collage and paint, engraved drawings and integral frames. Two works will be discussed – *Hot air* and *Pushing up the daisies*. *Hot air* is denoted by the artist as a non-hologram, sometimes called a shadowgram. It is a small laser transmission hologram on one sheet of glass; essentially a still life, but capturing the shadow of a hand and currents of hot air not normally visible with the naked eye. These appear black in the hologram because the lasers available at the time could not record subjects that moved even a fraction. The work has had two previous acrylic frames. The original artist's frame was damaged and the artist replaced it when the work went on loan to the US. The second acrylic frame was made by the NGA to the artist's specifications; this has since been lost. Correspondence with the artist confirmed that the work had been extensively exhibited prior to being acquired by the NGA and that it was already showing signs of deterioration when it was loaned to the artist for exhibition in New York in 1980. The artist believed that the surface contamination was due to poor processing, and washed the work prior to exhibiting it. The work is currently housed in an acid-free board folder in a solander box and has never been on display at the NGA. The laser required to exhibit the work, the lighting parameters and OH&S concerns have been a major obstacle to its display. Recently, working with the physicists at ANU the hologram was held in a temporary frame and successfully lit sufficiently to see the image. This work continues in order to establish lighting parameters and look more closely at the work. Initially a new frame will be constructed and then a more powerful selection of lasers will be trialled to establish the most effective way in which to reconstruct the image. As laser equipment is now much more accessible in terms of cost, size and safety, it is hoped that a laser can be purchased so that the complications associated with displaying this work can be reduced. It is anticipated that procedures will also be established for the use of lasers with works of art.

Pushing up the daisies, made in 1996, is a fairly large hologram (800mm x 600mm) depicting a soldier with flowers around his helmet. Gael Newton, Senior Curator of Photography at the NGA, has written that the work is a commentary on modern warfare, inhuman in its scale and complex technologies. The text borrows the well-known euphemism for being dead – 'pushing up the daisies' – from Wilfred Owen's First World War poem *A terre*. It is a collage of two holograms on film adhered to black card with added printed text. It was created by making laser transmission master holograms of a soldier and daisies with a pulsed laser; these were then transferred to reflection format at a later stage. The artist describes how she removed the emulsion from the edges of the work to allow an optical cement to be used on the film to adhere it to the black card. The frame and glazing arrangement are all original as made by the artist.

Fig. 5. Margaret Benyon *Pushing up the Daisies,* 1996, collage of two reflectance holograms on film with printed text. National Gallery of Australia, © Margaret Benyon.

Pushing up the daisies was called for loan in March 2012. There were a number of conservation questions, affecting both the long-term and short-term condition and stability of the work. Unfortunately a white bloom was evident on the interior of the glazing and the edges of the glass had been ground against the metal frame, so small fragments of glass were apparent throughout the work. The metal frame was flimsy and the backboard was Masonite. The package was unsealed and free to move within the frame. The two holographic films were directly against the glass glazing. This presented a number of questions for the artist. Could the frame be replaced with an alternative? Could the frame be modified so that better conditions for the work could be achieved? Did the work have to be against the glazing to achieve the correct reflectance? Was glass absolutely necessary or would acrylic glazing have a similar refractive index and behaviour to allow the image to be seen? Could the Masonite backboard be disposed of? What was the efflorescence? Had the film been processed adequately? How had the film been processed? Were the auxiliary elements off-gassing and causing breakdown in the image or film? Would sealing the frame more adequately. exacerbate this deterioration? Once some of these questions were answered, the information could possibly be applied to other works in the collection exhibiting similar problems.

The artist was contacted and insisted that the work remain entirely as is. So documentation and photography were completed and it was deframed. The fragments of glass were removed from the surface of the holographic film with tweezers and a soft brush. The glass glazing was cleaned with 50:50 IMS and water and the whole reassembled to include the Masonite backboard, ready to go back into the frame. Filmoplast P90 tape was used to seal the edges of this package. Further liaison with the artist is on-going as Benyon has suggested this work as the model for framing four new acquisitions – the *Web blue web* series – which are reflection holograms on film. It is hoped that during this process a compromise can be reached, enabling more stable materials to be used, and some answers can be provided to the many questions raised.

Conclusion

While holography may not have blossomed in the manner predicted, it remains integral to art, science and medicine. Holographic exhibitions are unlikely to replace the experience of viewing the original works for many people but the concept remains intriguing and it is possible that virtual exhibitions will be acceptable to future generations who are increasingly at ease with technological simulations. Exhibitions where holograms replace the fragile originals have been attempted previously; most recently the British Museum collaborated with other institutions in the UK, using the latest colour hologram technology, to develop an exhibition, which travelled to a number of locations in Wales. Known as *Bringing the artifacts back to the people*, the project allowed a number of extremely rare pieces, including a 14,000-year-old horse jawbone to be seen (albeit in holographic form) outside their institutions.

There is continuing interest in holographic art in its own right, with an exhibition of holograms in New York as recently as 2012; 'Pictures from the Moon: Artists' Holograms 1969–2008,' at New York's New Museum for Contemporary Art, featured holograms by Bruce Nauman, Louise Bourgeois, Eric Orr, Ed Ruscha, and James Turrell. The exhibition was promoted as offering '…a view of the persistent attempts by artists to wrest something more from technology than that for which it was invented…the enduring hologram continues to mesmerize by expanding the artistic and visual fields that lay before our eyes.' (Moore, 2013). These many fascinations that holograms provoke are perhaps best summarised by Paula Dawson quoting one of her favourite authors, Vladimir Nabokov, who wrote about 'Transparent things, through which the past shines!' (Davis and Ramsey, 2010). The advances in hologram technology, like many areas of conservation, exceed our ability to anticipate preservation requirements, and present constant challenges. At the

NGA we hope to continue to collaborate with artists and scientists to complete further investigation and analysis of holographic works in the collection.

Acknowledgements

I would like to thank Margaret Benyon, Paula Dawson, Robyn Beeche and Edwina Orr; Dr Alex Minovich, Research Fellow, Nonlinear Physics Centre, ANU, and Associate Professor Dragomir Neshev, QEII Fellow, Nonlinear Physics Centre, ANU, for assistance with technical information; NGA conservators Fiona Kemp, James Ward and Rose Peel for frequent and helpful discussion; Gael Newton, Senior Curator of Photography, NGA, and Anne O'Hehir, Curator of Photography, NGA, for guidance and assistance, and Gillian Currie, Research Library, NGA, for advice and reference material.

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Abstract: The Effect of Environmental Pollutants on the Deterioration of the Daguerreotype Image

Robyn E. Hodgkins, Silvia A. Centeno, and Alejandro G. Schrott

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

The sensitivity of the daguerreotype image to light and environmental pollutants, such as sulfur- and chlorine-containing compounds, as well as to damage by mechanical and chemical cleaning, has been previously reported and discussed [1-3]. To further characterize the formation of deterioration products frequently found in historic and artistic plates, test samples prepared following 19th century daguerreotype recipes were exposed to either chlorine or sulfur-containing environments. Original daguerreotypes and the exposed samples were analyzed using Raman spectroscopy and ultra-high resolution SEM-EDS, and deterioration products, such as silver chloride, silver sulfide, and silver oxide, were identified and characterized by these techniques. To assess the photoreactivity of the deterioration products, laboratory samples exposed to pollutants were illuminated using a micro-fading tester and monitored by diffuse reflectance. The areas exposed to light were subsequently analyzed by Raman spectroscopy and SEM-EDS to evaluate the chemical and physical changes. The illumination tests confirmed that the deterioration is light sensitive. Additionally, results from a modified Oddy test on silver corrosion sensors recently developed to assess replacement daguerreotype housing materials will be reported.

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Using Electron Back Scattered Diffraction (EBSD) & Energy Dispersive Spectrometry (EDS) to Characterize the Surface of 19th Century and Modern Daguerreotypes

Patrick Ravines, Lisa H. Chan, Matt Nowell and Rob McElroy

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

The daguerreotype is unlike any other of the many silver-based black and white photographic processes. The daguerreotype is an image that rests on the surface of a highly polished silvered copper plate. The final stage of the daguerreotype process is to affix the silver-mercury amalgam image particles to the plate by passive electrochemical coating with a thin gold film. Even though gold is a noble metal, tarnishing readily occurs on all of the components of the daguerreotype, namely the image particles and the background surface. Previous studies have suggested a correlation between the chemistry and morphology of the corrosion product or tarnish (Daffner et al. 1996; Gregory et al. 2007, Centeno et al. 2008).

This work presents a study of 19th century and modern contemporary daguerreotypes as seen in figure 1 using the two microanalysis techniques of energy dispersive X-ray spectroscopy (EDS) and, for the first time, electron backscatter diffraction (EBSD). While EDS provides the chemical composition, EBSD provides the microstructural and crystallographic information of a material.

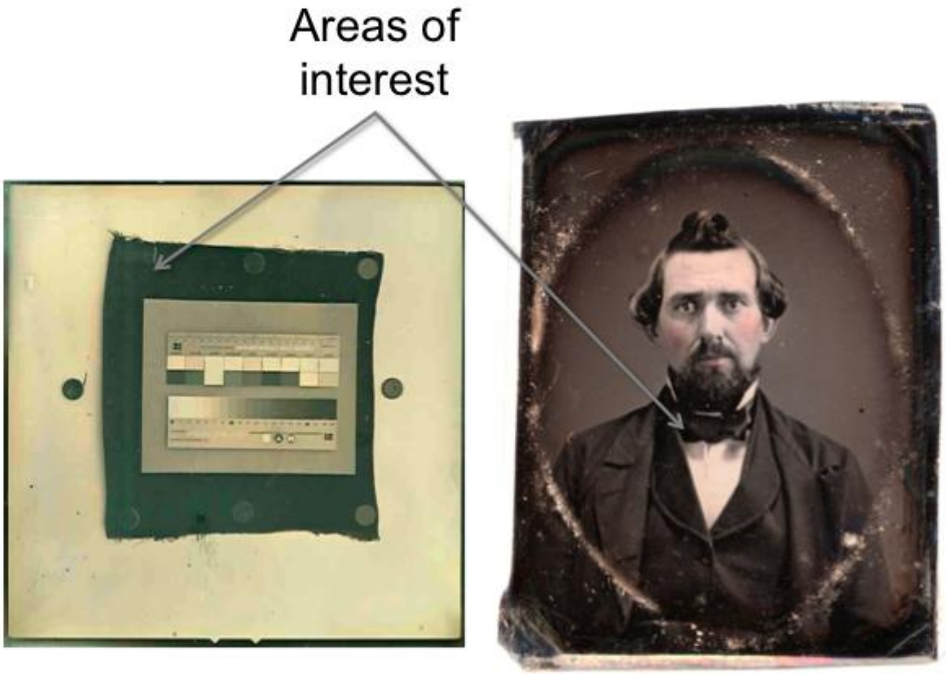

Fig. 1. Modern and 19th century daguerreotypes used in this study and the dark shadow areas of interest in both.

Even though the 19th century daguerreotype contains organic contamination, no cleaning procedure can be performed, as such cleaning actions could permanently remove image particles residing on the surface of the silvered copper plate. For this analysis, the daguerreotypes were not polished or cleaned prior to being tilted to 70 degrees in a Phillips XL-30 field-emission scanning electron microscope. An EDAX Hikari Camera and Apollo X silicon drift detector were used to collect EBSD and EDS information.

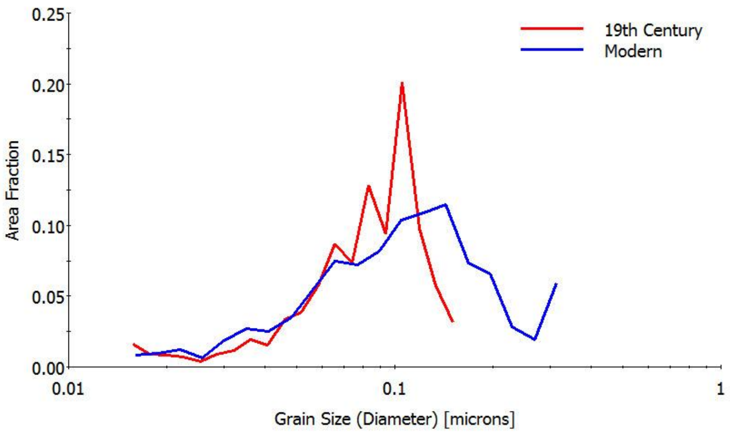

Fig. 2. Grain size distribution of the 19th century (red) and the modern daguerreotypes (blue). The average grain sizes were 86 nm for the 19th c daguerreotype and 121 nm for the modern one.

The grain size distribution of the 19th century daguerreotype is very different from that of the modern daguerreotype, as seen in figure 2, with the average grain size being 86 nm and 121 nm. The orientation data from each of the daguerreotypes can be seen in figure 3. Even though no preferential orientation distribution was observed, the orientation distributions are very similar between the 19th century and modern daguerreotypes. The ability to correlate chemical and crystallographic information with microstructural features provides the potential to explain the occurrence of tarnish as corrosion in the intergranular boundaries of gold grains on gilded daguerreotype surfaces. The similarities between modem and historic daguerreotypes also indicate that the modern daguerreotype making process is a good approximation of historic plates and, therefore, can serve as surrogates for further study.

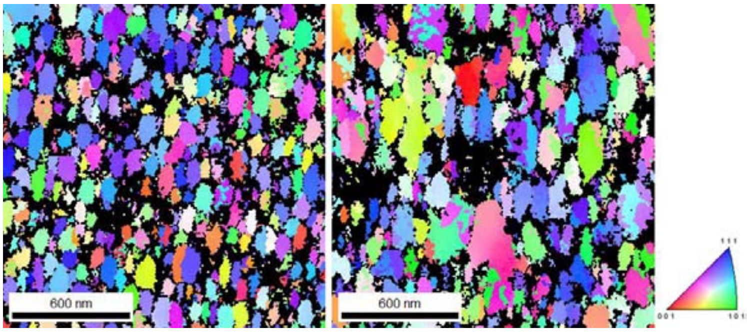

Fig. 3. EBSD inverse pole figure (IPF) maps of the 19th century (left) and the modern (right) daguerreotypes. The IPF maps color each measurement point according to the stereographic triangle showing the crystal directions that are parallel with the sample normal direction.

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A Summary of the National Science Foundation (SCIART) Supported Research of the Daguerreotype: George Eastman House International Museum of Photography and Film, and the University of Rochester

Ralph Wiegandt, Dr. Nicholas Bigelow, and Brian McIntyre

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Abstract:

Scientific advances in the chemistry and physics of nano-scale materials, especially silver and gold, require reconsideration of our material understanding of the daguerreotype.

As molecular structures approach dimensions of several hundred nanometers and smaller, their nano-scale surface properties become increasingly dominant, which differ significantly from their bulk material properties. Research undertaken in this initiative suggests that the daguerreotype image and its degradation exhibit predominately these nano-scale physical properties. This paper presents a nanometer scale investigation of the daguerreotype and its profound conservation implications.

Micron scale and macro properties of metals have been the basis for commonly held explanations of image formation, tarnish, oxidation, and environmental deterioration. Consequently, daguerreotype restorative treatments and preservation methods, both historically and currently, appear to alter the original structure in the former, and are inadequate for preventing progressive deterioration in the latter.

Taking into account the expanding body of research on the unique physical and optical properties of silver and gold, and to a lesser extent copper and mercury, we apply this recent research to our investigation of the daguerreotype. This paper proposes new explanations for the extraordinary bio-receptivity of the daguerreotype surface, and the optical effects that occur when gold and silver nanoparticles have dimensions considerably smaller than the wavelength of the visible light spectrum.

The intent of this paper is to alert the community of photograph conservators to the reactivity of the daguerreotype's highly nano-structured surface composed of silver and gold and their unique nano properties; and to propose new preservation strategies that can halt the nearly undetectable nano-level deterioration before it advances to micro and macro stages.

Introduction:

A National Science Foundation award through the SCIART program (Chemistry and Material Science at the Interface of Science and Art), was awarded to the University of Rochester in collaboration with George Eastman House International Museum of Photography and Film in 2009. The grand conservation challenge of this award is to advance the material science understanding of this extraordinary earliest photographic medium, and to research its complex deterioration responses.

George Eastman House holds one of the world's largest and most diverse collections of daguerreotypes, associated artifacts, and archives. It serves as an international resource for the history and study of the daguerreotype. The University of Rochester is a leading research university for optics, material science, and nanotechnology. The URnanocenter provides the instrumentation and expertise necessary to research the complex physical and chemical make-up of the daguerreotype.

The daguerreotype is considered to be the first commercially successful photographic process. It was practiced widely from 1840 through 1860, primarily in Europe and America. Invented in France by Louis Daguerre in 1839, the process achieved its technical maturity within five years. The daguerreotype's intrinsic high resolution and unique image forming properties have been of continued wonder and scientific interest from its inception.

The daguerreotype is the result of the irrepressible human trait of manipulating materials to create new forms that occasionally lead to discoveries that alter the course of human history. Daguerre's discovery burst onto the scene as the first truly engineered nanoparticle substrate, and from its unlikely emergence in 1839, it has required nearly 160 years of scientific advancement to unlock its secrets. Although the nano-optical properties of colloidal gold, silver, and other metals were known to Roman glass makers, medieval stained glass artisans, and later by producers of luminescent ceramic glazes; it is the daguerreotype that manifests the multitude of physico-chemical characteristics explainable only by emergent research in 21st C. nanosciences.

The paper addresses three primary themes of this research:

I. The daguerreotype is an artifact of nanotechnology

II. A daguerreotype is archaeological. It has recorded events that have happened to it or in its close proximity since its "first light". *[The term "first light" is defined as the initiation photons that exposed and created the image, and the light reflected by which the daguerreotype was first viewed after processing. We are considering this view as the daguerreotype's original state, or original condition.]*

III. Conservators should be advancing methods to preserve and protect the residual evidence of the daguerreotype's original state at first light.

[Note: this paper will not go into an explanation of the daguerreotype process, that information is widely available from many published sources.]

How is a daguerreotype an artifact of nanotechnology? *Nano* (from the Greek for dwarf) as in nano-technology or nano-science, is the size at which surface physical properties dominate in discrete structures that have at least one dimension between one nanometer and 100nm. A nanometer is one billionth of a meter; a human hair averages 30,000 nanometers in width.

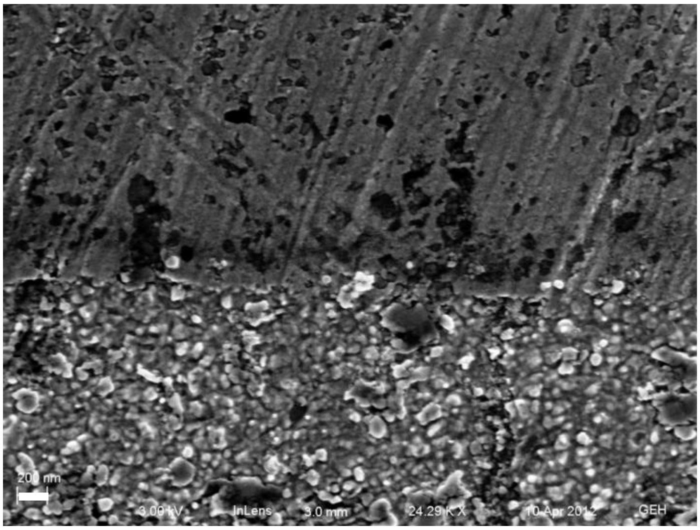

Fig. 1. SEM micrograph of a partially iodine-etched silver test coupon; scale bar is 200nm: section of a silver coupon coated with a lacquer barrier coating.

A daguerreotype becomes a nanostructured substrate by the act of sensitization. The silver halide layer that forms by oxidation when exposed to iodine, bromine, or chlorine vapors and subsequently removed (fixed) by sodium thiosulfate, creates a nano-structured surface.

Figure 1 is a scanning electron micrograph (SEM) of a silver coupon used for modern daguerreotypes: pure silver roll cladding over copper. It was roughly polished overall. The upper half was protected with a coating of lacquer prior to the sensitization and fixing steps.

1. The coupon was placed over iodine crystals in a fuming box for approximately 80 seconds to form a first order yellow-magenta interference color at grazing incidence viewing angle of silver iodide (approximately 250 nm thick). It was not exposed to light.

2. The silver iodide layer was removed in a standard photographic fixing solution of 5% sodium thiosulfate in distilled water, and immersion rinsed and dried.

3. The lacquer coating was removed by solvent.

4. The resulting SEM micrograph shows the effect of the exposure to iodine vapor that formed a layer of silver iodide, that when removed, left behind a highly granular etched silver surface structure with highly three dimensional features ranging from <10nm to 100nm.

5. Although the sample was not exposed to light and mercuralized, this simple test establishes the nanostructure of the daguerreotype. It clearly shows the vast increase in surface area caused by sensitization, and it is the starting point to propose the profound implications these nano features have on all aspects of the daguerreotype: image formation, interactions with light, and deterioration mechanisms.

At the nanoscale we begin to understand daguerreotypes very differently. The metals that constitute the daguerreotype surface: silver, mercury, and gold have physical properties that are different from those we know from their bulk material properties. The properties of materials change as their size approaches the nanoscale and the percentage of atoms at the surface becomes increasingly significant. For material dimensions larger than one micron, the percentage of atoms at the surface is insignificant in relation to the number of atoms in its bulk state. For example, gold, generally considered highly unreactive in its bulk metallic state, but as a nanoparticle its atomic properties predominate and it is highly reactive and acts as a powerful catalyst. Gold nanoparticles complex readily with sulfur compounds (thiols) and with other complexing agents, such as amines. Additionally, the optical properties of the constituent nano-metals of a daguerreotype exhibit localized surface plasmon resonance that is manifested in an exponential increase in light scattering when the frequency of incident light is resonant with oscillation of surface electrons. Other than an empirical interpretation and qualitative observation of this phenomenon, further research is required to determine the specific effects that surface plasmon resonance of silver and gold nanoparticles have on the optical qualities of a daguerreotype. It becomes important to determine how deterioration and/or deliberate interventions may alter these intrinsic visual qualities of the nanostructured gold and silver surface. This remains a yet to be characterized aspect of the daguerreotype, but one that must be considered as significant to original condition if "first light" is to be preserved, or perhaps regained in some future time through technologies yet to be invented.

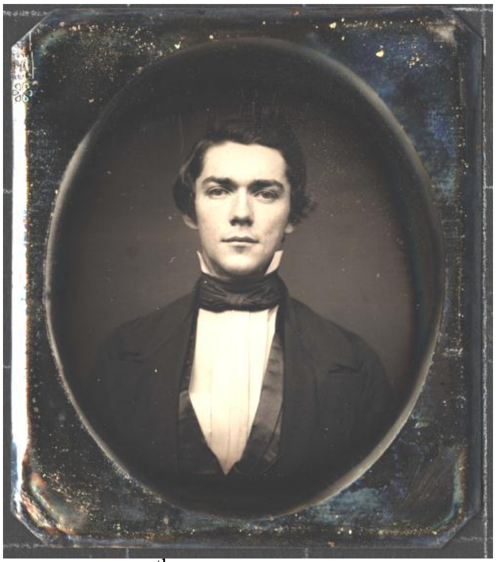

Fig. 2. 6th plate (3.25" x 2.5").

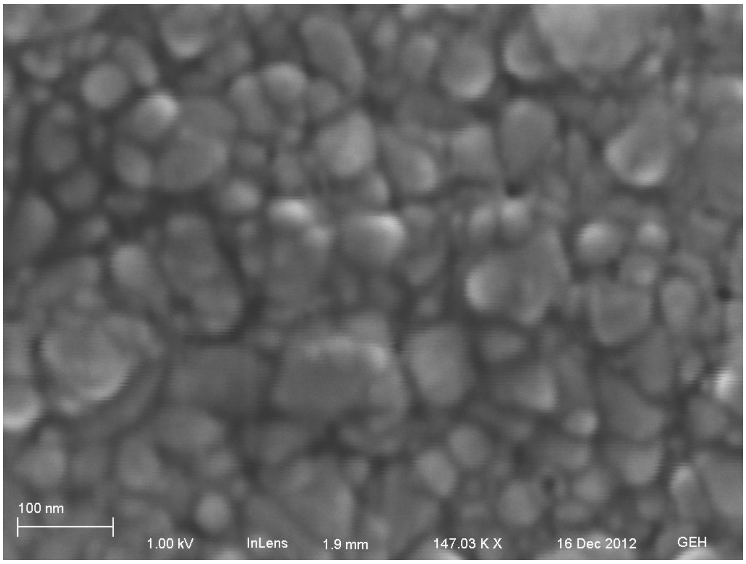

Fig. 3. SEM micrograph of the surface at 147 KX.

Figures 2 and 3 are of a daguerreotype in the Eastman House study collection that was extensively examined and analyzed by SEM. The plate is in excellent condition, and its preserver appeared to have not been opened. Figure 3 shows the surface 147,000 times magnified. This micrograph confirms the fundamental nanostructure of an historic daguerreotype, one that is both in excellent condition and demonstrates excellent mastery of process by the maker. The maker and sitter are unknown.

Biological Activity Found on the Daguerreotypes is a Function of Nanoscale Properties

The daguerreotype nanostructured surface is a fertile host for biological assembly and propagation. The constituent metals of a daguerreotype, as nano-particles, are capable of assembling organo-metallic structures and interacting with life chemistry. Current nanoscience research in the fields of bio-chemistry; bio-medicine; bio-engineering, bio-physics and others are demonstrating how the precise size, shape, and functional properties of metallic nanoparticles can lead to technological breakthroughs. Research into next generation energy sources; quantum computing; non-linear optics; nano-robotics; targeted cancer detection and treatment… and so on, creates demand for highly engineered nanoparticles –with gold and silver having particular value. Indeed, bio-generated metal nanoparticles are an efficient green pathway for controlled nanoparticle production, as well as a means to produce hybrid organo-metallic structures using biological linkages for bio-mimetic and bio-inspired assemblies of functionalized nano-metallic and nano-organic-metallic devices. This research is a literal goldmine for understanding the daguerreotype and it has been an essential resource in leading us to the reinterpretation of the daguerreotype as an artifact of nanotechnology, one that was serendipitously invented 174 years ago –long before the word *nano* came into parlance.

During those 170 plus years, many (possibly all?) daguerreotypes have served as de-facto petri dishes generating bio-metallic assemblies. The work by the Harvard group (Konkol et al 2011) was the first published experiment in harvesting such a biological sample from a daguerreotype, and successfully incubating, and identifying it as a fungus.

Working from extensive SEM imaging, energy dispersive X-ray (EDX) analysis and transmission electron microscopy (TEM), our group has documented and analyzed more than 50 daguerreotypes and have visually and compositionally confirmed the presence of living, or once living organisms on every one. The astounding variety of structures that have been documented in this research and the interactivity between the daguerreotype metals and associated chemistry has given us a window into a world of bio-metallic eco-diversity. The research cited in allied fields helps provide a plausible explanation for what we have been finding, and the sheer abundance of forms and manifestations of this phenomenon appear limitless.

We are developing a research framework to explain the phenomenon by looking into some essential questions: What are the physico-chemical mechanisms? What are the rates of growth? What was the initial biochemical landscape that initiated the process? We believe answers may have intrinsic scientific value, and profound conservation implications.

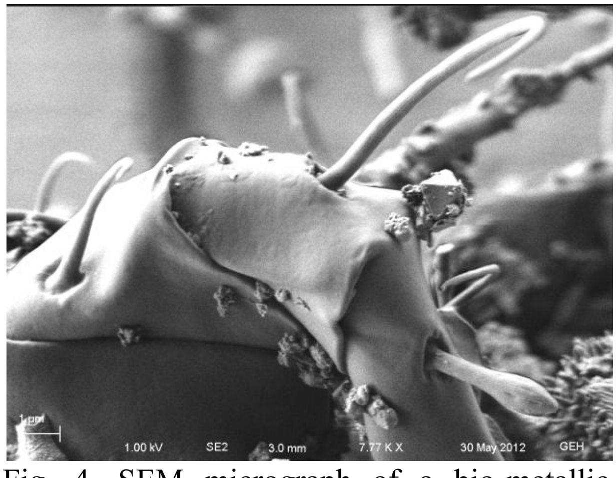

Fig. 4. SEM micrograph of a bio-metallic structure at 7.77 KX.

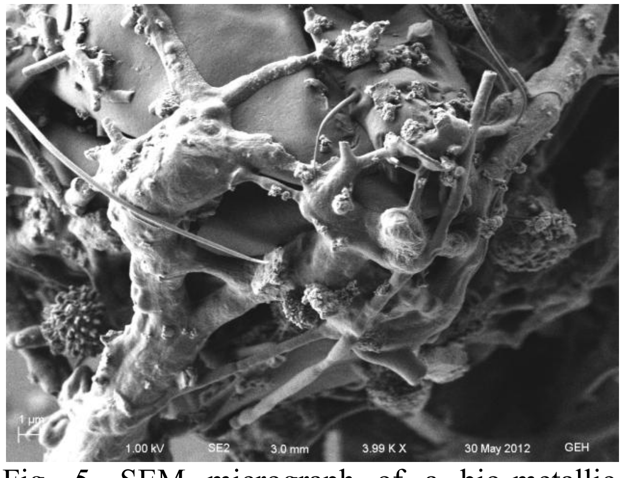

Fig. 5. SEM micrograph of a bio-metallic structure at 3.99 KX.

Figures 4 and 5 demonstrate the complexity of bio-metallic interaction that has been mediated over many years on a daguerreotype within a closed daguerreotype case. Perhaps it hosted multiple fungal, microbial, or any such broadly described biological entities. Maybe it was only a speck or two of dust, but in an adequately humid environment all the ingredients for the inception of nano-metallic biological propagation were present. This is a rather spectacular formation, but our research has catalogued a wide range of variations on this phenomenon. We propose that the complex structure in this example arises from the very specific local chemistry of the plate, the biological organism or organisms engaged, and the surrounding environmental conditions.

SEM examination provides for a visual understanding of the mechanisms by which gold and silver as nanoparticles in a plus (oxidation) state, can be reduced by biological cell contents composed of amino acids, peptides and other biological reducing chemistries. They are then mobilized to be absorbed and aggregated into or onto a biological structure.

Fig. 6. A sixth plate daguerreotype from the Eastman House study collection.

This plate was extensively examined and analyzed by SEM. While appearing to be in moderately good condition, in fact it hosts a generous variety of biological formations widely distributed across the plate.

The rectangle on the sitter's proper right arm delineates an area of biological activity that received examination.

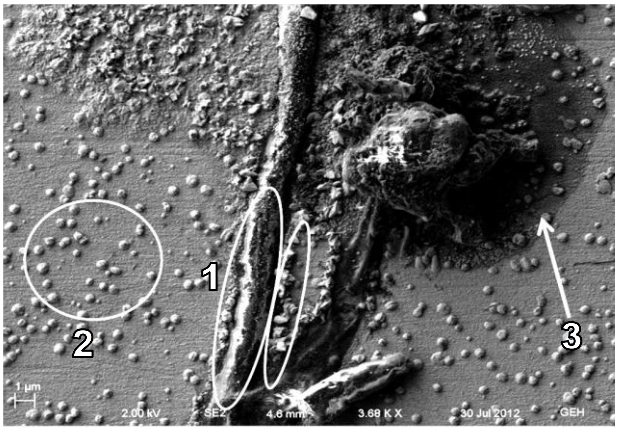

Fig. 7: SEM micrograph, feature at 3.68 KX.

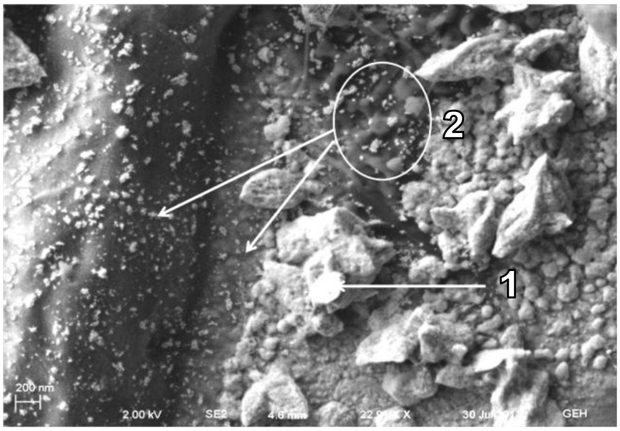

Fig. 8: SEM micrograph, feature at 22.91 KX.

Figure 7 reveals the nature of a commonly found linear carbon and oxygen rich form that we term biological fibers, or biofibers. There are many variations of these fibers found ubiquitously on daguerreotypes; most are engaged with the plate surface. Note the aggregation of particles along the main fiber [1], distinct from image particles [2]; and a surface level non-conducting film extending out from a large carbon rich mass [3].

Figure 8: At higher magnification (scale bar is 200nm), the biofiber surface is populated with nanoparticle aggregations composed of Ag and Au [2]; with similar particles emerging from the carbonaceous matrix (encircled) on the surface. The micron scale, non-uniform particles located along the fiber [2] are sulfur rich Ag crystals (confirmed by EDX analysis) that could well be formed as the moisture rich biological cell structures within the fiber reduces silver sulfide tarnish on the surrounding daguerreotype surface. The reduced silver is complexed within the extending "veil" emanating from the biofiber, and begins to aggregate with adjacent nanoparticles in the bio-matrix. The specific biochemistry and other parameters mobilize and direct the pathway of assembly on or within the biological formation. This explains the rich variation in bio-metallic formations on daguerreotypes, and helps us understand the formation of the characteristic crystalline sulfur particles that have accumulated along the edges of the biological growth, seen in detail in Figure 9 within the area labeled [2]; arrow [1] denotes the organic surface matrix that speculatively reduces the surface metals on a sub-nanometer scale and mobilizes them into the larger fiber structure. Figure 10 is the EDX spectrum of the > 1 micron angular crystals that have accumulated alongside the biofiber.

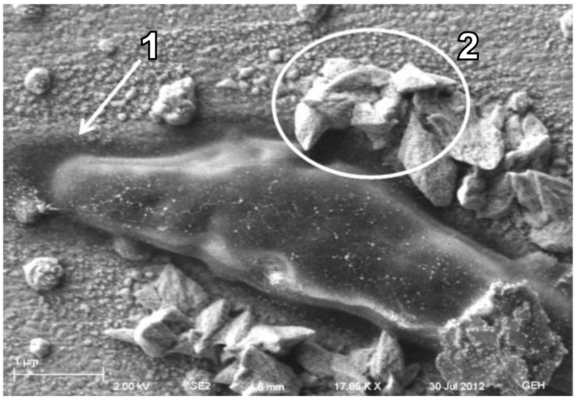

Fig. 9. SEM at 17.85 KX.

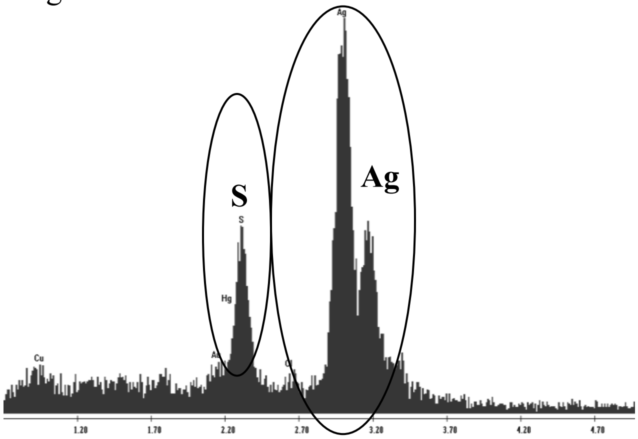

Fig. 10. EDX spectrum of crystals: predominant peaks are sulfur and silver.

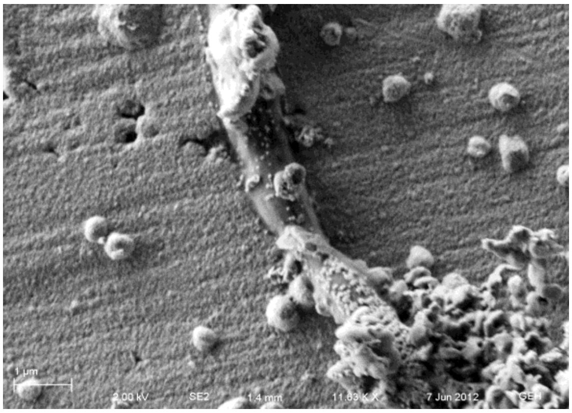

Fig. 10. Biofiber with progressive surface aggregation of Ag and Au nanoparticles.

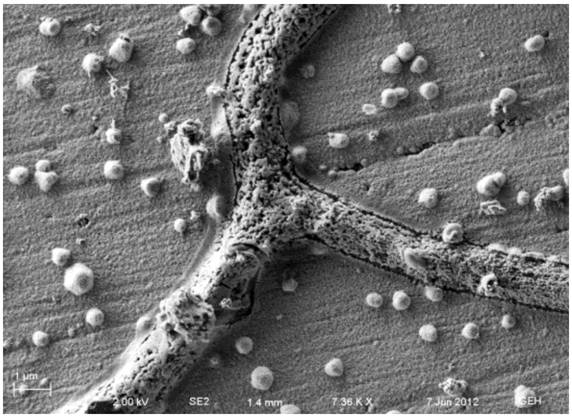

Fig. 11. Region of fiber that is nearly with encased with the aggregated nanoparticles.

The aggregation of metals on the exterior surface of this biofiber is similar to many others in our SEM examinations of daguerreotypes. We find both intracellular and extracellular metal particles; with many forming exterior clusters that appear to continue to agglomerate.

Figures 10 and 11 show Ag/Au nanoparticles fully mobilized through the biofiber, and completely covering a section in Figure 11. Note the edges of the fibers have a fully metallicized surface engagement corresponding to the organic “veil” noted in Fig. 9, indicating that the available reducing chemistry has fully reacted with the Ag/Au surface.

A review article by Rai et al (2010) lists published citations of fungal species identified for their metal nanoparticle fabrication properties.

So, why is fungus on daguerreotypes? Recent scientific publications demonstrate that fungi can systemically produce silver and gold nanoparticles when combined with solutions such as gold chloride and silver nitrate. The solution chemistry pathway is applicable to the silver and gold nano complexes that make up the daguerreotype surface. If sufficient moisture is present, ever present airborne fungal spores coming in contact with the plate will interact and mediate species specific nanoparticles composed of the daguerreotype constituent metals.

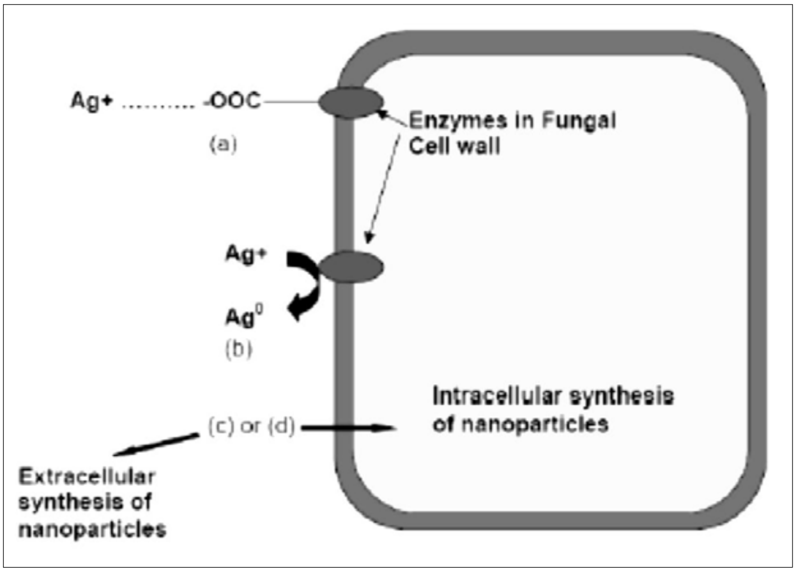

Fig. 12. Graphic from the cited review article (Rai et al 2010).

Captioned as follows: Fig. 2. Hypothetical mechanism of Nanoparticles formation in the Fungus; a. Electrostatic interaction between the metal ion and the enzyme present of the Fungal call wall; b. Reduction of the Ag^+ to Ag^0 by the enzyme; c. and d. The Ag^0 nanoparticles may be synthesized intracellularly or extracellularly.

The fungal propagation mechanisms require further research to fully explain the role each constituent plays in this complex system. SEM imaging and EDX analysis of bio-organisms demonstrate that they are found pervasively on daguerreotypes in our research –with fungi being only one possible source of biological reducing chemistry.

This graphic (Figure 12) describes a reduction pathway of silver by for nanoparticle fabrication. While recent work by the Harvard group in which fungal activity was identified and cultivated from daguerreotypes, there has not yet been a mechanistic explanation for it. An overview of current scientific literature provides plausible mechanisms to explain what our SEM imaging and analysis has revealed.

The scientific literature supports our findings and preliminary explanations for biological organisms propagating on daguerreotypes and assembling organo-metallic structures is explainable by the nanosciences. There is much more research necessary to determine the implication of these findings, assessing their risk, and developing appropriate mediation strategies.

Current Nanotechnology Research Provides New Insight into the Physicochemical Mechanism of Gilding, and Provides a New Hypothetical Model for the Surface Composition of the Gilded Daguerreotype

The reaction of the gilding solution with the silver surface of a daguerreotype has not been fully described in historic or recent research on the daguerreotype. Generally it has been considered to be a plating, or oxidation-reduction reaction, with the gold chloride being reduced and plating onto and displacing silver, and similarly displacing mercury in image particles (Barger 1990), yielding what has been reported as an accumulation of gold on the image particles (Ravines 2008).

However, current research in nanotechnology, in particular the synthesis of gold and silver nanoparticles, points toward an entirely different mechanism at play in the gilding step. Our experiments were carried out with a standard gilding solution used by daguerreotypists today, which is derived from Hippolyte Fizeau's 1840 formula (545): 0.2% gold chloride solution (aqueous) dissolved into a 5% solution of sodium thiosulfate. At this ratio, symmetrical polyhedral gold nanocrystals are formed, ranging in diameter between 10 and 20 nanometers, suspended in a colloidal solution. When the solution is heated on the plate, silver from the surface is intimately joined with the gold nanoparticles into macromolecular clusters that form a continuous gold-silver surface. This similar surface is formed over the mercury rich image particles, with mercury concentrated in the center of the image particle.

What is the basis for this hypothesis? A recent article (Zhang et al 2012) published in Nanoscale Research Letters used Fizeau's recipe to fabricate gold nanoparticles. This serendipitous research provides us with analyses that would be difficult to achieve within a conservation research laboratory.

The research group from the University of Louisville combined gold chloride and sodium thiosulfate solutions to make gold nanoparticles yielding a range of shapes and sizes by varying the solutions' molar ratios. They worked from first principles and had no knowledge of the daguerreotype, Fizeau, or Herschel's work. The UL research analyzed the solutions, quantified size, shape, and aggregation of the thiolated gold nanoparticles in solution spectroscopically, and by TEM. This highly relevant work revealed that the gold nanoparticles formed in Fizeau's classic recipe are between 10 and 25 nm in diameter, and are complexed by thiol groups that keep them from aggregating in solution.

We propose that the gold nanoparticles are well functionalized in solution by thiol bonding when they encounter the daguerreotype surface, and therefore do not participate in gold-silver displacement reactions. This is supported by TEM analysis of the spent gilding solution drawn from modern plates while in process. Neither silver nor mercury is detected in the reacted/spent solution –and would be detected if it were a displacement reaction.

Our most conclusive research on the surface structure of a daguerreotype has been achieved by SEM examination in the focused ion beam mode (FIB). This view is of a cut on the vertical axis creating cross section trench through the image forming strata. A < 10 micron cut allows the surface to be characterized and analyzed elementally in-situ by EDX. This minimally invasive technique carried out on surrogate daguerreotypes and selective historical study collection plates, reveals the physico-chemical dynamics of the gilding process on daguerreotypes. The FIB section in Figure 13 is from the daguerreotype in Figure 2, which is in excellent condition, and a very well executed daguerreotype.

Figure 13 shows a nearly continuous gold-silver layer 200nm above the underlying silver substrate. An explanation for the super layer and the corresponding sub-surface void proposes that the thiolated gold nanoparticles in the gilding solution energetically create a favorable dynamic for drawing the nano-structured halide etched silver into a discrete gold-silver super layer. Molecular clusters (yet undescribed) of the two metals fusing together, physically depletes underlying silver by the dimensional equivalent of the thickness of the super layer. This makes empirical sense because gold and silver have nearly equal metallic radii. The FIB section bisects a well formed image particle which is anchored to the silver substrate. EDX mapping shows a mercury-silver gradient that becomes increasingly mercury rich, extending radially from the center-base of the section face. At the particle surface, gold, silver, and mercury are detected. We have observed subsurface voids at the perimeter of image particles, raising the notion that similar dynamics are at play on the particle surface as on the plate surface, but we have not analyzed the precise elemental makeup.

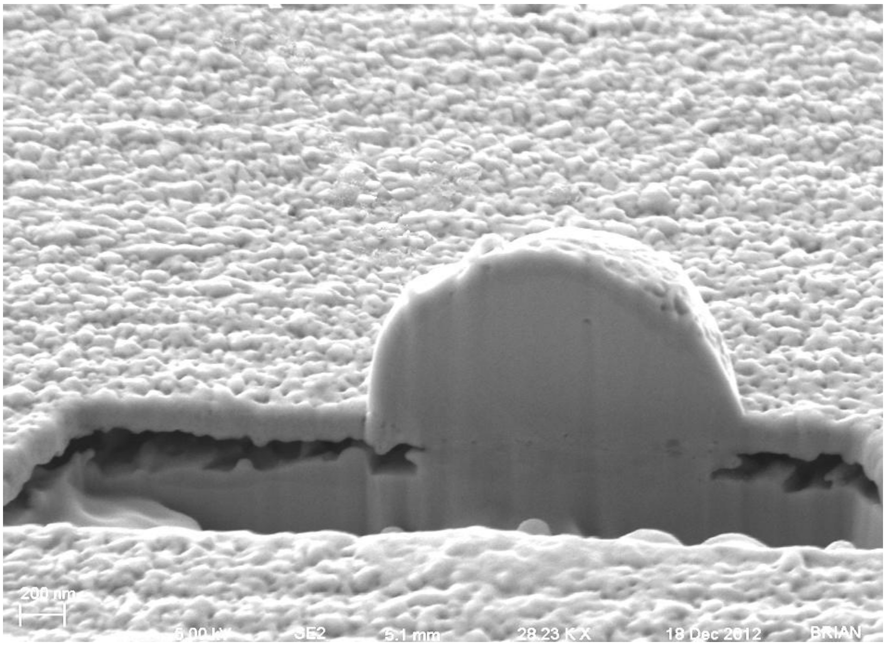

Fig. 13: FIB cross section of a gilded historic daguerreotype at 28,230 KX. Scale bar is 200nm.

To further reinforce these findings, we have conducted FIB examinations on both historic and modern ungilded daguerreotypes. We find no subsurface voids –even in association with the mercury developed image particles. On this repeated finding we are proposing that the gilding step creates subsurface voids below the surface as the heated gilding solution transports the nanostructured silver into gold-silver molecular formations. The precise molecular structures formed on the surface have yet to be characterized.

Figure 14 is an ungilded historic sixth plate (Scoville mark) from the Eastman House study collection. The associated FIB trench in Figure 15 shows no subsurface voids or disruption in the continuous silver layer –even in association with the mercury developed image particles. This FIB trench also sectioned several biological growths engaged with the surface, visible as the elongated dark forms.

Our current research shows that increasing the amount of gilding solution and lengthening the duration of the gilding process leads progressively to an extended subsurface horizontal void and formation of the super layer – which can precipitously disassociate and exfoliate from the underlying silver stratum. This phenomenon may actually be what occurs, in some instances, when exfoliation is the described condition on daguerreotypes. The assumption, prior to these experiments, has been that exfoliation on a daguerreotype occurs at a silver plating–subsurface interface and is a result of plating adhesion failure. The exfoliation due to extended or more abundant gilding is also a likely occurrence. This condition needs to be examined in greater detail by extrapolating our research results to the condition as observed on the historic daguerreotype. We believe we see this condition in some of the masterworks of Southworth & Hawes, as well as other highly accomplished daguerreotypists' work made at the technical peak of the process. Achieving the greatest optical response from the plate may result from the most gold deposition, which also creates the most extensive subsurface voids –and most tenuous surface.

Fig. 14. Sixth plate, ungilded.

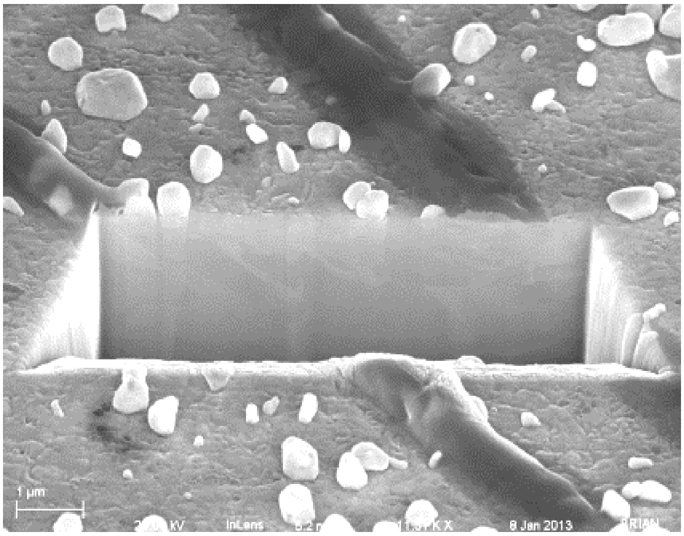

Fig. 15. FIB view of the ungilded plate, scale bar is one micron.

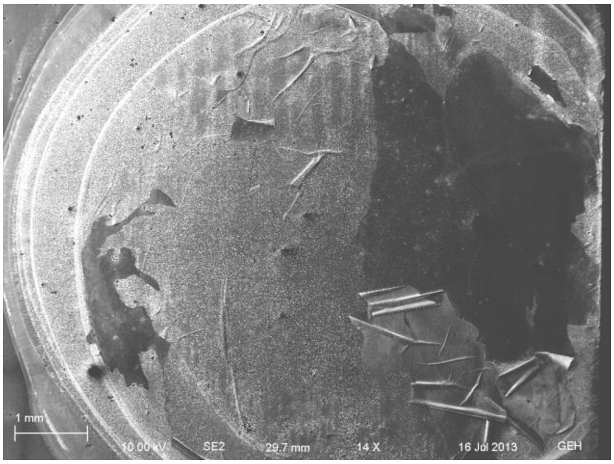

Fig. 16. SEM view of an over-gilded test region showing delamination, loss, and exfoliation on a Becquerel test sample.

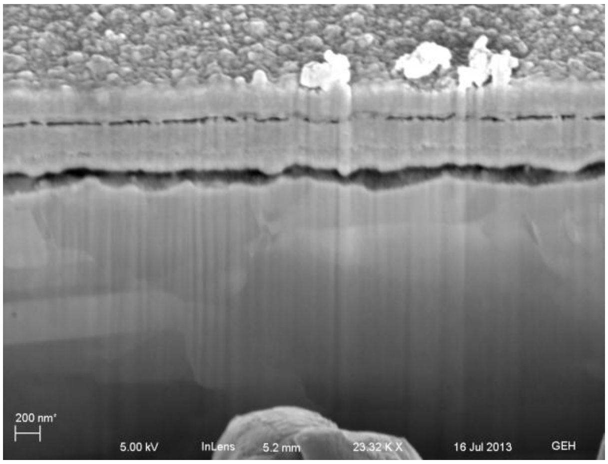

Fig. 17. FIB view of a region of intact gilding Ag-Au layer adjacent to the delaminated area.

Figures 16 and 17 are from an experiment that documented the effects of progressively adding gilding solution, in process, to the point of delamination and exfoliation. This work was carried out by Emily Thompson (Clemson University) during an NSF funded Research Undergraduate Education grant at the University of Rochester and George Eastman House. The results were startling in that there appeared to be a self-limiting thickness of the Ag-Au super layer visible in Figure 17, at which point a secondary super layer began to form. At the final stage, the entire composite structure pulled away from the base silver deformed and curled up into rolls as seen in Figure 16.

Conclusions

The presentation paper at AIC-PMG & ICOM-CC included a section on the archaeological and event history that the highly reactive surface records over time. That will not be addressed here. The primary new information coming from the NSF sponsored research on the daguerreotype through the SCIART investigation is summarized:

- We do not have a full understanding of the physico-chemical structure of the daguerreotype.

- We have yet to fully define and characterize the nature of the Ag-Au surface –which applies to the majority of daguerreotypes.

- We have yet to deduce the many avenues of deterioration by environmental agents, including light induced responses.

- Deterioration conclusively includes biological and organic interactions at the nano-scale.

- Scanning electron microscopy at 50,000X and above is necessary to study the nano-structure of the daguerreotype. It is the magnification required to detect the residual record of an historic daguerreotype closest to its state at "first light", which should be the standard in considering treatment options.

- Research is revealing that immersion treatments that engage vigorously with the surface, irrespective of the chemical reaction or energy source, will profoundly alter the daguerreotype surface. Such treatments will inevitably move the daguerreotype to a state further removed from its "first light".

- Daguerreotypes have active surfaces in all habitable environments in which they can be viewed. Therefore there is a threshold of physico-chemical change happening at all times, unless there is a modified air environment surrounding the daguerreotype.

On the basis of this research, George Eastman House has embarked on the development of a low cost, aesthetically pleasing, archive use enclosure that is designed to hold a long-term argon atmosphere. It can be monitored from the exterior by an optical probe that senses oxygen accurate to 1/100 of a percent in air. The enclosure allows full view of the daguerreotype edge to edge, recto and verso. The enclosure can be recharged with argon through ports without disassembly.

The clear rationale for this solution, based on experience and research, is that the absence of oxygen and moisture will terminate biological activity, and prevent intermetallic or organic phase reactions that would progress in any modified or non-modified air environment, no matter how clean and ideal it may be perceived.

The application of this enclosure by George Eastman House was initiated through a National Endowment for the Arts "Save America's Treasures' grant to improve its imperiled 1,270 item Southworth & Hawes daguerreotype collection –which represents the largest holding of one daguerreotype studio, anywhere. The collection came to the Museum without any historic enclosures –the plates had been kept by the Hawes family in original plate boxes that had slots for vertical storage of the bare plates. They had been rehoused by the Museum in the 1970's in packages composed of buffered matboard, window glass, and a variety of edge binding tapes. These unique circumstances allowed for new concepts to be considered for preserving this treasure.

We acknowledge that it would be difficult to introduce a modified air environment for a typical American style cased daguerreotype. Alteration of an historical presentation is a very important ethical and value laden issue –but there is a real cost to not considering altering current practices with the least intervention and maximum gain to preserve the primary object. Much of the answer lies in engineering. Eastman House is currently researching ultra-thin, surface modified flat glass with extraordinary strength at 0.5mm thickness. Its use will permit an interior enclosure, exquisitely thin, that can reside as a low profile sealed argon enclosure within a typical daguerreotype case –with room for the original glass to be retained. Only in relatively few instances are daguerreotypes larger than their brass mats. Variations on this system can be readily adapted to the French passe-partout style housing, or any framed daguerreotype, to accommodate an interior argon preservation enclosure with minimal intervention.

The threats to the daguerreotype from nanoscale deterioration are real and ongoing, in spite of a perception that many daguerreotypes have not changed within collective memory. However there is no natural passivation for a daguerreotype, there is only less damaging and slower deterioration in both historical original cases, and current best practice archive packages.

In sum: There are emerging solutions and advanced scientific explanations that will improve the preservation prospects for the daguerreotype. Pursuing them is essential for this singular artifact of human ingenuity, artistic expression, and visual record that captured a mere twenty years of human existence –through nanotechnology.

Acknowledgements

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Abstract: The Platinum and Palladium Initiative: Tools and Strategies for Interdisciplinary Collaboration

Matthew L. Clarke, Alisha Chipman, Constance McCabe, Christopher A. Maines, and Sarah S. Wagner

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Platinum and palladium prints are among the most rare and highly valued photographs in today's collections, yet their chemical nature and their degradation processes are not completely understood. The photograph conservation program at the National Gallery of Art has initiated a comprehensive collaborative investigation of platinum and palladium photography, which will culminate in a 2014 symposium and subsequent publication. An international group of conservators, scientists, curators, historians, and photographers is currently pursuing research on the history, chemistry, materials characterization, connoisseurship, preservation, and conservation treatment of these materials.

This expansive collaboration requires the partners to develop standardized research methodologies for gathering and sharing information, and to coordinate research efforts to minimize duplication and maximize limited resources. Various types of research, which include scientific analyses, imaging, and study of technical literature, require different approaches to gathering and sharing information.

Cross-institutional scientific analyses must be performed using instruments and protocols that yield comparable data. Imaging methods, including copy photography and microphotography, must be standardized between collaborators for ease of comparison and to ensure high quality. The historic literature, such as journals, handbooks, and other publications, includes vast amounts of technical information, illustrations, advertisements, and product samples; gathering and sharing these resources poses significant challenges.

The presentation will summarize several approaches for standardizing and sharing research, including:

- Imaging and scientific analyses, including X-ray fluorescence spectroscopy, microtomy, light and electron microscopies, and cross-section preparation.
- Fabrication of platinum and palladium prints as analytical standards and in aging studies
- Procedures producing comparable photomacrographs taken with various microscope set-ups
- An electronic database to record data files for all scientific analyses and photographic documentation
- An electronic database to track and describe historic literature, advertisements, and samples and a virtual cloud-based reference library for global sharing of resources among project collaborators

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Christopher A. Maines, and Sarah S. Wagner
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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Abstract: Measuring Color Change in Photographs

Katherine Sanderson

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

It is possible to broadly predict the lightfastness of a photograph based on the known characteristics of its component materials. However, exposure guidelines developed based on this information alone are general at best. Through the use of color-monitoring equipment such as densitometers, spectrophotometers and, more recently, micro-fading testers, it has become possible to obtain more object-specific predictions of longevity.

This presentation focuses on a two-year project at The Metropolitan Museum of Art measuring color change in photographs over time. The project relies on data collected in 1999 by Mellon Fellow in Photograph Conservation, Dana Hemmenway, using a reflectance spectrophotometer during a baseline survey of a group of over 100 photographs in The Met's collection. The works chosen for the project represent a cross-section of the Museum's photographic holdings, including a wide range of processes and condition states. Additional photographs were included based on their popularity for in-house exhibition or loan. The objective of the current project is to take new readings of these photographs as a means of discovering to what degree they are changing, evaluating the methods used to monitor this color change, and ultimately to use this data to inform focused monitoring and exhibition policies for the future.

Previous studies conducted by Henry Wilhelm, Douglas Severson and John McElhone, among others, have laid important groundwork for color monitoring photographs using densitometry and spectrophotometry. The value of this study is its scope: it includes over thirteen years of data on over twenty different photographic processes. The collected data provides information about the aging characteristics of individual prints, and more general trends are discernible for certain photographic processes. In some cases, the data also reveals aging characteristics of the work of individual artists. Finally, the relationship between spectrophotometric measurements taken over time and micro-fading data will be introduced.

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Characterizing United Press International's Unifax Facsimile Prints

Margaret Wessling

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Abstract

This paper explores an outmoded facsimile printing technology employed in wire transfer facsimile machines in the mid-twentieth century. Major news agencies such as the Associated Press and United Press International provided wire-transfer facsimile services to share news images with their subscribers. Facsimile printing machines accelerated the transmission of images, subsequently printing them using a variety of techniques including traditional gelatin silver printing, and electrostatic and thermal processes. This paper describes a technique called electrolytic printing, which has been largely left out of the dominant literature on facsimile technology. Electrolytic printing was popular in news agency machines from the mid-1950s to approximately the mid-1970s. Prints from this process have distinct features including a warm image tone, limited detail in the high-density areas, partially translucent paper supports, and the image is almost as clear on the verso as it is on the recto. The image materials are investigated, as well as preservation concerns.

Introduction

In 2006 the Tamiment Library & Robert F. Wagner Labor Archives at New York University (NYU) acquired the archive of the Communist Party of the USA (CPUSA). The collection contains the photograph morgue of the CPUSA's newspaper, the *Daily Worker*, which comprises 224 linear feet of press images made in various photographic processes. As part of the cataloging protocol NYU staff archivist Hillel Arnold and Conservation Librarian Laura McCann worked to identify the processes and news sources. They identified gelatin silver developed-out prints and chromogenic prints made by the *Daily Worker*'s staff photographers, as well as electrostatic and thermal facsimile prints made on wire transfer facsimile printing machines from both the Associated Press (AP) and United Press International (UPI). One type of print found in the collection was distinctly different from all the others and Mr. Arnold and Ms. McCann identified the source as UPI's facsimile printer, the Unifax. Research into the Unifax revealed it was inaugurated February 27, 1954 (*Editor & Publisher* March 6, 1954, page 12). However, further investigation revealed that no literature exists to describe how the printer worked, or what composes the image material. Given the absence of information and concerns regarding the long-term stability of Unifax prints, the project was passed on to the author with the following goals: research the history and development of wire transfer facsimile printing and create a timeline for the development and use of the Unifax printer; determine the materials and methods of production of Unifax prints; and conduct preliminary research into the stability and preservation of Unifax prints.

History of Wire Transfer Facsimile Printing and Unifax

The invention of wire transfer facsimile printing is intertwined with technological developments of the Industrial Revolution, and it played a significant role in the globalization of information through the nineteenth and twentieth centuries. The timeline begins following Samuel Morse's 1837 invention of the telegraph, a method for coding and sending messages as electrical current. Shortly after a man named Alexander Bain invented the earliest concept of a facsimile printer, which he received a patent for in 1843 (Costigan 1978, 2). Bain developed the idea for this printer from his prior invention of a synchronized clock system. He determined that if synchronization could be maintained between a master and a system of machines, then the same could apply for replicating text and images. For his facsimile printer Bain designed a metal stylus that simultaneously traced the original text (which needed to be in relief) and contacted a piece of paper saturated with water, sulfuric acid, and a saturated solution of yellow prussiate of potash (Costigan 1978, 3). The electrical reaction between the metal stylus and the wet components created the dark areas of the image. Bain's system was not economically viable for its time, but it did incite continued research including Giovanni Caselli's "pantelegraph", which received a patent in 1861. Caselli oversaw the construction of telegraph lines specifically for his instrument throughout France and Europe in the 1870s, which transmitted hand-written notes and simple line drawings (Huurdeman 2003, 49).

Dr. Arthur Korn is another important inventor credited with setting up a dedicated transmission system between Berlin and London in 1910, and for sending the first transatlantic image via radio wave from Rome to Bar Harbor, Maine, in 1922 (Costigan 1978, 4). The transmission stirred American interest in this technology, leading three companies to establish their own dedicated systems: the American Telephone and Telegraph company (AT&T), the Radio Corporation of America (RCA), and Western Union. In 1934 the AP bought out AT&T's picture division, and then dramatically unveiled a nation-wide system at one o'clock in the morning on January 1st, 1935 (20 Years with AP Wirephoto, 1). The AP's innovative network of telephone wires connected newspapers in twenty-one cities across the country to a central hub in New York. There, a machine would scan a photographic print and convert the density information to electrical signal. The signal would then travel over the telephone lines to distant cities where receiving machines would reconvert the signal into density information and transfer it to photographic negatives. This meant the receiving newspaper had to subsequently print the negative into a positive silver image, which had many drawbacks including limiting the speed at which a newspaper could turn around an image for printing.

Nearing the middle of the twentieth century new non-silver printing technologies began to be introduced into facsimile printing systems. Interestingly, the AP and UPI almost simultaneously introduced similar non-silver systems in 1954. UPI received a trademark for the Unifax in June of 1954, and the AP received a trademark for their version, Photofax, the following August (United Press Associations Corporations, trademark 71668129; Associated Press Corporation, trademark 71671083). Curiously, no patents exist for the Unifax or Photofax machines. These two machines employed the same technology, which appears to have used materials similar to Alexander Bain's original concept (Diamond and Carr 1972, US patent #3,668,079). The technology is referred to as "electrolytic facsimile printing" and it relies on a chemical reaction facilitated by an electrical current in the presence of an electrolyte solution. Unlike the later techniques of electrostatic and thermal facsimile printing, electrolytic printing was entirely abandoned as a facsimile technique. Very little literature or research exists describing this process, despite its otherwise wide and popular use in the middle of the twentieth century.

Technical Description of the Process

Unifax prints, and electrolytic facsimile prints in general, have many unusual characteristics. An image created by the Unifax machine is printed on a partially translucent paper support, and is monochromatic in a range of warm brown densities. The paper support retains good flexibility and feels satiny to the touch. There is no baryta or similar ground layer, nor is there evidence of a binder such as gelatin. The image is made up of many parallel lines, barely visible to the naked eye. Detail is often lost in the high-density image areas, resulting in regions of flat, dark color. Perhaps one of the best identifying properties of electrolytic prints is that the image is almost as clear on the verso as it is on the recto. Frequently the edges of the prints are unevenly trimmed, although two opposite edges will always be machine-cut. This is a result of the paper being fed from a roll. Finally, there will always be a strip of printed text as part of the image identifying the subject and the news source.

During cataloging of the *Daily Worker* collection archivists noticed the Unifax prints had a tendency to offset ghost images onto each other, and they appeared to have stained their original, poor-quality folders. These observations raised concerns regarding their preservation, which have yet to be resolved. The Unifax prints were rehoused at Tamiment Library in good-quality folders, separated from the other photographic materials as a precaution against further offsetting. After approximately two years the prints do not appear to have caused any changes to their new folders or to each other.

While no patent is available for the Unifax printer specifically, many patents can be found for various electrolytic facsimile printers and printing papers. It seems likely that UPI and the AP were re-branding printers made by other companies and simply providing a non-stop stream of images. U.S. patent #3,668,079, filed by Arthur S. Diamond and David E. Carr in 1971, is the only patent to reference the Unifax printer (and the AP Photofax printer), and it has provided the basis for the following description of the printing process. Electrolytic facsimile printing works on the same principle as an electrolytic cell, whereby a flow of electrons is established from an exterior energy source between a metallic anode and cathode in the presence of an electrically conductive solution. The result of such a cell is the depletion of metal at the anode and plating out of metal at the cathode. In the electrolytic facsimile printing machine there is a cylinder with a metal wire wrapped around it (called a helix wire), which acts as a cathode and rotates during printing. Positioned below the cylinder is a stationary metal blade, commonly made from iron, steel, copper, or silver, which acts as an eroding anode. Paper is fed from a roll between these two parts and receives the facsimile image. A single rotation of the cylinder causes the helix wire to mark a single line across the printing surface. The image is then built up from many printed lines in succession.

The physical creation of color on the facsimile paper is a result of the reaction of metal ions from the anode with chemicals in the paper. A manufacturer supplied the blank facsimile recording paper impregnated with an electrolyte solution and a special "marking compound". Information regarding the "marking compound" is limited and appears to be proprietary, although most sources agree it is a polyphenolic compound, and was often catechol. The electrolyte solution contains an ionizable electrolytic salt, such as sodium chlorate (Diamond and Carr, 1971). During printing the helix wire in the mechanism receives the electrical signal from the wire transmission and a current is established between the anode and cathode, maintained by the electrolyte solution in the paper. The current causes the eroding metal blade to deposit metal ions into the blank facsimile paper. The metal ions then react with the "marking compound" to form the image (see Figure 1). The signal strength varies in accordance with the image densities of the picture being transmitted, so a stronger signal corresponds to a high-density area and a weaker signal corresponds to a lower-density area. When the signal is strong more metal erodes and a darker color is formed on the facsimile paper. Conversely, when the signal is weak only a small amount of metal erodes from the anode and a lighter color is formed.

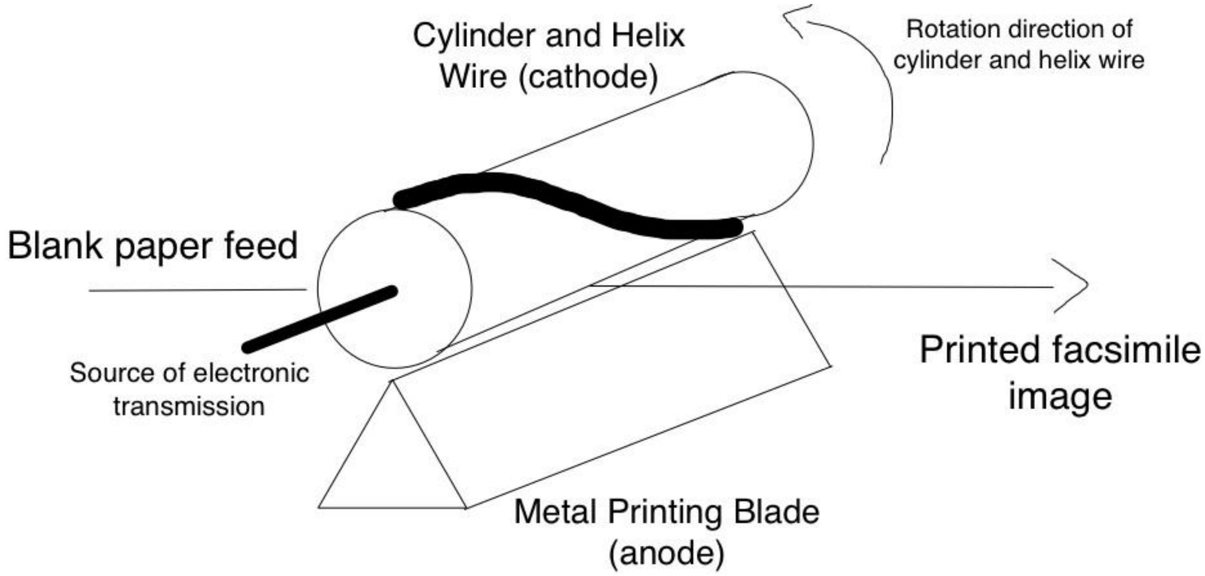

Fig. 1: Illustration of the basic mechanism of the electrolytic facsimile printer. Paper is fed from the left side between the helix wire and the printing blade. The electrical signal received from the transmission establishes a current between the helix wire and the printing blade. Metal ions then erode from the blade into the paper and react with the polyphenolic marking compound to create color.

As an aside, it is important to note there appear to be two types of "electrolytic printing". There is the type described above, which shares similar features with the original invention of Alexander Bain, and there is another version that can be found in several texts regarding facsimile technology (Batterham 2008, Nadeau 1989). This second technique is described as a paper covered with a thin metal foil, coated with zinc oxide. Electrical charge is applied to the paper in order to produce a facsimile image. It appears the main application for this version was the positive reproduction of microfilm. No text has been discovered yet to explain why these two techniques share a common name, but for the purposes of this research the second version will not be regarded.

Material Investigation

Published descriptions of the electrolytic process shed light on the mechanical operation of the facsimile machines, however they do not explore the chemical makeup of the image material. Three prints from the *Daily Worker* archive were deaccessioned for analysis to be used as representative examples of the Unifax process. The goal of the analysis was to determine more precisely the chemical composition of the image material and the paper support. Information culled from a 1948 research paper on high-speed electrolytic facsimile printing explains there are four types of chemical reactions that may occur in any order during electrolytic printing. The first reaction is caused by general introduction of foreign ions into the paper blank, the second by discharge of ions at an electrode while in contact with the blank, the third by oxidation or reduction at the electrode when in contact with the blank, and the fourth reaction occurs through increasing the concentration of an ion at the contact point to induce a pH change (Greig 1948). One or several of these reactions may occur during printing, however the initiating reaction distinguishes the processes and may depend on the particular chemicals present during printing. Based on subsequent descriptions of the reactions it appears the Unifax method can be classified as an introduction of foreign ions into the paper blank. In the process foreign ions react with the organic solution impregnated in the blank to form metal-organic chelate compounds, precipitated metal, or colored inorganic metal derivatives (Greig 1948). The analysis subsequently described here aimed at confirming this information with the resources and equipment available to the author.

Beginning with non-invasive tests, the Unifax prints were observed under short wave ultraviolet radiation. The image areas did not exhibit any significant fluorescence, however portions of the unprinted paper fluoresced a bright white. These portions correspond to areas that look like dried water spots when viewed under normal lighting conditions.

The next technique employed on the Unifax sample prints was X-ray fluorescence spectroscopy with a Bruker Handheld Tracer III-V, using an air-backed set-up. Tests were run for 120 seconds at 40 kV and 1.5μa without a filter. The spectra revealed significant peaks for iron in the high-density areas of the image, which became proportionally shorter in the medium-density areas and almost negligible in the non-image areas (see Figures 2 and 3). Other significant peaks corresponded to chlorine, calcium, chromium, and nickel. The intensity of the calcium and chlorine peaks did not vary in relation to the image area, thus these elements are likely a component of the paper or relate to the electrically conductive solution. However, the intensity of the chromium and the nickel peaks corresponded by ratio to the intensity of the iron peak, so they are likely components involved in the image making process resulting in an iron-chromium-nickel image. Given the above description of how electrolytic printing works, it is likely these metals were present in the eroding anode printing blade. In addition, the combination of iron, nickel, and chromium is a formula for stainless steel, which is a documented metal alloy for printing blades.

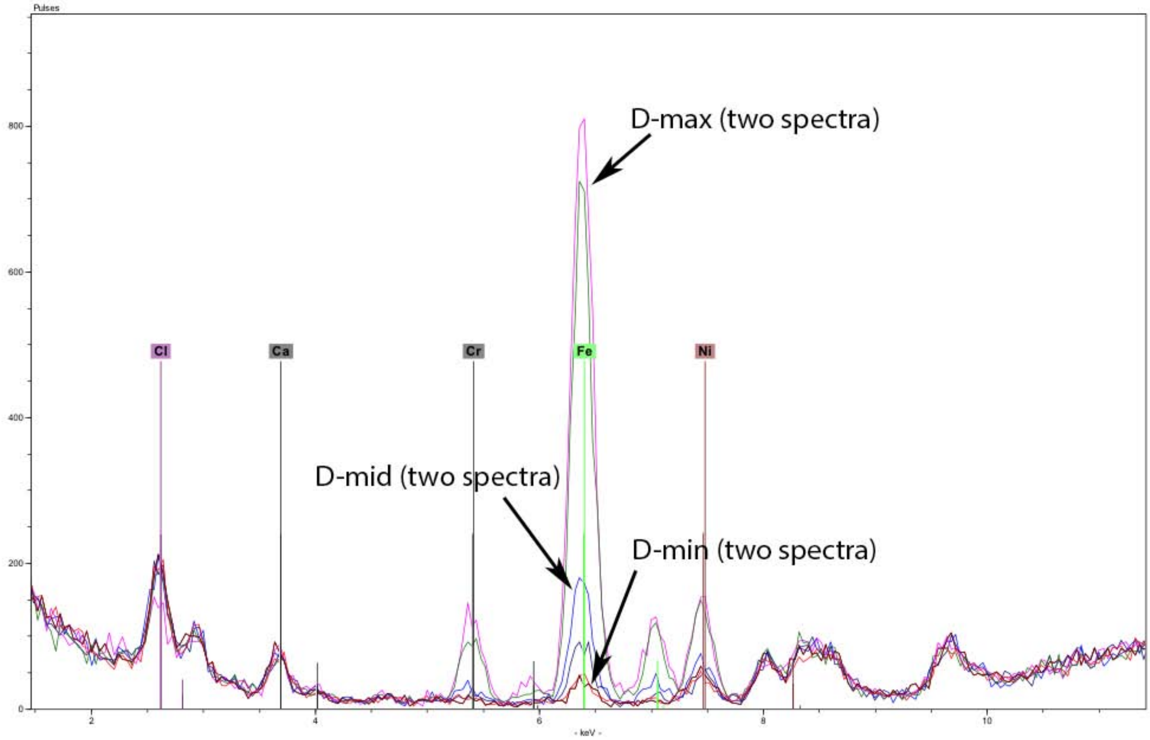

Fig. 2: Sample print #1: showing chromium, iron, nickel peaks for the maximum-, mid-, and low-densities of the image.

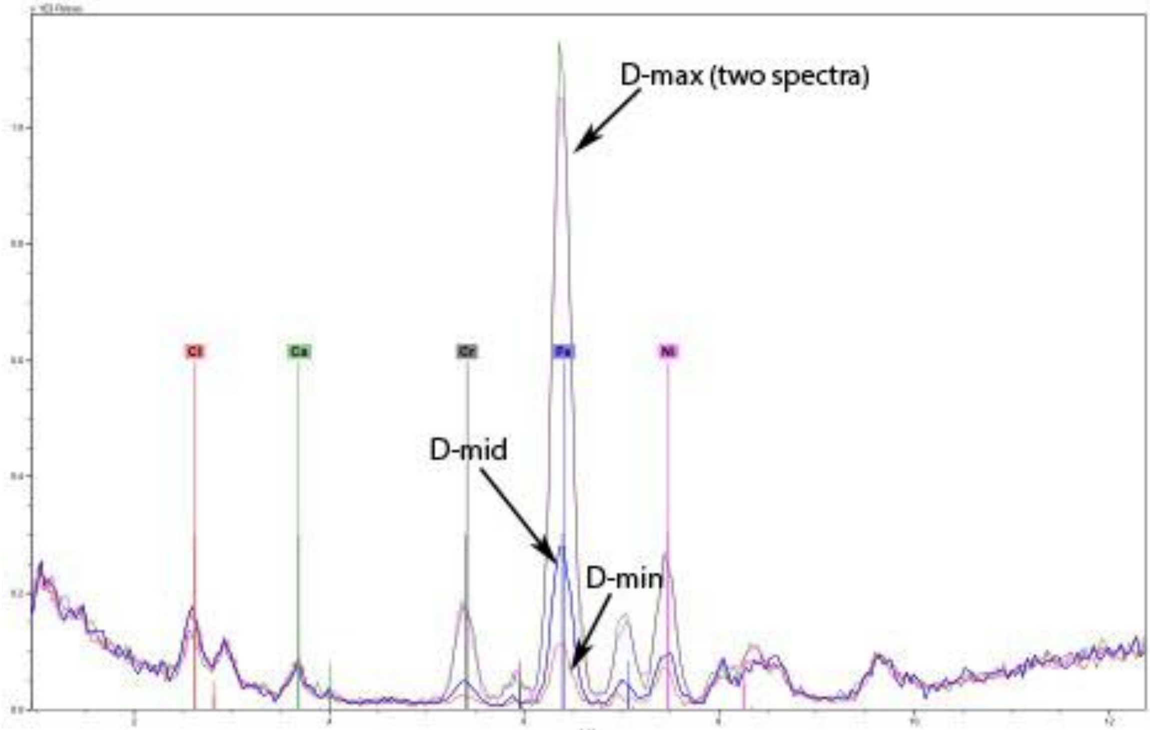

Fig. 3: Sample print #2: spectra for this sample as well as for sample #3 were virtually identical for the spectra for sample #1.

Scanning Electron Microscopy coupled with Electron Dispersive Spectroscopy (EDS) was performed with a Hitachi TM3000 desktop SEM connected to a Bruker Quantax EDS unit. High magnification images of the samples revealed only paper fibers; no image particles could be detected. SEM images of the high-density image areas showed no distinction from the low-density image areas (see Figure 4). Compositional analysis in high-density image areas was run at 15 kV and revealed average weight percent distributions of 49% oxygen, 44% carbon, 4% sodium, 1% chlorine, and less than 1% each of iron and sulfur. The composition remained roughly the same in the mid-density areas of image, with less than half a percent of iron. In the non-image areas no iron could be detected. The low content of iron found may be due in part to the detection limits of the instrument (operating at 15 kV). Unfortunately, this did not allow any mapping of iron on the surface of the sample to correlate iron content and image density. Since no specific local accumulations of iron were found, the EDS results suggest the iron from the eroding anode does not sit on the paper fibers as discrete particles, but is both finely dispersed and likely bound to molecules from the organic marking compound. This assessment describes a material that is similar in make-up to an ink or a dye.

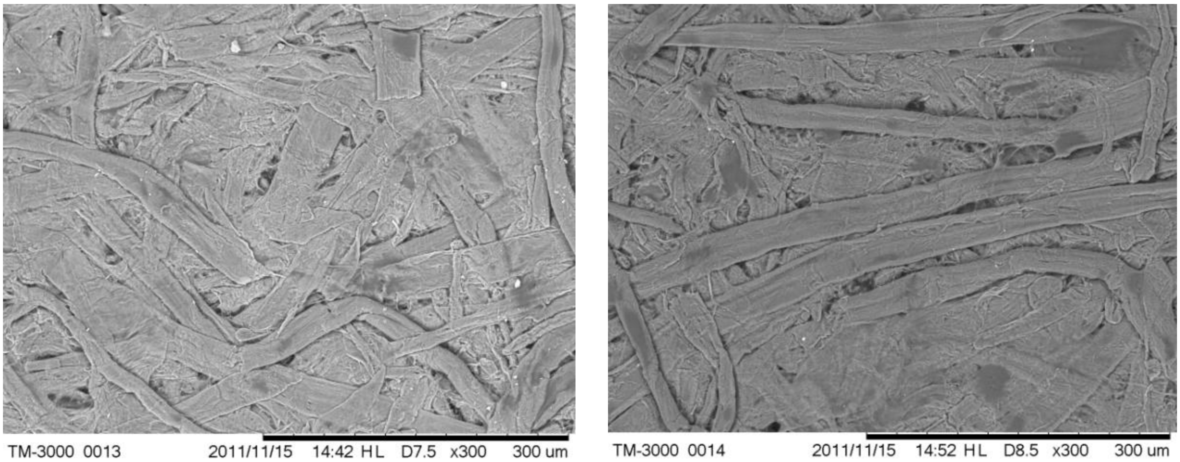

Fig. 4: SEM microphotographs of two areas on the same sample: high-density image area (left) and low-density image area (right) reveal similar features: presence of paper fibers and absence of image particles.

Initial analysis with Fourier Transform Infrared Spectroscopy has not provided and conclusive information regarding the image material. Spectra taken in situ on the sample prints show bands typical for paper fibers consistent with spectra for cellulose and natural fibers.

Preservation Concerns

An important observation was made during FTIR analysis regarding the solubility of the image material. In an attempt to isolate the image material from the paper support small samples taken from high-density image areas on the sample prints were soaked in water. Almost immediately brown color from the samples began to dissolve into the water. Some color still remained in the paper after several days of immersion, suggesting that some, but not all, components of the image material are readily soluble in water. This discovery has important repercussions for the handling of electrolytic facsimile prints. It is important to protect these prints in collections from exposure to moisture and water, either from high ambient relative humidity, exposure to sprinkler systems, or in local treatments such as hinging and mending applications.

To address questions about the light stability of the image material, a sample print was tested with a Newport Oriel OMF-T microfading tester at The Metropolitan Museum of Art. Color change in maximum-, mid-, and low-density image areas were compared to Blue Wool standards 1, 2, and 3. All Unifax sites faded at slower rates than Blue Wool 3 (see Figure 5). These results suggest that the prints are less sensitive to light than the most light-sensitive Blue Wool standards (Whitmore, 1999).

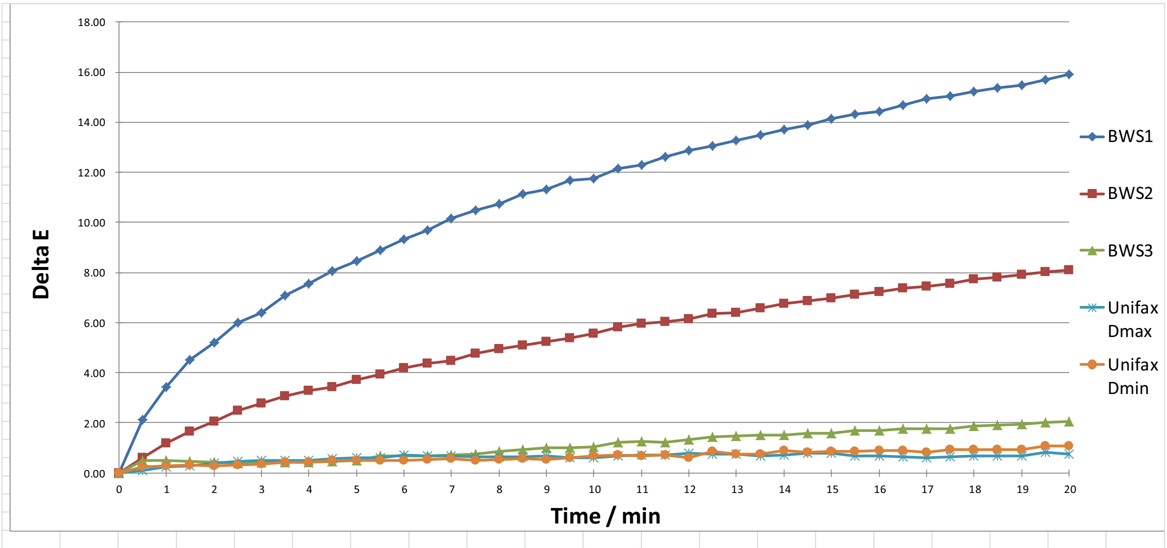

Fig. 5: Color change of Unifax D-max and D-min areas as compared to Blue Wool Standards in a microfading experiment; BWS 1 shows the most light sensitivity and Unifax D-max shows the least light sensitivity under the same amount of light exposure.

Re-creation of the Electrolytic Process

The recipe for producing an electrolytic facsimile print seems straightforward based on the descriptions provided by the Diamond and Carr patent. An experiment was carried out to determine if the principle was truly as simple as described. Similar to the set-up for a spot test, a 6-volt battery was used to supply an electrical current. A steel pushpin was clipped to the anode cord of the battery, and a piece of filter paper soaked with a 50:50 solution of sodium chloride and catechol (both in solution in deionized water) was clipped to the cathode cord. When the pushpin at the anode was touched to the wet filter paper at the cathode a dark color was instantly formed on the paper (see Figure 6). Given the wet nature of the paper the color had the tendency to spread after contact. The color formed was immediately a dark black, but as it bled it often changed to a green or reddish tint. Further experimentation revealed that when the paper was partially dried before contact with the anode the mark made by the pushpin was less likely to bleed or to change color. Rapid drying of the paper with a hair dryer after contact with the anode also moderated the bleeding and color change. This experiment proved the simplicity of the electrolytic printing concept and shed light on the process of making a clear facsimile image. XRF of the filter paper in marked and unmarked areas revealed similar results to the sample

Unifax prints. Iron and nickel were found in the pushpin, and incidents of iron and nickel greatly increased in the filter paper after marking (see Figure 7).

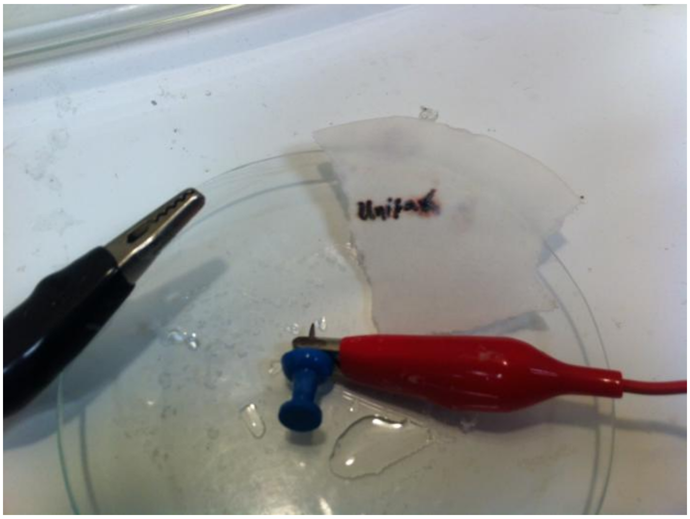

Fig. 6: Re-creation of electrolytic process: the left clip is the cathode (not attached to the filter paper in this image) and the right clip is attached to the metal point of the pushpin acting as the anode. The filter paper is resting on a watch glass and is still slightly damp, causing the written "Unifax" to have bled slightly (the "x").

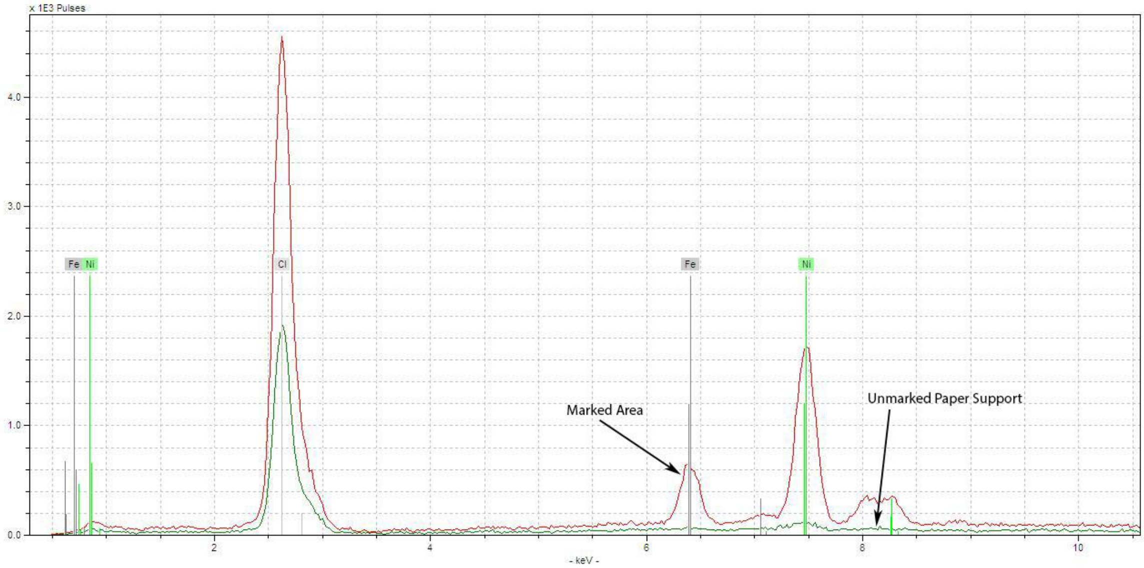

Fig. 7: XRF spectra of electrolytic facsimile re-creation.

Conclusions

Electrolytic facsimile printing has been overlooked by the dominant conservation literature on facsimile printing, however historical research has revealed that press agencies employed the technique to distribute news images between the mid-1950s and 1970s with great success. The *Daily Worker* image archive at Tamiment Library at NYU is an outstanding example of a well preserved photograph morgue from the twentieth century, and it is a model for the processing and handling of objects in other photograph morgues as they leave newspapers and enter archival collections. Current research efforts by NYU Conservation Librarian Laura McCann are focused on discovering electrolytic facsimile prints and categorizing other facsimile processes in photograph morgues around the country. It seems likely that many more collections contain these prints and that they are misidentified. The prints are significantly different in material makeup than other facsimile processes and they may warrant special attention for storage, treatment, and exhibition.

Electrolytic facsimile printing would benefit from expanded analytical research to more precisely determine the nature of the image material. Based on historical literature and initial testing it appears the image material is a metal-organic complex, similar to an ink or a dye. There are likely other components in the facsimile papers such as fillers, optical brighteners, and humectants that may also affect the preservation of the prints and warrant further research. Based on the discovery of the soluble component of the image material electrolytic facsimile prints should be protected from exposure to moisture. Microfading results indicate the prints will likely be stable in conservative exhibition conditions, although further testing should be conducted in non-accelerated conditions.

Finally, the author would like to request that readers contact her if they encounter electrolytic facsimile prints in their collections or practices. Contact information is provided below:

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Pushing the Limits of the Identification of Photographs: Variants of the Gum Dichromate Process

Art Kaplan and Dusan Stulik

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand

Abstract:

Advanced methods of non-destructive chemical analysis of photographs have been developed and tested for identification of all major photographic processes used during the era of so called "chemical photography". Using visual and microscopic clues in combination with the identification of inorganic material using X-ray fluorescence spectrometry (XRF) and organic material using attenuated total reflectance (ATR) Fourier transform infrared (FTIR) spectroscopy (ATR-FTIR) and enzyme-linked immunosorbent assaying (ELISA) allows for highly reliable identification of almost all photographic processes used in the past. Many major photographic processes described in photographic and technical literature had many different variants and modifications introduced by photographers or researchers to achieve certain visual or textural qualities of resulting images or to simplify or speed up darkroom processing. A reliable and clear identification of these process variants is possible only when the resulting photographic images have substantially different chemical composition or a specific image structure characteristic only for a given variant of the photographic process. Photograph conservators as well as collection curators and managers need to know what the current, scientifically based process identification methodology can do and what are its' current limits. Researchers in photographs also need to know the limits of current, non-destructive analytical procedures and which identification questions might be answered by analysis requiring micro-sampling (ELISA). The experimental photographic process album created by the photographer Ted Jones, from the collection of Alex Novak, contains a number of different variants of gum dichromate pigment prints re-created using published historical recipes. The analytical (XRF/ATR-FTIR/ELISA) investigation of all gum dichromate prints in the album that included modified recipes, multiple and tri-color pigment gum photographic prints as well as some special variants of the gum pigment process (glue as gum, gum using acrylic paint, etc.) provided interesting insight into variants of the gum dichromate process and their identification.

Introduction:

In November 2000 the GCI organized an international expert meeting of conservation scientists, photograph conservators, photography art historians and educators working in photograph conservation at the George Eastman House in Rochester. The goal of the expert meeting was to identify several important research ideas that were needed by the photograph conservation field but that were not sufficiently covered by other sister photograph conservation research institutions worldwide. Following the discussion several research ideas were identified as high priority needs that also corresponded well with the existing expertise of GCI scientists and equipment available for the project at the GCI scientific and analytical laboratories. At the end of the meeting participating experts identified advanced research in the scientifically based identification of photographs, photographic materials and photographic processes as one of the most important research topics needing to be fully developed. Without knowing the photographic processes used when making a given photograph it is very difficult to work out the environmental conditions needed for its long term preservation as well as proper display or exhibition conditions. A detailed knowledge of the process chemistry, its' processing and post-processing treatment and its' potential deterioration pathways are critical in developing strategies for its conservation and preservation treatments.

For this work the GCI began developing a methodology and assembling a portable scientific laboratory (fig. 1), composed of a digital microscope, UV lamp, micrometer, caliper, XRF, ATR-FTIR and several computers, that could be moved between collections to identify and analyze examples of various photographic processes and materials (Stulik 2005). The portable laboratory is already in its third iteration and is constantly being upgraded with well tested and rugged portable instruments. One of the major goals of the project was to publish an *Atlas of Analytical Signatures of Photographic Processes* that would document the analytical signatures (microscopy, XRF, FTIR, SEM) of all of the processes and process variants of the chemical photography era. When work began on documenting the analytical signatures of historic photographic processes it quickly became clear that the identification of well characterized and well identified examples of all photographic processes would be a significant hurdle. Most photographic material in museums, archives, libraries and private collections is not well identified and in some cases incorrectly identified. Since the beginning of the project the GCI photo project team has contacted a large number of collections of photographs regarding access to examples of unique and often difficult to find and identify photographic processes.

Fig. 1. The GCI portable scientific laboratory.

In 2008 a frequent collaborator of our project, the photography dealer Alex Novak, contacted us in regards to a process album he had obtained from his friend, photographer Ted Jones. Jones spent a significant portion of his career working in TV production, editing, producing and directing various shows and received numerous awards for his work. In 1977, Jones began freelancing making videos, films and photographs. His photographic work focused on 19th century non-silver photographic processes with a particular focus on the gum dichromate process. A retrospective traveling show of his gum dichromate prints was exhibited throughout Scandinavia during a two year period and his photographs are in the collections of the St. Louis Art Museum, the University of New Mexico Art Museum and the James A. Michener Museum of Art. Jones passed away quietly at his home in August of 2007.

The Jones process album was created in the early 2000s and is composed of 43 prints all made using different photographic processes. The process used to create each print is described in the text accompanying the album with the amount of information ranging from only a reference to the published recipe to having a complete list of chemicals, processing steps and materials used to create a particular print. Of particular interest to us were 10 variants of the gum dichromate process (Table 1) that were included in the album and created using historical recipes (Maskell and Demachy 1897; Eastman Kodak 1898; Richards 1905; Scopick 1978; James 2000). These examples were ideal for inclusion in the Atlas of Analytical Signatures of Photographic Processes.

Inventory Number	Process Description
TPB001	Demachy gum process
TPB002	Multiple gum printing
TPB003	Gum printing in color (three color)
TPB004	Albumen-gum dichromate process (Renger-Patzet 1904)
TPB005	Gum process (Sawyer 1933)
TPB006	Gum dichromate (Richard's process 1896)
TPB007	Photo aquatint (Demachy postscript)
TPB026	Casein printing
TPB028	Glue as gum
TPB033	Gum using acrylic as pigment

Table 1. Inventory of gum dichromate process variants in the process album of Ted Jones.

The gum dichromate process is very flexible and two individuals producing prints using the exact same recipe can achieve very different results, primarily because the process relies on the hand coating of paper and the personal pigment preparation and application technique of the artist. The development of the print can also greatly affect its appearance and analytical signature depending on the water temperature, length of development and the use of localized development. This inevitably results in a non-uniform application of material to the paper and as such the quantitative analytical results are expected to vary even between two examples of the exact same process created by the same individual.

Each print was analyzed using XRF, ATR-FTIR and ELISA in an attempt to identify all of the inorganic elements and organic components of each print as well as to determine the capabilities of the methodology and instrumentation in differentiating variants of the gum dichromate process.

Determination of Elemental Composition Using X-ray fluorescence Spectroscopy:

X-ray fluorescence spectroscopy (XRF) is a non-destructive, non-contact technique that is often used in photograph conservation to determine the elemental composition of a photograph and its support. The technique makes use of the ability of high energy x-rays to ionize atoms by the ejection of inner shell electrons from the sample being analyzed. As the excited atoms de-excite they generate fluorescence x-rays which are then detected by the instrument and sorted based on their energies. The energies of the fluorescence x-rays are characteristic of the particular elements in the sample and can provide both qualitative and quantitative data. XRF analysis has been widely used in the study of cultural heritage primarily due to its portability, ability to perform non-destructive/non-contact analysis, and ability to provide elemental information on all elements in the periodic table with an atomic number greater than sodium (Potts and West 2008; Stulik and Kaplan 2012). Numerous studies of photographs and photographic materials related to authentication, provenance, identification and artist techniques have been performed using XRF analysis (McCabe 1995; Stulik 2008, 2011; Grieten 2010; Stulik and Kaplan 2012).

The XRF analysis of the gum dichromate pigment prints in the Ted Jones album was performed using a Bruker Tracer III-V air path portable XRF spectrometer with an approximately 1 cm spot size, with a Rhenium x-ray tube, Si-PIN detector, and a Yttrium foil internal standard. All analyses were carried out using an Al/Cu primary beam x-ray filter, operating at 40 kV and 15 μA for 300 dead time corrected seconds at a distance of approximately 3 mm from the sample. To obtain information on the presence of elements with an atomic number lower than potassium the analyses were performed with a vacuum attachment, without an x-ray filter, operating at 15 kV and 12 μA for 300 dead time corrected seconds at a distance of approximately 3 mm. Each print was analyzed in the maximum image density area (D-max) and minimum image density areas (D-min), both in the ambient environment and under vacuum, in order to identify the elements present and their location in the print (image area, paper support, or both).

The goal of the XRF analysis was to identify any elemental differences between the different variants of the gum dichromate process present in the album including detection of chromium from the sensitizer or other sources, detection of any fillers, buffers or opacifiers in the paper base, identification of any additional inorganic elements added during the processing of the prints, any inorganic pigments used, and to identify any elements present in the prints that are inconsistent with the historical recipes.

The major differences between the different variants of the gum dichromate process present in this album primarily have to do with differences in the concentration of the sensitizer, the choice of ammonium or potassium dichromate, the amount of gum arabic and pigment used, with the one exception being the Renger-Patzet variant which utilizes manganese sulfate in the sensitizer (Wall 1931).

The typical XRF spectrum for a gum dichromate print (TPB001) showing analysis of both the D-min and D-max areas is shown in figure 2. The print was created using Robert Demachy's

French formula (Eastman Kodak 1898) and utilizing an unknown pigment. Elements detected include calcium, titanium, chromium, manganese and iron. When comparing the spectra for both the D-max and D-min areas it is observed that the levels of calcium, chromium, manganese and iron are significantly higher in the higher density image areas of the print while the amount of titanium detected is lower in the D-max area of the image. From this information we can state that the titanium is from the paper substrate, most likely as titanium dioxide (TiO_2) whitener in the paper. While the presence of calcium, chromium, manganese and iron are all from the image areas. The most likely source of calcium, manganese and iron is from the pigment used to create the print, most likely umber, a brown toned pigment composed of manganese and iron oxides which may also contain other material such as calcite or silicate (Eastaugh et al. 2008). The higher titanium signal in the D-min area of the print is due to the fact that there is less material between the paper base and the instrument to attenuate the titanium signal from the paper.

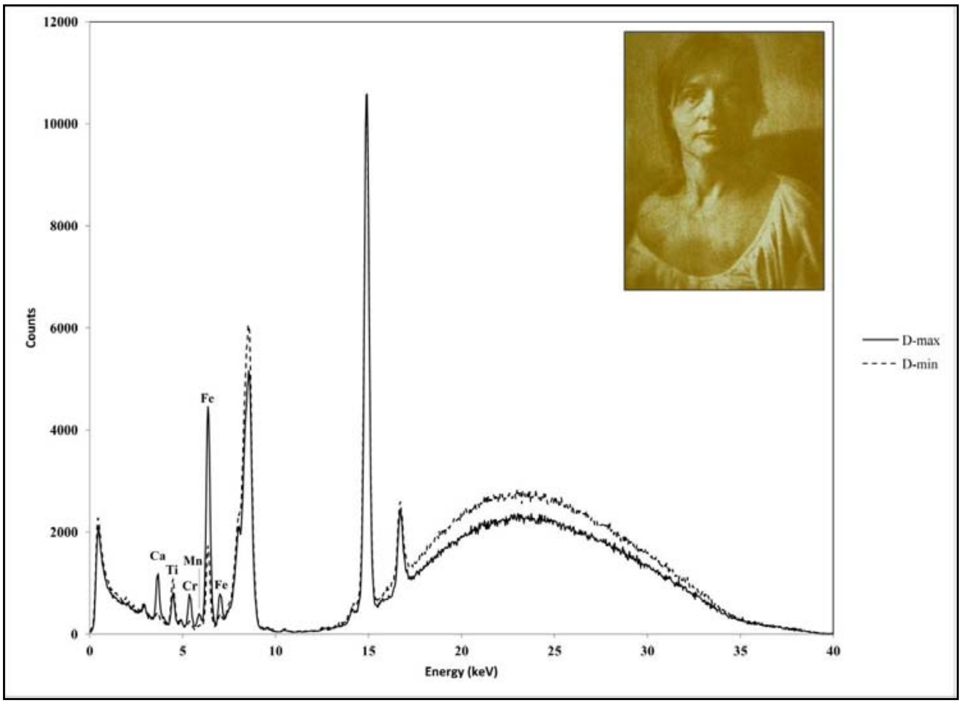

Fig. 2. XRF analysis of the D-max and D-min areas of print TPB001.

The chromium is present from the dichromate in the sensitizer. There are other possible sources of chromium that could account for its presence either as a pigment or as a hardener (chrome alum) in the sizing of the paper. In order to compare the chromium signal from gum dichromate prints created using a chromium based pigment as opposed to those where the sensitizer is the only source of chromium we compared the XRF analysis from the Sawyer variant print of the gum dichromate process in the album, which was created using a chrome oxide pigment, to the chromium signal from the other 9 variants in the album, none of which utilized any chromium based pigments. The analysis of chromium in the 9 prints where the sensitizer and possible sizing agent were the only sources of chromium found that the peak area for Cr Kα ranged from 1741 to 8648 counts while the peak area for the Cr Kα in the Sawyer process gum print using a chrome oxide pigment was found to be 20041, a value two and a half times that of the highest chromium signal observed for any of the other prints. From this comparison it can be seen that the signal observed for chromium in chromium pigment based prints is significantly higher than when the sensitizer and sizing agent are the only sources of the chromium signal. An exception to this may be seen with pigment processes where a very small amount of chromium based pigment was used, e.g., mixed with other pigments in order to create a specific hue in a particular layer or in a layer containing a very small amount of chromium based pigment to enhance particular image details or for other aesthetic reasons.

In researching the historical recipes for the 10 variants in the album it became clear that the only print exhibiting any changes in the elemental composition, excluding pigments, in its recipe was the Renger-Patzet (TPB004) variant. The recipe for the variant calls for the addition of manganese sulfate to the sensitizer. The process claimed to be an improvement over the gum dichromate process especially in the rendering of half-tones (Wall 1931). The recipe calls for the use of 5 grams of manganese sulfate in 12 mL of sensitizer, a relatively small amount of manganese. Figure 3 shows the XRF spectrum for the print analyzed in both the D-min and D-max areas and the detection of the manganese signal. The manganese signal is low but is still well above background to be able to positively identify its presence and suggest the possibility that the print may be the Renger-Patzet version of the gum dichromate process. One caution in regards to this interpretation is that in addition to the presence of manganese in the sensitizer there are also a number of manganese based pigments (Eastaugh et al. 2008) that could have been used. Since the manganese is carried in the gum layer of the image it's XRF signal varies with the thickness of the gum layer which can lead to difficult interpretation problems, in particular that the XRF signal would behave the same as it would for a manganese based pigment in that the amount detected varies in proportion to the amount of gum and therefore pigment in the layer. In this case the artist listed bone black as being the pigment he used and so we know that the only likely source of the manganese signal is from the manganese sulfate in the sensitizer.

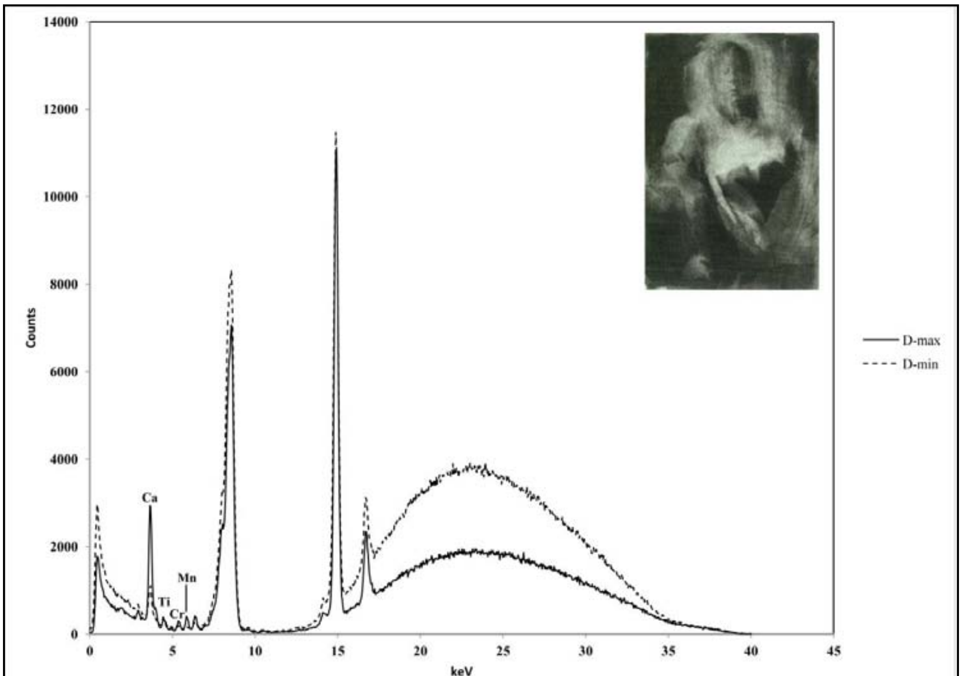

Fig. 3. XRF spectrum of the analysis of the D-max and D-min areas of TPB004.

One of the most useful aspects in using XRF to analyze gum dichromate prints, or any pigment prints, is the ability to identify inorganic pigments in the prints and provide information as to the prints long term stability and aid curators, conservators, archivists and collectors in determining proper storage and exhibition conditions for the print. It has long been known that pigments vary greatly in terms of their light stability and environmental susceptibility and as such it is critical to properly identify the pigments used to create the prints in order to properly exhibit, conserve and store them without causing any damage.

Of the ten prints in the album eight of them had the pigments used to create the prints listed (Table 2). Because some of the variants in the album where from multiple printings the number of pigments actually described was 13 with 2 of the pigments used not identified. Of the pigments listed 3 were organic and undetectable using XRF analysis while 2 others were described but the manufacturer did not provide any information as to their composition and XRF analysis did not detect any inorganic components.

Inventory Number	Manufacturer	Pigment Used	Elements ID'd
TPB001	None listed	None listed	Fe, Mn
TPB002	Winsor & Newton	Cadmium red deep	Cd, S, Se
	Winsor & Newton	Golden yellow	Cd, S, Se
TPB003	Grumbacher	Cadmium red light	Cd, S
	Winsor & Newton	Golden yellow	Cd, S
	None listed	Rembrandt blue	None
TPB004	None listed	Bone black	Ca, P
TPB005	Winsor & Newton	Chrome oxide	Cr
TPB006	None listed	None listed	None
TPB007	Van Gogh	Permanent red light	None
TPB026	Winsor & Newton	Spectrum red	None
	Winsor & Newton	Permanent yellow deep	None
TPB028	Winsor & Newton	Chinese orange	None
TPB033	Utrecht	Acrylic red oxide	Fe
	Utrecht	Gold ochre yellow	Fe

Table 2. XRF identification of pigments in gum dichromate prints

The XRF analysis confirmed the presence of four cadmium based pigments, both in the form of cadmium sulfide, a yellow colored pigment, cadmium selenide, a red colored pigment, and cadmium sulfoselenide, a mixture of the two, which can vary in color from yellow to orange to red, and is identified by the presence of cadmium, sulfur and selenium in the spectrum.

The XRF analysis was able to confirm the presence of iron based pigments in two of the prints and also identified an iron and manganese based pigment, possibly umber, used to create one of the images (TPB001) for which no pigment was listed. The identification of bone black pigment in TPB004 was confirmed by the detection of elevated calcium and phosphorous in the D-max area of the spectrum obtained under vacuum as compared to analysis of the D-min area (Fig. 4).

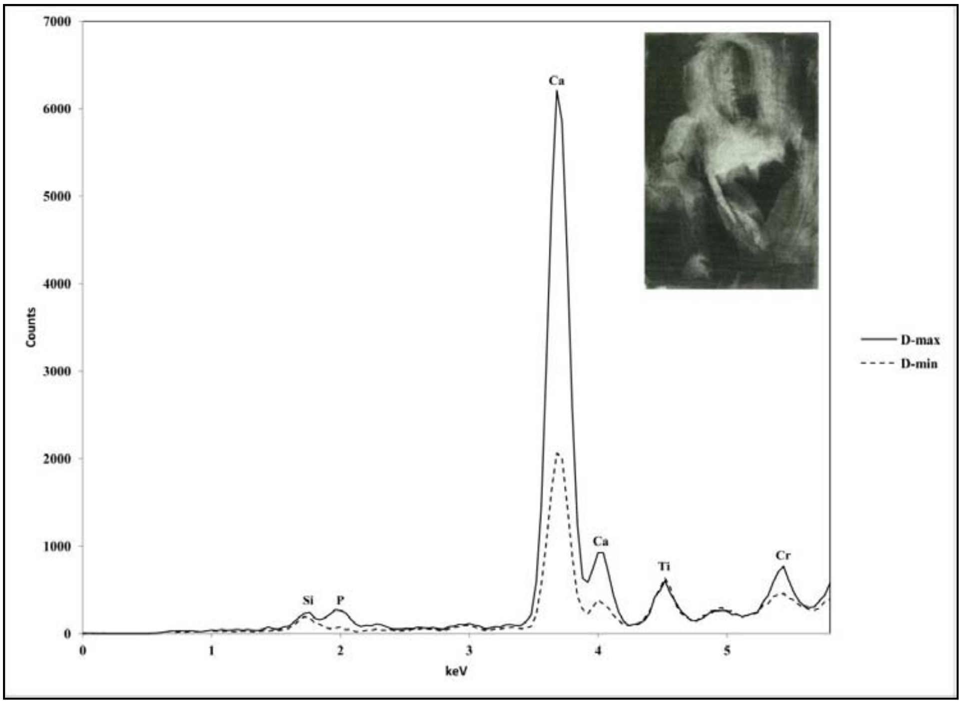

Fig. 4. XRF analysis using vacuum to identify low Z elements in the D-max and D-min areas of TPB004.

Identification of Organic Components by Attenuated Total Reflectance Fourier Transform Infrared Spectroscopy:

Attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FTIR) is an important tool in the examination of historic art materials. The technique provides information about the bonding features between atoms or functional groups in a molecule and can also provide important information about chemical changes in a sample following aging or chemical treatment through the appearance of new bands, band shifts or changes in the intensity of existing bands in the spectrum. The technique is ideal for the study of museum objects because it requires no sampling or sample preparation and is an ideal complement to XRF analysis in the study of photographs and photographic materials because it can provide objective analytical information on the presence of organic materials in the photographic support, binders in the image layer and coatings and varnishes that may have been applied to a photograph print, film or negative post processing (Derrick et al 1999; Khanjian and Stulik 2003).

The technique makes use of the ability of infrared radiation to cause rotational, translational and vibrational motion within molecules. As the infrared radiation is absorbed by the sample the instrument generates a spectrum depicting the absorbance or transmittance of the sample versus the wavelength or wavenumber. The spectrum for a particular molecule is unique and is often called a "fingerprint". Unknown materials can be matched against a spectral library of well know and well characterized materials to identify it. This can be done because the position of particular absorption bands in a spectrum are often unique to particular functional groups and occur at or near the same wavelength regardless of the composition of the material.

All of the prints from the Jones album were analyzed using a SensIR *TravelIR* ATR-FTIR, with a HeNe laser, DTGS detector and a single bounce diamond crystal mounted on a stainless steel DuraDisk. The instrument performs 64 scans at a 4 cm^{-1} resolution through a spectral range of 4000 to 650 cm^{-1}. The results were matched against a custom built library created from the analysis of over 15,000 photographs and photograph components.

The identification of gum dichromate prints using ATR-FTIR analysis has one significant deficiency and that is the composition of the gum arabic. Gum arabic, or acacia gum, is a natural plant gum harvested in Africa and Western Asia. Gum arabic is a polysaccharide composed of long-chain polymers of sugars and falls into the same group of molecules as cellulose, a monosaccharide and the primary component of most papers. As such the ATR-FTIR spectrum of gum arabic and cellulose are very similar, both exhibit two broad bands at ~1000 and ~3300 cm^{-1} along with a band at ~1300 cm^{-1} and ~1625 cm^{-1}, (Fig. 5) and it can be easy to mistake one for the other, the one significant difference being that the ~1625 cm^{-1} peak is typically more pronounced in gum as opposed to cellulose but this can vary depending on the particular sample. Although difficult it may still be possible to differentiate the spectra of cellulose and gum arabic by either looking at differences in some of the minor bands in the sample or, in the case of gum dichromate prints, comparing the spectrum of the image area to the spectrum of the paper base to see if they differ (Fig. 6). Unfortunately, in most cases, the spectrum of gum arabic prints and the paper material on which they sit are almost identical, with the exception of a situation in which a sized paper was used where the amount of sizing agent was high enough to be detected by ATR-FTIR thereby providing some indication of a difference in composition between the paper and the image layer. Any differences would most likely be minor and it is important not to over-interpret the spectrum and mistake something like sizing in the paper for some indication of a particular photographic process. This can be additionally difficult because the 1625 cm^{-1} peak for gum arabic and cellulose overlaps the Amide I protein peak (~1650 cm^{-1}) that is present in gelatin and albumen photographs as well as in protein sized paper.

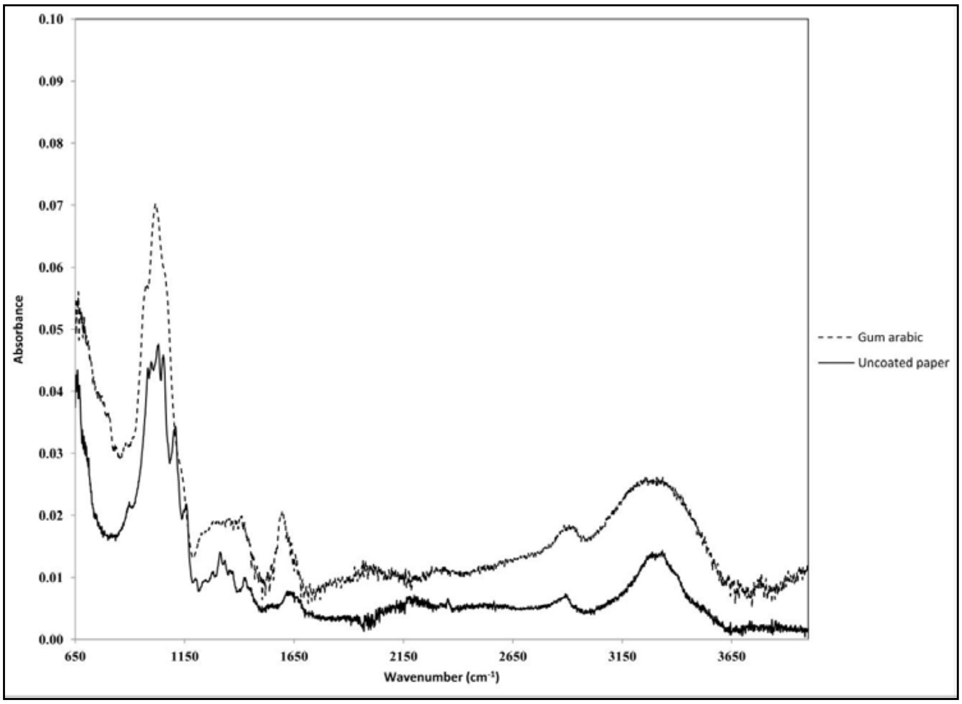

Fig. 5. FTIR spectrum showing the analysis of gum arabic and plain paper.

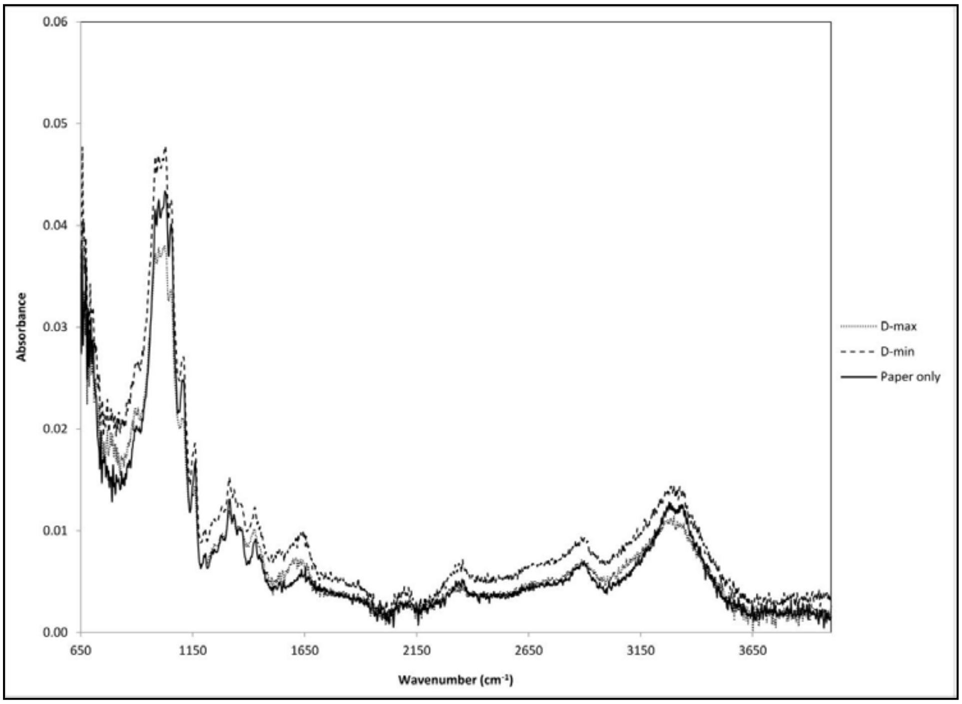

Fig. 6. FTIR spectrum of the D-max, D-min and paper only areas of print TPB001.

Several variants of the gum dichromate process that were included in the Jones album were of particular interest to us in testing the limitations of our instrumentation and methodology. Among these were the Renger-Patzet albumen gum dichromate process (TPB004) and the glue as gum (TPB028) variant. Figure 7 shows the ATR-FTIR spectrum of TPB004 and the Amide I (1633 cm^{-1}) and Amide II (1537 cm^{-1}) peaks are clearly visible along with the 1021 cm^{-1} peak. Only the 1537 cm^{-1} gives any indication that the material being investigated is something other than cellulose or gum, since we know the variant used to create the print we can clearly identify the peak as being the Amide II peak of the albumen protein. However without this additional information there is nothing in the spectrum alone that would lead one to suspect that the print was created utilizing gum dichromate unless you had additional information (e.g., XRF detection of chromium, ELISA detection of plant gum) from other analyses.

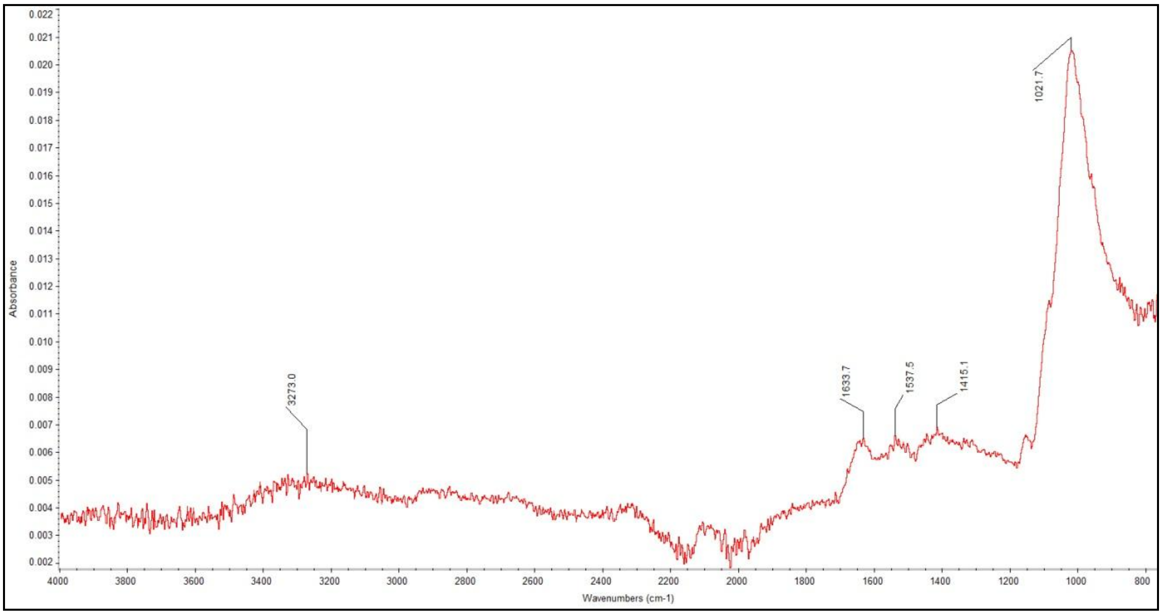

Fig. 7. ATR-FTIR spectrum of the albumen-gum dichromate print (TPB004).

The ATR-FTIR analysis of print TPB028 (Fig. 8) illustrates the importance of building comprehensive spectral libraries. The print is the glue as gum variant of the gum dichromate process and has no gum arabic, rather the pigment is mixed with animal glue and potassium dichromate before exposure. The XRF spectrum clearly shows the presence of chromium and can lead one, based on visual and microscopic examination, along with XRF analysis to identify it as being gum dichromate, carbon or some other photographic process based on the ability of dichromate to harden organic colloids upon exposure to light. Fortunately for us the artist listed the specific adhesive he used for the glue component of the print, Lineco adhesive, which we were able to acquire. From the ATR-FTIR spectrum we can see that all of the spectral peaks from the adhesive are also clearly visible, at the same position with changes in intensity, in the analysis of the print. This example clearly illustrates the benefit of having a comprehensive spectral library of materials as well as a comprehensive analytical methodology for the analysis of photographs and photographic materials.

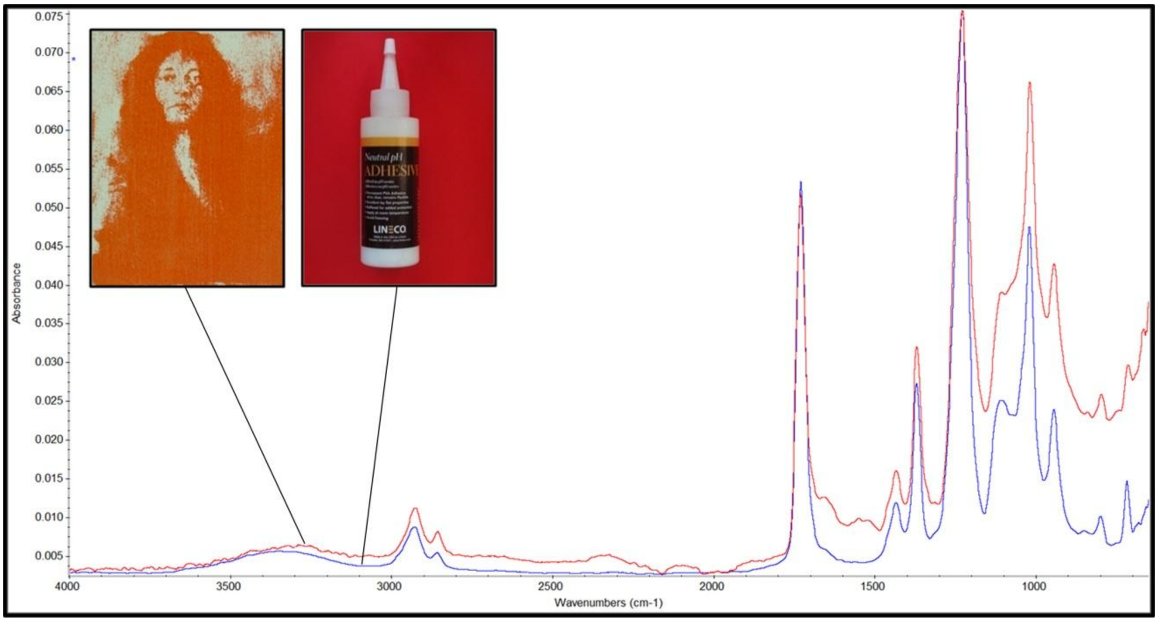

Fig. 8. ATR-FTIR spectrum of a glue as gum print (TPB028) and the glue alone.

Identification of Gum Arabic in Photographs by Enzyme-Linked Immunosorbent Assay:

Enzyme-linked immunosorbent assaying (ELISA) is a technique used for detecting and quantifying the amount of various substances (proteins, antibodies, hormones, etc.) in a sample. The technique is able to identify and quantify a number of substances used in photographic processes including albumen, casein and plant gums (Mazurek 2008, 2010). The technique works by using antibodies specific to the substance of interest, which are bound in the wells of a microplate. Once sampled, the substance being investigated will bind to the antibodies on the plate and the bound sample-antibody complex with either directly cause a color change in the solution or a secondary antibody is added that binds to the sample-antibody complex and causes a color change. The absorbance of the solution is then measured at an appropriate wavelength using a UV-Vis spectrophotometer. The color change is compared to a series of standard solutions to determine if the solution contains the substance of interest. The amount of substance present in solution can be determined based on the absorbance of the solution as compared to the absorbance of standard solutions. ELISA was used to test the prints in the album in order to identify the presence of gum arabic as well as to test the application of the technique for use in the identification of variants of the gum dichromate process through the detection of albumen and casein as well as to test the methodology for possible false positives from the improper binding of antibodies to other materials.

For the analysis a dry cotton applicator was used to swab the surface of a photograph. Dry swabbing works because the typical surface of a gum dichromate photograph has no coating and the gum arabic is exposed and fragile enough that lightly dragging something across the surface of the print removes material. Swabbing the surface of the photograph with a dry swab and very light pressure, similar to dusting, can remove enough material for analysis yet leaves no visible evidence of the sampling. The swabbed sample was then prepared and analyzed using ELISA. The detection limits for gum arabic are typically in the range of ~1 ng/ml but vary based on the manufacturer of the product. Because the amount of material removed from the surface varies based on several factors (pressure applied during swabbing, surface condition, gum arabic concentration, etc.) quantitative results are not possible unless the amount of material removed can be standardized. A negative result is not a confirmation that there is no gum arabic in the photograph rather the amount of material removed during the dry swab procedure may not contain enough gum arabic to obtain a positive result.

For the ELISA analysis each sample was swabbed and tested for casein, albumen and plant gum in order to confirm the presence of gum and to identify evidence of possible variants of the gum dichromate process in the cases of TPB004 and TPB028. After swabbing all visible sample material was removed while keeping the amount of cotton removed from the swab to a minimum. The samples were prepared for analysis according to Mazurek (2010). The absorbance of each solution was measured at 405 nm using a Finstruments model 341 microplate spectrophotometer.

The results from the analysis are shown in figure 9. A positive result is one where the absorbance of the solution is above 0.3, a value well above what was measured for the blank. Each of the prints tested positive for the presence of plant gum with the exception being TPB028 which came in just below the cutoff for a positive test. TPB028 is the glue as gum variant of the gum dichromate process and uses no gum arabic. The elevated signal for the presence of gum arabic may be due to some cross contamination during the ELISA procedure from other samples or it may be due to something else in the sample that could lead to a false positive for plant gum. One additional aspect of the ELISA analysis of TPB028 was that it also came close to testing positive for the presence of casein. This should not be unexpected since this print contains pigment mixed with glue as opposed to gum. Casein based adhesives exist and have been used in everything from wood glues, canvas sizing and pigment binding (Tracton 2006). This close positive may be an indication that some component of the glue may be close in structure to what the antibody used typically binds to in plant gums. Further evidence to suggest the possibility of this "improper" binding of the antibody to the incorrect target molecule is that the antibody itself doesn't exhibit strong specificity to gum arabic but rather binds to a whole range of plant gums (Mazurek 2008) thereby increasing the likelihood of false positives.

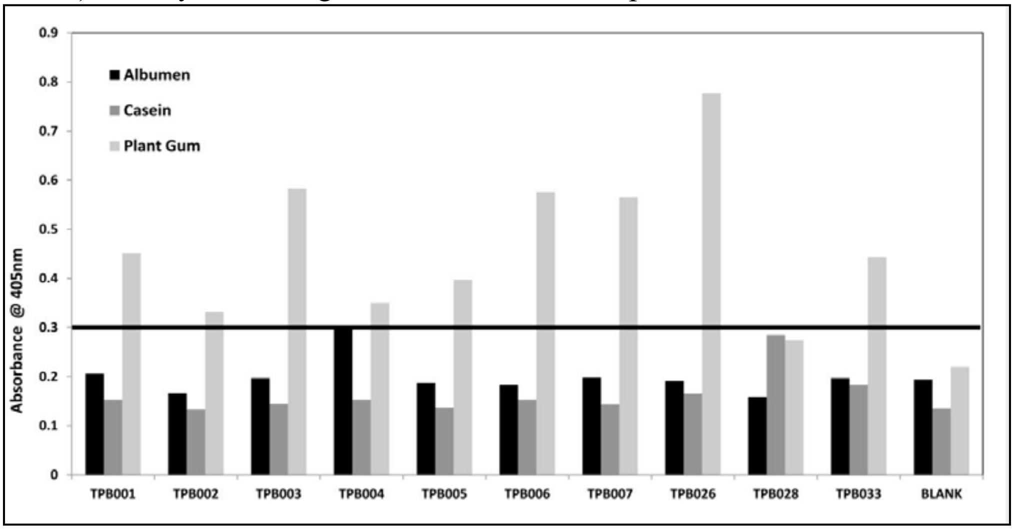

Fig. 9. Results of ELISA analysis for the gum dichromate variants in the album.

The other variant of the gum dichromate process that was interesting to test using ELISA was TPB004, the Renger-Patzet albumen-gum print. TPB004 tested positive for the presence of both plant gum and albumen which would indicate that the dry swab sampling was able to remove enough gum and albumen from the surface of the print for the ELISA analysis to detect both.

The greatest advantage of ELISA as opposed to ATR-FTIR analysis is in the fact that unlike ATR-FTIR which has a hard time positively identifying the presence of gum arabic in a gum dichromate print because of the similarities in the spectrum to cellulose, ELISA analysis can positively confirm the presence of a plant gum in the print, making it a useful tool when either confirmation of FTIR results are desired or if positive identification using other methods aren't possible.

Conclusion

The identification of gum dichromate prints using noninvasive analysis works well when identifying gum dichromate prints in general but the identification of different process variants requires the existence of clear chemical signatures (markers) that are unique for a given variant of the process. XRF analysis is a particularly useful tool when analyzing the majority of inorganic pigments that contain heavier chemical elements (e.g., different variants of cadmium pigments). Vacuum XRF even allows one to differentiate between lamp black and bone black pigments based on the detection of phosphorous and calcium in the pigment. The absence of metal elements in an XRF spectrum of color monochrome or tri-color pigment prints clearly indicates the use of organic pigments or dyes. In the analysis of the Ted Jones album confirmation or identification of 9 out of the 15 pigment used was possible and the presence of chromium was identified in each of the prints where it was present.

FTIR analysis can provide information on organic binders and coatings or varnishes present in many photographic processes as well as chemical changes that may occur due to aging or chemical treatment of a photograph. Analysis of all the prints in the Ted Jones album using ATR-FTIR showed that regardless of the variant of the gum dichromate process used all of the ATR-FTIR spectra were very similar with the one exception being the albumen-gum variant which had some indication of protein being present, however the amount detected was so low that it was difficult to determine the source (e.g., binder, paper sizing, etc.). FTIR detection of gum arabic is complicated by the fact that both gum arabic and the paper substrate contain polysaccharide backbones.

In cases where the identification of the presence of gum arabic as part of the photographic process is found to be critical and sampling of the material has been authorized other analytical techniques can be used. One such analytical technique is ELISA and it requires minimum sampling due to its high sensitivity. Utilizing a cotton swab and extremely gentle pressure we were able to remove enough material to positively identify the presence of plant gum in all of the samples in the album where it was used. We were also able to show that the analysis of certain variants of the gum dichromate process may benefit from the use of virtually nondestructive ELISA testing for the detection of gum, glue, casein or albumen when used as a pigment binder. The establishment of a more consistent sampling procedure that could also determine the mass of material removed would be a necessary step for the use of ELISA for quantitative analysis.

Since 2000, the development of an objective scientifically based methodology for the identification of photographic processes and materials has been a focus of the GCI photo project team. In order to achieve this goal the GCI team assembled a portable laboratory of non-destructive scientific equipment. While the laboratory was a great start its capabilities, along with the developing methodology, could not be fully tested without having the proper material to analyze and it quickly became clear that the existence of well characterized and accurately described photographs are rare in collections. The photographic process album of Ted Jones was an ideal example of well characterized and described photographs that served as a test case to examine the capabilities of the GCI's constantly evolving portable laboratory and to provide some insight into the identification of numerous variants of the gum dichromate process. The scientific investigation of the album also demonstrated the strong advantages of a comprehensive scientific investigation of photographic prints in order to gain a more complete understanding of the composition of a particular print. Our future collaborative work with current alternative process photographers (Stulik and Kaplan 2010) working and experimenting with different pigment dichromate processes will be very beneficial to conservation scientists when pushing the envelope of current limits of the identification of pigment process variants.

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Pigment-Based Photographic Processes: A Technical Study of Pictorialist Works in the Metropolitan Museum's Collection

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Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

By the late 1800s, photography had become highly manufactured, standardized, and accessible to the public. Pictorialist photographers countered this popularization of the medium by turning to meticulously hand-crafted processes that allowed them full control and flexibility to express their creativity [1-3]. These artists printed one-of-a-kind works by using a variety of specialized techniques. They hand-coated papers, locally manipulated images, used multiple negatives, and often layered one process on top of another. Among the processes most commonly used during this period were gelatin silver, platinum, palladium, cyanotype and numerous pigment-based techniques, such as gum dichromate, direct carbon, carbon-transfer, bromoil, bromoil transfer, and ozotype.

The definitive identification of gum prints has proven to be a challenge due to the many variations and intermingling of processes used by photographers during this period. This research began with an investigation of the historic sources, followed by the creation of test samples strictly based on historic recipes, and the chemical analysis of these tests [4]. In the past, the presence of pigments and the identification of chromium have been directly associated with a gum dichromate or other dichromated colloid processes. Results of this research revealed that the presence of chromium and pigment has more complex sources, requiring a more discriminating approach and a modified protocol for the definitive identification of gum dichromate photographs. This protocol combines XRF, FTIR, in transmission and/or ATR, and Raman analysis and has shed light into the photographic techniques used in a number of Pictorialist works in the Metropolitan Museum's collection [5].

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Crystalline Deterioration on Glass Cinema Slides

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Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Abstract
Glass cinema Slides are similar to glass lantern slides. The slides are photographic images either created on an emulsion coated onto a glass plate or a section of photographic film sandwiched between two glass covers. The slides are intended to be viewed by projection onto a screen. The slides were used in many ways, such as advertisements and "sing-a-longs", during cinematographic performances from the dawn of cinema until the late 1970's.

Typically slides are robust, with physical damage the most common form of deterioration. However the National Film and Sound Archive (NFSA) collection contains examples of slides with significant crystalline growths that have formed within the slide.

Four slides from the 1930's, both black and white and hand colored, were made available to be deconstructed to closely examine the nature of the growths. The slides were deconstructed by removing the paper binding tape and separation of the glass plates. This was done in a way that permitted the slides to be reassembled with the original tapes intact.

Raman Spectroscopy identified the substance as sodium sulphate. Further testing using FTIR Spectroscopy proved inconclusive. Previous research by Ishikawa had determined that the adhesives used were unlikely to be the source of the sodium sulphate.

There was little technical information found on the paper used as the binding tapes. However based on the physical characteristics of the material required it was thought that kraft paper was possibly used. The limited information also indicated that kraft paper may be the source of the sodium sulphate. However, since the information is scant, further research is being conducted to follow this suggestion through.

The simplest approach to removing the sodium sulphate by gently swabbing with water was followed. However due to the water soluble nature of the color dyes great care was needed, as was the requirement to avoid drying marks.

Introduction
Glass Lantern or Cinema Slides are positive transparent images on glass designed to be viewed by projection onto a screen. The process for manufacture of a lantern slide required a negative to be exposed onto a photographic glass plate to form a positive image for projection. Later processes used a gelatin plate process to develop the image and photographic manufacturers used plates coated with silver chloride or silver bromide plus other organic compounds for the process. The photographic image was produced in monochrome and could be tinted, chemically

toned or hand colored. As the 20th century moved on, lantern slides were also made on film supports that were then sandwiched between glass.

Figure 1: Typical glass slide structure.

Once the photographic image was produced on glass it was sandwiched with a cover glass and then sealed around the edges with binding tape. Binding tapes made of paper with the adhesive already applied were sold commercially. The adhesive was activated by moisture and was usually gum based.

Research Aims

The National Film and Sound Archive (NFSA) hold a large collection of Glass Lantern and Cinema Slides. Within this collection there were a small number of slides exhibiting a white crystalline deterioration. As the most common type of deterioration for lantern slides is usually breakage of the glass support or damage to the photographic image layer, the deterioration on these slides was uncommon.

The aim of this research project was to identify the nature of this white crystalline deterioration. Once the nature of the crystalline substance had been confirmed, the information was to be used to develop a hypothesis of how and why this deterioration process occurred and to develop a treatment plan for the safe treatment of the deteriorated slides.

Four glass cinema slides, two colored and two black and white, were chosen for testing. No provenance or documented history was found to provide information on the age, usage or the storage conditions of these particular slides prior to their acquisition by the National Film and Sound Archive of Australia.

Investigation into the printed information on the paper binding tape of the pink colored glass slide, stating the glass slide manufacturer's name and address (Fig. 2), suggested that this slide was made in the early 1930's by Gunn's Slide, 9 Collins Place (Melbourne, Australia), between 1926 and 1938.

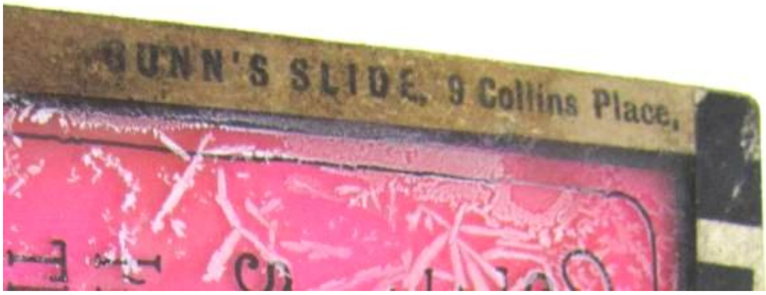

Figure 2: Binding tape showing the name and address of the slide manufacturer.

This information, as well as research into the song lyrics reproduced on the slides, indicates that it is probable that the slides were made around the same time that the songs were released. This would date the slides to be around 70 to 80 years old.

Methodology

It was essential that all testing techniques conducted on the glass cinema slides had to be non-destructive. A treatment was sought to remove the aesthetically blemishing and potentially pernicious substance. It was also important that once the research had been conducted and any appropriate treatments carried out, the slides could be reconstructed and the original paper binding tapes re-adhered to the glass.

Microscope Examination

A microscopic examination of each glass cinema slide being used in the research was carried out using an Olympus SZX9 microscope. Images were taken at several locations on each slide to examine the physical characteristics of the crystalline formation. Examples of these are shown in Figure 3.

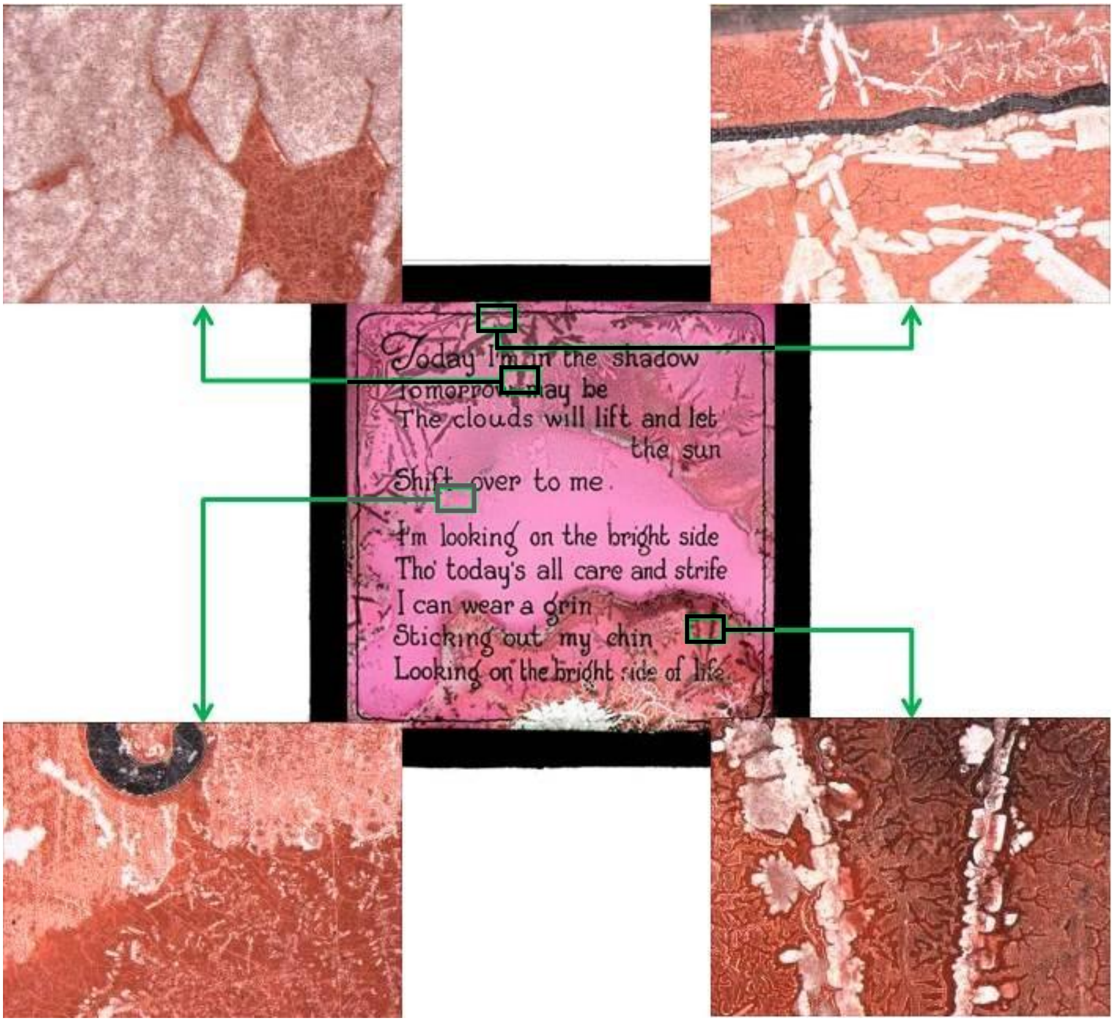

Figure 3: Photomicrographs of deterioration.

Slide Deconstruction

To access the white crystalline deterioration, the cover glass on each slide had to be removed.

The paper binding tape was detached from the glass slide on one side only, leaving the tape adhered to the other side of the glass slide. This was accomplished using a preservation pencil to relax the adhesive and soften the paper tape. It was then possible for a septum lifter to be guided under the edge of the paper tape and the paper lifted up to detach it from the glass.

This method of removal was generally straightforward except in a few areas which had an excess of adhesive. There were also some places where the tape was better adhered onto the vertical sides of the glass; it was hypothesized at the time that this may have been due to the deterioration process.

Once the paper tape was removed, the cover glass of the cinema slide was separated using a scalpel to pry the edges of the slide apart and break the seal. After separation, the crystalline formation was evident on both parts of the deconstructed slide.

Raman Spectroscopy

Raman Spectroscopy was chosen as a testing technique because of its non-destructive quality and minimal sample preparation requirement. It was serendipitous that the cover glass of the cinema slides fitted perfectly onto the Raman microscope stage eliminating the need to remove samples from the glass.

The Raman Spectrometer was set for testing using a 785 nanometer laser. This laser being closer to near infra-red, has lower energy than the alternative 653nm laser, thus reducing the potential for fluorescence in the test sample. Raman Testing was undertaken at the University of Canberra with the assistance of Alana Treasure, Paintings Conservator at the Australian War Memorial.

The testing was carried out in two separate locations on each cover glass. Initially, two visibly different areas of deterioration were chosen. However the finer thread like deterioration was not picked up by the Spectrometer and results showed peaks only for glass in these areas, possibly because the deterioration was too thin. Therefore each testing area was chosen for its solid white appearance (see figures 4a & 4b).

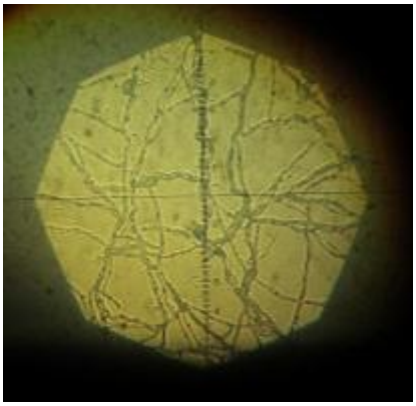

Fig. 4a: Threadlike deterioration.

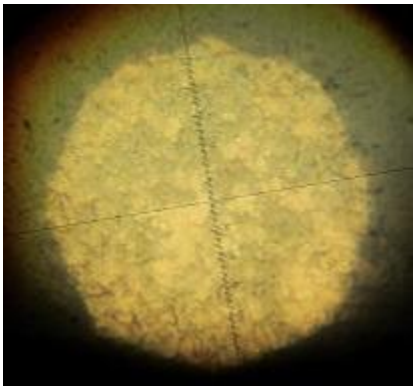

Figure 4b: Solid white deterioration as seen through the Raman microscope.

Binding Paper Test

The initial examination of the slides indicated that the crystalline deposits appeared to have started at the edges of the slide and progressed towards the centre of the slide. This suggested that the source of the crystalline substance was possibly external to either the glass or photographic image.

A test was conducted to see if any deterioration products could be extracted from the paper binding tape using a simple water extraction. A section of binding tape was removed from the black and white slide titled “My Shining Hour” (1) and the blue tinted slide titled “I’m Saying Goodbye with a Sigh” (2). Two test tubes were set up and the binding paper placed in the test tubes with 5mls of distilled water.

After a week, the water in test tube 1 was slightly cloudy while test tube 2 was less so.

The water from each test tube was qualitatively transferred to small beakers and the water was evaporated by heating (65-90^{o}C). After the liquid had evaporated a brownish residue remained in the bottom of each beaker. A sample of each residue was analyzed by FTIR Spectroscopy.

Fourier Transform Infra Red Spectroscopy (FTIR)

As a complimentary test and to confirm the Raman results, FTIR testing was undertaken at the National Archive of Australia.

With the assistance of the Archives’ Conservation Chemist, Ms Rajani Rai, analysis of samples of the crystalline substance was carried out using a Thermo Nicolet Nexus FTIR spectrometer in attenuated total reflection (ATR) mode.

Samples from each of the cover glasses from the four cinema slides were tested individually and samples of the residue from the extract of the two binding papers were also tested.

Crystal Growth Experiment

The morphology of the crystals as observed under the microscope showed that the growth was probably from the edge of the slide inwards and that the parent substance was located outside the slide microenvironment.

To test this hypothesis a simple experiment to observe the growth of salt crystals within the slide microenvironment was conducted.

Two glass plates of the same dimensions as typical glass slides were bound together on all sides with paper tape and held with metal spring clips (Figure 5). The entire apparatus was placed in a sealed vessel and left for 48 hours.

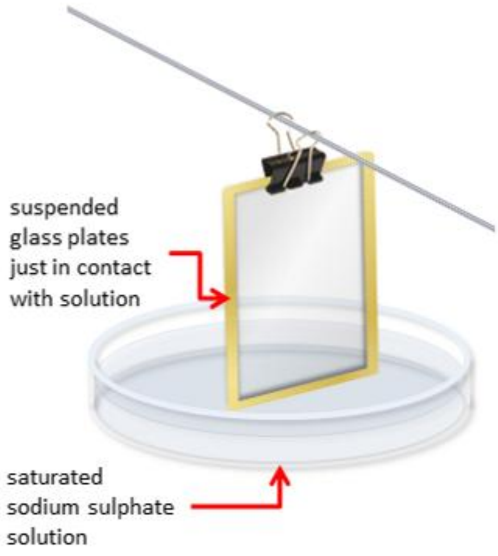

Figure 5: Crystal growth experiment.

The glass plates were removed from the vessel and left to sit under room conditions for several weeks until all the liquid that had been drawn between the plates had appeared to have evaporated and crystal growth had commenced.

Results

Raman Testing

The samples from all four glass cinema slides showed identical peaks, Figure 6 shows the typical spectrum. The peaks on the sample spectra substantially matched sodium sulphate (Na_2SO_4).

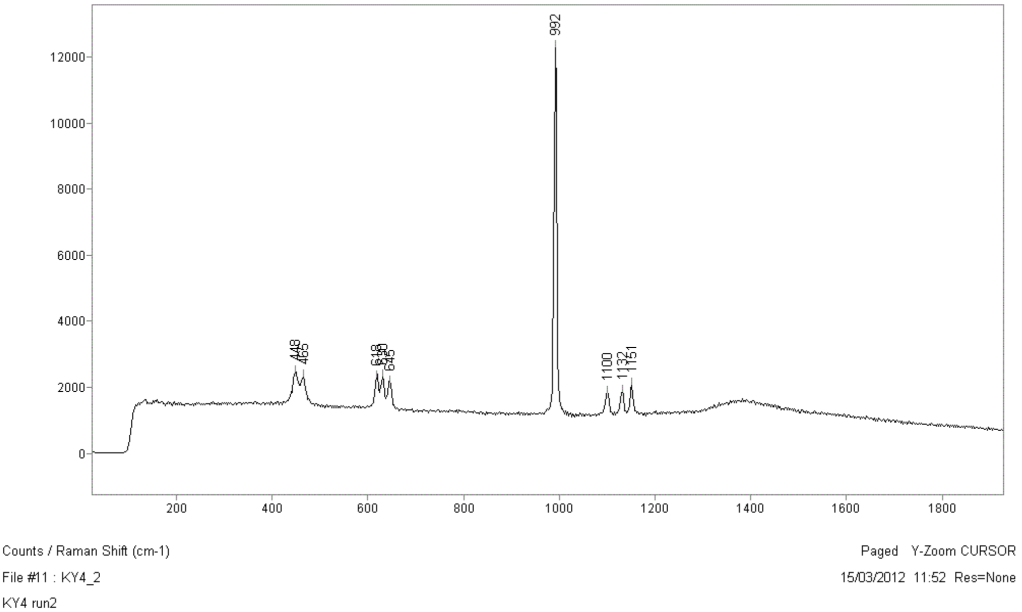

Figure 6: Raman analysis spectrum, typical from cover glass samples.

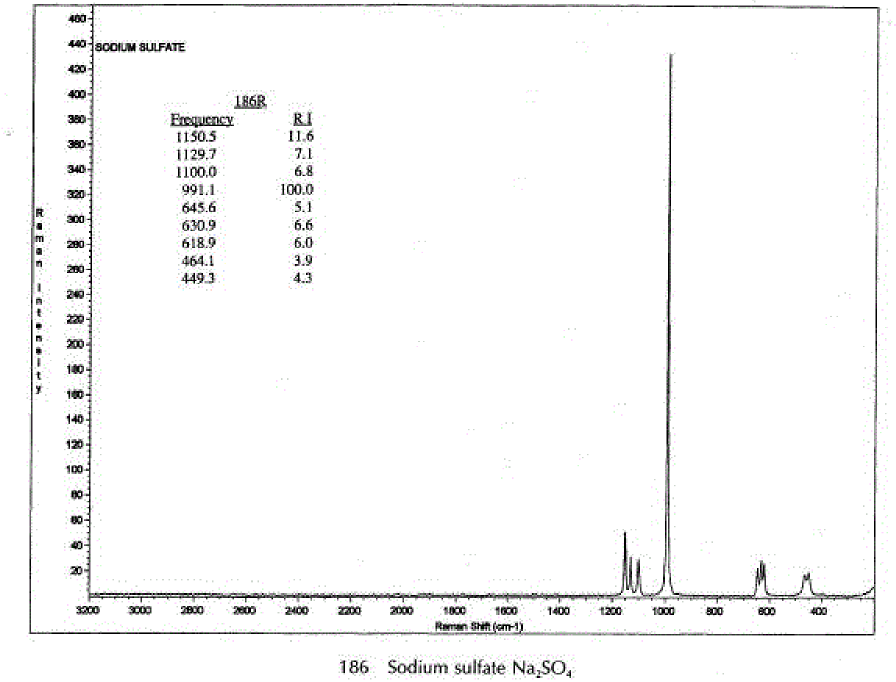

Figure 7: Sodium sulphate Raman spectrum.

FTIR Results (Cover Glasses)

FTIR results from samples from all four cover glasses showed that there were strong peaks at 610-640 cm^{-1} and also at 1098-1110 cm^{-1}. Small peaks at 1633-1637 cm^{-1} and at 3274-3301 cm^{-1} was also noted on all four samples.

Research indicates that sulphates show two characteristic frequencies, one at 610 to 680 cm^{-1} and the other at 1080 to 1130 cm^{-1}. The area around 1633-1637 cm^{-1} is also an indicator for Na_2SO_4. These results confirmed the presence of sodium sulphate in the crystalline substance.

However, the Spectral Library at the National Archive of Australia returned the nearest match for the cover glass spectra results as Logwood Extract (Figure 8).

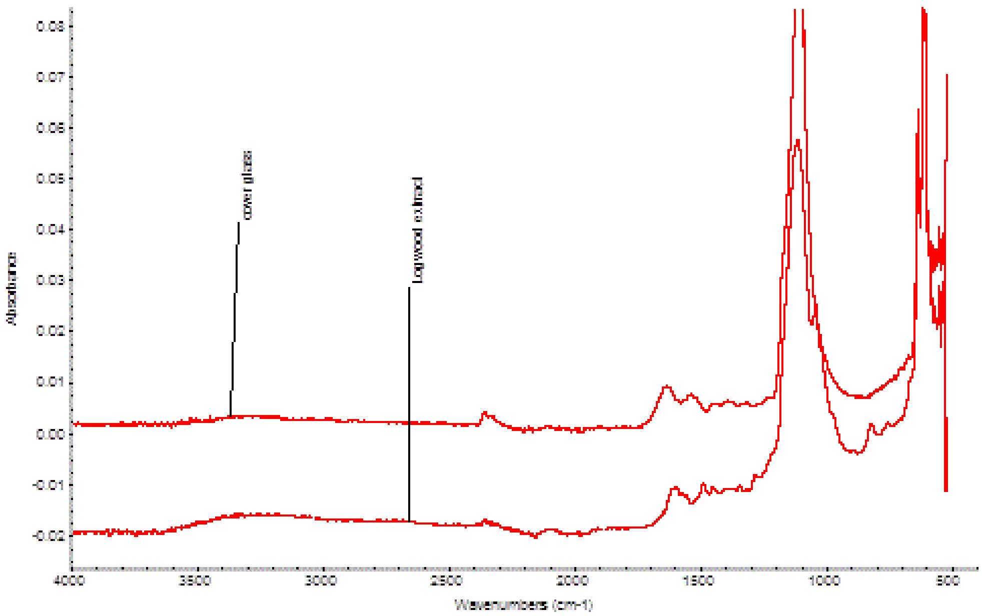

Figure 8: Overlayed spectra, cover glass sample and Logwood extract

Logwood extract is a dye which originates from the heartwood of the Logwood tree. This dye was used in the early 1900s to dye paper pulp and it was also used as a component of some inks. Further research is needed to determine whether this is a feasible match.

FTIR Results (Paper Extracts)

The FTIR results for the test sample from the paper extract contained strong peaks in the 1100 and 600 regions indicating a probability for sodium sulphate in the test sample. However, the National Archives Spectra Library showed the closest match for the paper extract was kaolin (Aluminum Silicate). Kaolin is used as filler in paper though it is insoluble in water.

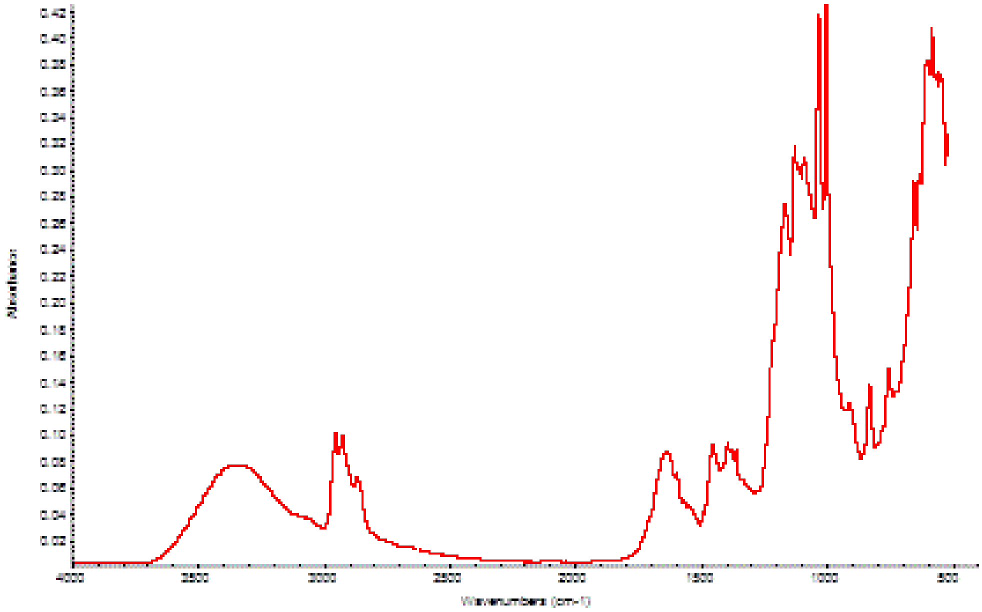

Figure 9: Paper extract 1.

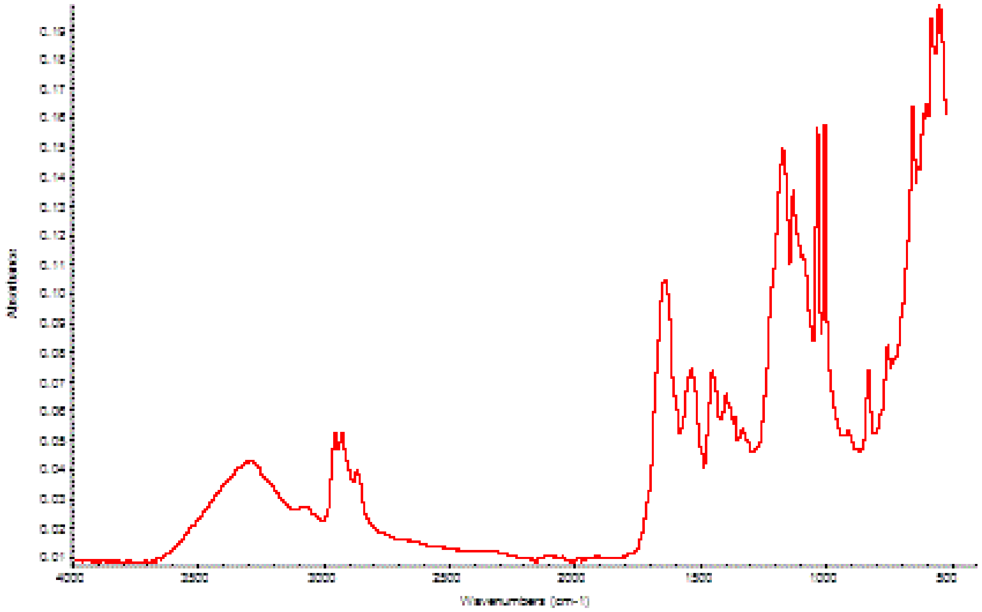

Figure 10: Paper extract 2.

Analysis of adhesives used on the binding paper tape from lantern slides held in the NFSA collection was conducted in 2010. The spectra result from this analysis showed a match for vegetable gum (Fig. 11) and it is considered highly probable that the slides used in this investigation used the same or a similar adhesive.

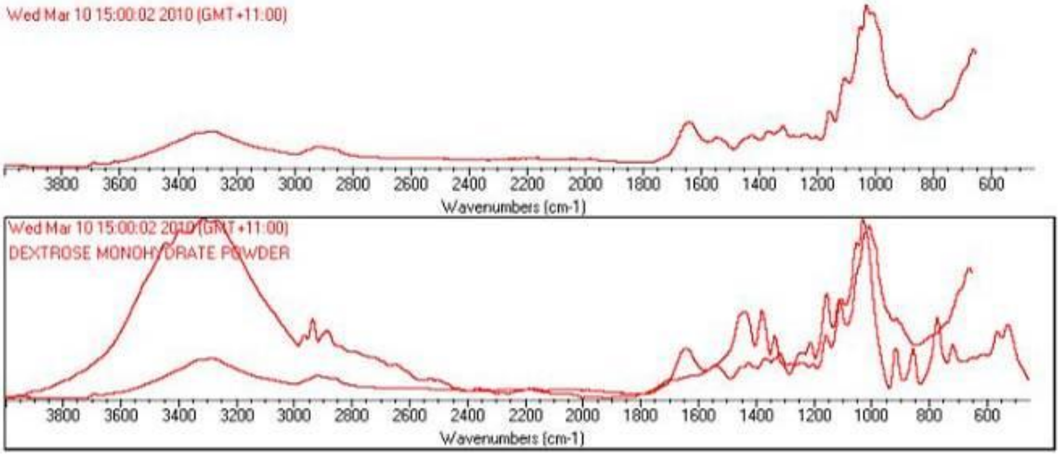

Figure 11: Binding tape adhesive FTIR (NFSA 2010).

Crystal Growth Experiment

Between the two plates a number of crystals had formed that were similar to the structure observed in the original glass slides under examination. (Fig 12). The nature of the crystal growth so closely followed the pattern in the experiment that it indicated that there may have been a great deal of water present at some time in the slides life, such as a water based disaster. A second close examination for signs of such a disaster was undertaken and clear signs of water damage found.

Figure 12: experimental analogue (left), original deterioration (right).

Hypotheses as to the Source of Sodium Sulphate

The Raman spectra clearly show that the predominant species in the crystalline substance is sodium sulphate. However the primary source of the sodium sulphate remains unclear as the FTIR Spectroscopy did not provide sufficient information.

The sodium sulphate present on the lantern slides may have come from a number of sources including the binding paper, glass and residual photographic chemicals or possibly even a combination of these sources.

Paper
Literature searches on the paper used for lantern slide bindings have not provided conclusive information. Physical examination shows the paper to be comparatively robust.

Sodium Sulphate is used by the pulp and paper industry in the production of cardboard and brown paper. It is also used in the manufacture of kraft paper. The Kraft process for paper manufacture was developed in 1883. This process produced a stronger paper pulp by the addition of sodium sulphate to the paper making process and by the early 20th century it was the most important pulping process.

Residual Chemicals
Glass cinema slides follow the typical photographic development process. From this era there were various formulations for fixing solutions, however “hypo” or sodium hyposulphite ($Na_2S_2O_3$) is predominant in all the formulations. Other chemicals commonly used in fixing solutions included potassium metabisulfite ($K_2S_2O_5$) and sodium sulfite (Na_2SO_3).

After fixing, the slide was washed. A washing regime described in contemporary literature (hypo) to be sufficient to remove the fixing solution recommended 2 minutes agitation in water repeated 7 times with fresh water for each wash. Depending on the efficacy of the washing procedure, residual fixer may have been present within the gelatin layer within the slide.

Glass
Sodium sulphate is used in glass making as a firing agent. The percentage is less than 1% w/w. The glass showed no obvious signs of deterioration.

Conservation Treatment
Due to inconclusive FTIR results it was decided to remove the deterioration from only 2 of the 4 slides so that if further research was to be conducted there would still be samples of the deterioration product available for testing.

Sodium Sulphate is soluble in water and therefore preparation and application for removal of the white deterioration product was straightforward. To test how the slides and the deterioration would respond to cleaning, the cover glasses were cleaned first using cotton swabs dipped in deionised water. Black pigment/color that had delaminated from the painted border (mask) of the slide was picked up by the swabs along with the sodium sulphate. It was not expected that the delaminated black color would be water soluble. The cover glasses cleaned up very well with all traces of the deterioration being removed.

Cleaning of the gelatin based side of the slide was conducted with extreme caution as it was not certain whether the text and colored tint on this side of the slide was also water soluble. Damp cotton swabs were lightly rolled across the surface of the gelatin emulsion. Black pigment was picked up by the swab but this was only around the outer edges of the slide. The text did not appear to be water soluble. Some faint color from the blue slide was picked up but this did not seem to have an effect on the appearance of the slide. The sodium sulphate was removed from the gelatin layer however crevices left by the deterioration product in the gelatin were still visible once the sodium sulphate had been removed in this area.

Due to the natural reaction of gelatin swelling when moisture is applied to its surface, the slides were left overnight to give the gelatin layer time to return to normal and to make sure there were no other problems prior to the reconstruction of the slides and re-adhesion of the paper binding tapes.

New binding tape was applied to the black and white slide on three sides as this slide had only one binding taped side prior to deconstruction. The original binding tape was re-adhered to the blue colored slide. All original binding tapes were re-adhered to the slides using methyl cell paste with deionised water.

The pink colored slide and the other black and white slide were also reconstructed but without any conservation treatment to the deterioration.

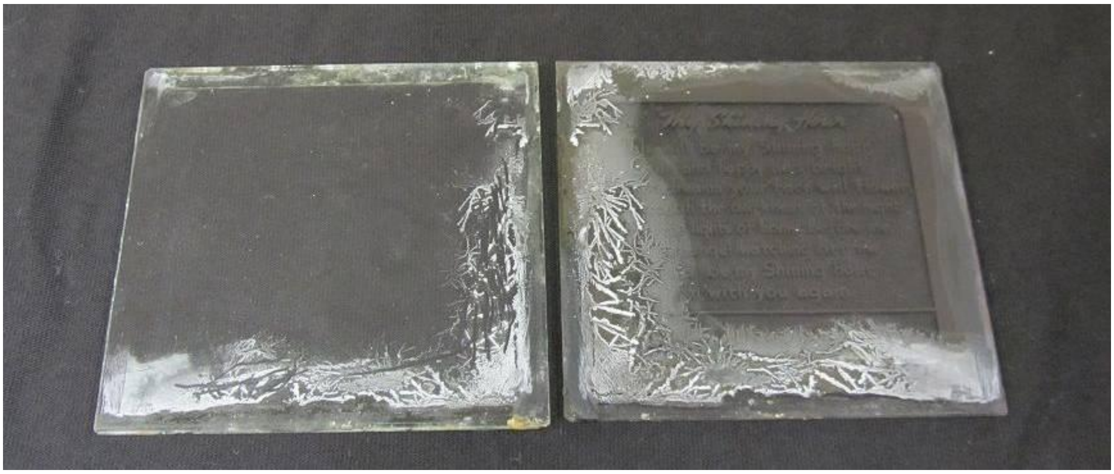

Figure 13: Before Cleaning (30.4.2012).

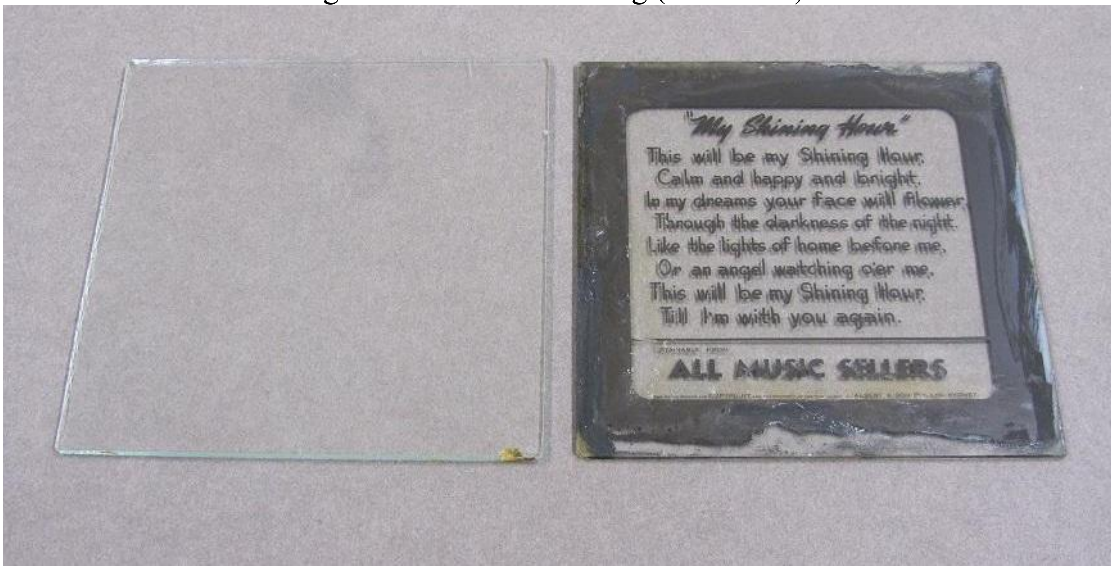

Figure 14: After Cleaning (14.5.2012).

Figure 15: Before Cleaning (30.4.2012).

Figure 16: After Cleaning (14.5.2012).

Conclusion

With the positive Raman test results it was possible to identify the crystalline substance as sodium sulfate, devise a treatment plan and remove the deterioration product from the glass cinema slides.

A definitive result was not obtained from the FTIR spectra results and this would have been helpful in establishing where the deterioration product had originated.

However, the location and direction in which the deterioration product had formed within the glass slide indicates that the deterioration initiated at the outer edges of the slide. This would suggest that the paper binding tape as a result of a water based disaster was the catalyst in the formation of the deterioration.

Acknowledgements
Thanks to Alana Treasure, Paintings Conservator at the Australian War Memorial, for her assistance with the Raman Spectroscopy analysis at the University of Canberra.

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Technical Investigation of a 20th Century Hand-Colored Opaltype

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Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Abstract

This technical study investigates a 1930s, hand-colored opaltype of a young boy from the Winterthur/ University of Delaware Program in Art Conservation (WUDPAC) study collection. The object remains in fair condition but without any identifying documentation in the WUDPAC files. Analysis was undertaken using X-ray fluorescence (XRF), scanning electron microscopy with energy dispersive x-ray spectroscopy (SEM-EDS), Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, gas chromatography- mass spectrometry (GC-MS), infrared reflectography (IR), long-wave and short-wave ultraviolet illumination (UV), fiber optic reflectance spectroscopy (FORS), cross-section microscopy, and polarized light microscopy (PLM). Results show that the support is a non-leaded fluorine-opacified glass, the photographic process is a silver-gelatin photograph, and the following pigments were used to color the portrait and the background in an oil binder: vermilion, Prussian blue, and iron oxide in the background, ultramarine blue and zinc white in the clothing, and iron oxide and madder lake in the flesh. Analysis of the housing components was not a critical goal of this study but helped assign economic context to the object. Analysis of the housing components has shown the materials to be of mass-market quality: a gilded brass frame, leaded cover-glass, and a poor-quality paperboard back mat. The results of this study help place this object within the history of opaltype manufacture and help inform future treatment decisions for this object and for others of its kind.

I. Introduction

Opaltypes

Opaltypes, also called opalotypes, were a popular form of portraiture from the late nineteenth century through the 1930s and 1940s but are now quite rare in photograph collections. They can be made from a number of photographic processes on an opaque white glass and resemble the miniature portraits that were often painted on opacified glass, ivory, and other similarly colored materials long before photography became widely available to the public. They were favored for their permanence as well as their appearance (Gernsheim 1969, 342). Opaltypes were so desirable in the nineteenth century that on April 10 1866 Victor Griswold introduced an "opaltype" which was more an "opal ferrotype" or a tintype made to look like an opaltype by coating plate iron with white, opaque collodion. This process was claimed to be cheaper than the traditional opaltype and unsusceptible to cracking (Schimmelman 2007, 81-21). Opaltypes could also be created by "burning-in" the image by firing the plate in a kiln. However, this process usually changed the tonality of the image and the majority of opaltypes were not processed in this manner (Gernsheim 1969, 342).

Glass Manufacture

Glass has been used as a photographic support since 1847, when Niépce de Saint-Victor used albumen as a binder on a glass support. Although the first documented use of opal glass as a photographic support was in 1856 by James Good Tunny, Glover and Bold of Liverpool first patented opaltypes in 1857. Two types of opal glass were commonly used: "pot" or "pot metal" glass which is opaque white throughout, and "flashed" glass which is not a true opaque or opalescent glass but has one or more layers of opaque glass that have been flashed onto a clear glass. Pot opal was apparently the choice material for making opaltypes in the US and is the type of glass examined in this study (Egunnike 2005, 8-9). Opal plates were usually sold in packs [of six], and often already prepared by the manufacturer, such as "Cowan's Organic Chloride Opals" sold by Marion & Co., or Scovill's glass which were made to be used with Eastman's Transferotype Paper (Werge 1973 and Scovill & Adams 1890, 81). The opaltype examined for this study is considered a 1/6 plate (3 ¼" x 2 ¾").

Hundreds of formulae for opal glass manufacture were available by the 1930s. The physical and chemical characteristics of individual glass plates can vary greatly from one another. In industrial glass manufacture, two kinds of glass are typically made – soda-lime glass (silica, soda, and lime) and lead glass (silica, lead oxide, and sodium or potash) – by melting the respective ingredients in various proportions in a pot in a furnace with the opacifying agent(s) included. Opacifiers are a number of tiny inclusions in the glass that diffuse light, making the glass appear white but still translucent. Since the eighteenth century, glass manufacturers have been using white metal opacifiers such as lead arsenate [$Pb_3(AsO_4)_2$], and phosphates (such as sodium phosphate [Na_2HPO_4]) (Vogel, W 1985, 266 and Doremus 1973, 102). These technologies continued throughout the nineteenth and twentieth centuries.

Clair Tragni examined several opaltypes in her study of ultraviolet-induced visible fluorescence in photographic materials for the advanced residency program at the George Eastman House. She found that only opaltypes identified as gelatin and that were produced in the twentieth century exhibited a dull rose color when examined under shortwave ultraviolet illumination and a dull violet color in long wave illumination. The glasses in Tragni's report were then examined using X-ray diffraction to identify the opacifiers, and were found to have a greater content of feldspar and alumina (and therefore classified as fluorine opal due to the fluorine-based opacifying agents) than earlier opaltypes that were made on leaded glass. These earlier glasses appear bright blue in ultraviolet illumination (Tragni 2005, 43).

Preparation for Photography

Glass plates require a fair amount of preparation before they can be used as supports for photographic processes. Preparation includes cleaning, subbing (with dilute albumen or gelatin if necessary) and cutting to the desired shape. Cleaning was done either by hand or machine using several methods, including alcohol and whiting (calcium carbonate) or rottenstone, or by soaking the plate in lye, sulfuric acid, and nitric acid sequentially. A more detailed description of the cleaning process can be found in Towler's *The Silver Sunbeam* (Towlder 1864, 129). Subbing involves applying a layer of dilute albumen or gelatin to the surface of the glass before application of the image-bearing layer in order to help one adhere more thoroughly to the other. Subbing could be done overall or only at the edges. (Egunnike 2005, 13-16). Three distinct surface finishes for opal glass were popularly used: patent plate opal (the plate is ground then polished), egg-shell finish (the plate is left unfinished), and smoothed opal (the plate is ground but not polished). The level of polish can be easily distinguished by the naked eye, and hand polishing was considered to be higher quality, although a certain amount of "tooth" was sometimes desired for hand coloring (Egunnike 2005, 13-14).

Photographic Processes Used on Opaltypes

Almost any photographic process could be applied to opaque glass to produce an opaltype, from albumen and collodion to carbon and silver gelatin. Trends in processes used on opaltypes parallel the popularity of processes used on paper (Egunnike 2005, 2). Collodion opaltypes were typical from the 1860s to the early 20th century, albumen from about 1860 to 1890, carbon transfer from the mid 1860s until 1940, and silver gelatin from the 1880s until about 1940. The two processes most popular during the date attributed to the opaltype examined in this study (1935) were gelatin and carbon transfer. The process for creating a gelatin opal is essentially the same as the dry plate negative process (credited to John Burgess of London in 1873). The sensitized gelatin – the light-sensitive halide being chloride, bromide, or "chloro-bromide" – is applied to the plate either by transfer paper or directly to the plate by machine. The plate can then be exposed in the camera (a direct positive), in contact with a negative, or by an enlarger. It is then developed and the binder hardened with a chrome alum solution and fixed with sodium thiosulfate (which must be thoroughly washed after fixing to prevent deterioration) (Egunnike 2005, 49-52).

Hand-Coloring Photographs

Photographs were often colored by hand to compensate for the challenges of capturing realistic color in the 19th and early 20th centuries. Various methods were available and some were favored over others depending on the photographic process. For example, daguerreotypes and ambrotypes were most commonly colored with dry pigments that were dusted onto under-bound gum Arabic or isinglass. Albumens were also sometimes colored in this manner. In contrast, tintypes and opaltypes were more often colored with opaque oils or watercolors (Henisch 1996, 104 and 119). Even though laborious color photography processes had been available to consumers since the mid-19th century, hand coloring remained a popular method of achieving life-like images as evidenced by the number of hand colored photographs found in collections. During the gelatin opal period, heavily hand-colored opaltypes received a generous amount of attention as they mimicked the painted portrait miniature.

Hand coloring with oil, watercolor, crayon, or dry pigments and even a varnish layer was common on gelatin opaltypes above other photographic processes (Egunnike 2005, 7). Opal glass, or milk glass, was desirable for hand colored photographs because it is smoother than paper and highly reflective – traits which add to the visual sense of depth and volume in two-dimensional images. Several manuals on coloring photographs were available by the turn of the 20th century; however, those that address coloring of opaltypes specifically are rare. The earliest handbook regarding opaltypes is by Delacy & Son and aptly titled *The Secret of Coloring Photographs on Glass, to which is added the Best Formula Yet Discovered for Making the Silver Bath, the Developing and Fix for Direct Positives, and the Cause of and How to Remedy Stains, Markings, Fogging, etc.* (Henisch 1996, 119). Three nineteenth century handbooks were studied for this investigation: A. N. Rintoul's *A guide to painting photographic portraits, draperies, backgrounds, etc, in water colours*, George Ayres' *How To Paint Photographs In Water Colors* *and In Oil*, and J. S. Templeton's and A.H. Wall's *The Guide to Miniature Painting and Colouring Photographs*, as well as a twentieth century photographic magazine *The Photo Miniature* edited by James Tennant. Although these manuals predate the opaltype examined in this report, they were selected because they provide detailed instructions for painting photographic portraits, and more specifically portraits of children.

Ayres' manual includes the most specific instructions for painting portraits of women and children. Special attention is given to "flaxen hair" for which he recommends first a wash of ocher, shaded by Roman ocher and sepia, and shadowed with raw umber, roman ochre, sepia, or bistre (Ayres 1878, 71). Templeton recommends more simply for "the lighter and warmer hair of all the various hues" burnt sienna, Italian ochre, lake, raw or burnt umber, and ultramarine in various combinations (Templeton 1867, 31). Rintoul also suggests a combination of Roman ochre, yellow ochre, raw sienna, carmine, or "any of the yellows which may be modified with sepia to suit the various shades" (Rintoul 1870, 50). Of particular note in Ayres' manual are his suggestions for blue eyes:

> If they are light blue, use thin cobalt; shadow delicately with the same and a touch of indigo; add white to cobalt for the illuminated part of the iris – if it is not left sufficiently clear in the photograph. If they are dark blue, use a deeper tint of cobalt and shadow with indigo. If deeply, darkly, beautiful blue (as are some children's eyes), the effect can be heightened by using French Blue, but carefully, as it is a powerful color (Ayres 1878, 77).

Tennant, on the other hand, suggests that pupils should be painted with sepia and black, and made larger than they appear in the photograph without altering their shape or position. Whites can be painted with Chinese white (zinc oxide) tined slightly with gray (Tennant 1902, 370). Flesh tones recommended for fair-skinned women and children are further broken down into areas of general flesh tone, cheek, and lip by the three selected authors. Ayres and Tennant instruct the reader to paint women and children with Indian yellow and pink madder or vermilion, the cheeks in a similar mixture of pink madder and vermilion, but cautioning that children require more vermilion in both the cheek and lip (Ayres 1878, 62, 72 and Tennant 1907, 526). Rintoul similarly comments that a fair complexion should be created by rose madder and raw sienna, and in the flesh of children vermilion (Rintoul 1870, 46).

Clothing is only regarded in Tennant's magazine. He recommends that it should be painted in plain colors and shaded with a deeper tint of the same color, or by mixing a little black in the blues and grays and dark brown in the reds (Tennant 1907, 526). The authors also make specific points regarding the painting of backgrounds. Templeton writes: "Plain backgrounds in all their varieties, from warm to cold and from the deepest toned to the most transient hue, may be produced by the use of sepia, ultramarine, light red, and Italian ochre" (Templeton 1867, 44). Ayres also shares his opinion on backgrounds: "The figure should always stand prominently before the background, which should consequently be unobtrusive and retiring, with but few details, and no pure colours; dark backgrounds give the most forcible effect" (Ayres 1878, 36). All of the authors agree that backgrounds should be quiet and harmonious with the subject. Preparation beyond washing the print is hardly mentioned in the nineteenth-century manuals, but

Tennant declares that a sizing of white glue must be laid on a gelatin photograph before oil painting (Tennant 1902, 379).

Coloring kits produced by suppliers of photographic materials were commonly available since the 1850s. The amateur photographer or even the collector could color their own photographs as a pastime instead of going directly to the professional studio. Advertisements for photo colors are rampant in photographic supply catalogues and painting manuals. These advertisements often mention pigments by common name or simply refer to the number of opaque or translucent "tinting" colors available rather than list the specific pigments.

Housing Opaltypes

Opaltype housings follow the styles appropriated for other cased photographs of the same time periods (daguerreotypes, ambrotypes, and tintypes). A popular frame style for smaller plates, such as the one examined in this study, is the stamped metal frames designed to stand alone (Egunnike 2005, 53).

This Investigation

A small, hand-colored opaltype and its housing components (including a metallic frame, a cover glass, and a textile back-mat with a stand) belong to the Winterthur/ University of Delaware Art Conservation Program (WUDPAC) study collection (figure 1). The photograph is a portrait of a young boy, around the age of 5, seated in a ¾ turn with his face turned to the front, his eyes focused somewhere beyond the camera's lens. The boy's face and costume have been delicately painted in vibrant, opaque colors, while the background has been enhanced with touches of red, blue, and green paint. The object was separated from its housing prior to this investigation; its components include a curved cover glass, a decorative metallic frame with a hanging loop at the top edge, and a black back-mat with an attached stand. This back-mat/stand element is constructed from a poor-quality paper board, covered on the presentation side by a black velvet textile and on the interior (non-presentation) side by a two types of black paper: one with a faux-leather texture that is found directly under the textile turn-ins, and a secondary smooth black paper that appears to have been more hastily cut and applied to the back-mat and stand. Three straight pins are inserted into the stand, and a red ribbon with evidence of red paint extends from a hole in the back of the back-mat.


Fig. 1. WUDPAC Opaltype

No correspondence could be found regarding this object. However, a somewhat legible inscription on the reverse includes the date "9/10/1935." Although it is unclear whether this date is the date of the object's manufacture, the boy's costume can be used to infer that the photograph was taken around that time period. Although the half portrait does not reveal the lower portion of the boy's outfit, it appears to be closely related to the "buster' suit" in which the boy's shorts are attached to the blouse at the waist by buttons. The button-down blouse has wide, rolled sleeves embellished with delicate designs, which would have likely been embroidered on the sitter's costume. This style of boys' clothing remained popular through the 1930s and 1940s (Rose 1989, 141-144 and Martin 1978, 139-144).

Condition
The opaltype is in relatively good condition. Minor losses in the support and image occur at each of the four corners, most notably the bottom two. A fragment of one of these losses with some binder and paint still intact remains with the object. Minor edge loss of the hand-coloring and image binder is found on all four edges of the image but it appears to be in otherwise good condition. It is difficult to assess the condition of the image material and binder through the presence of the opaque hand-coloring in most areas, although the image appears to have a warm, brown tonality overall.

The housing components are in overall poor to fair condition. The cover glass is broken into two pieces and suffers some minor losses in the upper corners. The metallic frame has evidence of wear, most notably on the vertical edges, but remains in otherwise good condition. The black back-mat/ stand element is in poor condition. The join at the upright stand is weak and should be handled with caution. Some fading and wear of the black textile is evident on the sides of the stand element. It is not entirely evident whether the three straight pins in the stand are original to the object, but numerous holes in the back-mat, stand, and red ribbon suggest that they were once used to hold the stand in position so the object could remain upright for viewing. These holes have caused losses in both of the black papers on the mat's non-presentation side.

II. Experimental

Infrared Reflectography (IR)
Infrared reflectograms provide information regarding the absorbance of pigments used in the hand-coloring on the opaltype and may help clarify the inscription on the verso of the glass plate. Images will be captured using an ALPHA NIR Infrared Camera with National Instruments Labview Frame Grabber using Indigo Systems Corp. IRvista 2.51 software. The camera is equipped with an indium gallium arsenide (InGaAs) detector with a 320x 256 focal plane array and a spectral response from 0.9 to 1.7 µm.

Cross-Sectional Analysis
A small edge fragment containing some paint from the opaltype was already detached from the object when it was selected for this study. Although it is unclear precisely where this fragment originally belonged on the object, it can be assumed that, because it contains some of the paint layer, it also contains some of the binder layer and image-forming material as well. This sample was halved with a diamond-tipped scribe and the segment with more paint was mounted in Extec polyester resin and polished using 150 grit silicon carbide paper to 12,000 grit Micromesh silicon carbide paper to reveal the sample in cross section (cross-section 1). During handling and examination, a second, smaller fragment became detached from the upper right edge. This was also mounted and polished (cross-section 2). The cross sections were examined using a Nikon Eclipse 80i microscope equipped with a Nikon digital camera DXM1200F at 100x, 200x, and 400x magnification in both visible light and ultraviolet illumination (using a BV-2A cube, excitation from 400-440nm, barrier 470nm, dichroic mirror wavelength 455), as well as with the

B-2A filter cube (excitation 450-490nm, Barrier 520nm, dichroic mirror wavelength 505) and with the G-1B cube (excitation 546-510nm, barrier 590nm, dichroic mirror wavelength 575). They were stained with the following fluorochrome stains for medium identification:

- 0.02% Rhodamine B [Sigma: R6626] in denatured ethanol. A positive reaction for the presence of oils is indicated by a red fluorescence when viewed with the G-1B filter cube.
- 4% Triphenyl Tetrazolium Chloride (TTC) [Sigma: T-8877] in anhydrous methanol. A positive reaction for the presence of carbohydrates is indicated by a red/brown when viewed with the BV-2A filter cube.
- 0.2% Alexafluor 488 [Molecular Probes] in a 0.5% Sodium Barate buffer of pH 9.0. A positive reaction for the presence of proteins is indicated by green fluorescence when viewed with the B-2A filter cube.

Energy Dispersive X-ray Fluorescence (XRF)

Qualitative ED-XRF spectroscopy was performed to gather data regarding the elemental composition of the opal glass, pigments used in the hand-coloring, and the elemental composition of the framing elements (particularly the metallic frame); no sample preparation was necessary. Analysis was performed with the Artax µXRF spectrometer using a molybdenum x-ray tube (700µA current, 50kV voltage, 100 seconds live time irradiation, approximately 70-100 micron spot size) with element range of potassium (K) to uranium (U). Spectra were interpreted and labeled using the Artax Basic version 5.3.21.0 software. Graphic documentation of the areas analyzed was obtained using an integrated CCD camera.

Scanning Electron Microscopy – Energy-Dispersive X-Ray Spectroscopy (SEM-EDS)

SEM-EDS was used to identify elements that are either too low atomic number or in too small a quantity to be detected using Winterthur's Artax XRF. The elements found using SEM-EDS can also be mapped in order to visualize their locations and relative quantities. In preparation for analysis, the edges of cross-section 1 were coated with a layer of SPI-Chem carbon suspension particles in order to prevent charging while in the SEM vacuum chamber. The sample was mounted on a SPI-Supplies pure carbon 15mm mounting stub using double-sided carbon tape. It examined at 1000x magnification using a Topcon ABT-60 scanning electron microscope with a Bruker Quantax 200 XFlash EDS detector, an accelerating voltage of 20kV, and a working distance of 22mm. The software used to process the BSE images and X-ray spectra was Bruker Quantax Esprit version 1.8.2.

Raman Spectroscopy

The opaltype was placed directly on the microscope stage, which minimized the need for sampling in image areas (particularly the sitter's face and hair). Pigment samples that were taken for the purpose of polarized light microscopy were also analyzed before they were mounted. The instrument that was used to analyze the pigments is a Renishaw in Via Raman spectrometer with a 785 nm diode laser or a 514 nm argon laser with a vibrational spectral range of 100 – 3200 cm^{-1}, a microscope equipped with a 10x, 20x, and 50x objectives (with magnifying capabilities up to 500x) and an approximately 3" x 15" x 4.5" stage. Areas of the opaltypes surface measuring approximately 1µ by 20µ were scanned using a range of laser powers (0.1% - 10% for the 785 nm laser which is Watts) for 30 seconds per scan at accumulations of 1 to 4 scans. Published Raman spectroscopic libraries, including the University of College London's online library and the Tate Museum Tom Learner Organic Pigments library, and articles were used for reference spectra to gather information about the pigments used to color the opaltype.

Fourier Transform Infrared Spectroscopy (FTIR)
FTIR spectroscopy was used to help characterize the binding media of the photograph and the paint, and possibly the fluorescing layer between the photographic layer and the support. Small samples were collected from the existing unmounted fragment (FTIR 1) and from the edges where paint could be scraped without deforming the image (PLM 1-5) using a stainless steel scalpel. The sample was then transferred to a diamond half cell and rolled flat with a steel micro-roller to make the film even and appropriately transparent to perform absorption spectroscopy. The sample was viewed and analyzed with a Thermo Scientific Nicolet 6700 FTIR spectrometer with a Nicolet Continuum FTIR microscope. The spectra were obtained using Omnic 8.0 software (Thermo Scientific) in the spectral range of 600 to 4000 cm^{-1} with a 4 cm^{-1} resolution; spectra were analyzed in comparison with SRAL's collection of commercial reference spectral libraries and the IRUG database.

Gas Chromatography – Mass Spectroscopy (GC-MS)
A small sample was removed from the upper right edge of the opaltype in an area of existing damage using a stainless steel scalpel under magnification and was placed in a glass vial. The sample was derivatized with 100µL of 1:2 MethPrep II reagent (Alltech): benzene in the glass vial. This mixture is used to convert carboxylic acides and esters to methyl ester derivatives. The vial is then heated to 60°C for one hour, and then allowed to cool to room temperature. The instrument used in this analysis was a Hewlett Packard 6890 series GC system equipped with a HP5973 mass selective detector, a HP7683 automatic liquid injector, and a HP59864B ionization guage controller. Agilent Technologies MSD ChemStation control software was used to collect and analyze the chromatogram and mass spectrum gathered from the sample. The inlet temperature and the transfer line temperature to the MSD (SCAN mode) were set to 300°C. A sample volume of 1µL was injected onto a 30m x 250m x 0.25µL film thickness HP-5MS column (5% phenyl methyl siloxane) at a flow rate of 1.5mL/minute. The over temperature was held at 50°C for two minutes, then programmed to increase by 10°C every minute until a temperature of 325°C was reached and held for 10.5 minutes, a total run time of 40 minutes.

Near Infrared - Fiber Optic Reflectance Spectroscopy (NIR-FORS)
Visible reflectance spectra were collected using an Ocean Optics NIR FORS spectrometer equipped with an Ocean Optics tungsten halogen lamp (LS-1), which was calibrated against a Labsphere reflectance standard (TiO_2). Spectra were collected and analyzed using Ocean Optics SpectraSuit software.

Polarized Light Microscopy (PLM)
This technique was performed last because it involves destructive sampling. Scrapings were removed from the sitter's clothes at the lower edge (PLM 1), lower left arm (PLM 2), two areas of the background including yellow-green and blue samples from the right edge (PLM 3 and PLM 4), and at the top left corner where the paint has extended beyond the plane of the image (PLM 5). Fiber samples of the velvet textile (PLM 6), black papers (PLM 7 and PLM 8), and board (PLM 9) were removed from the backmat. Pigment samples were mounted onto glass slides using Cargille Meltmount (refractive index 1.66) and analyzed using a Leitz Laborlux 12

polarizing light microscope with a transmitted visible light source, equipped with 10x oculars and 4x, 10x, 25x, and 40x objectives. Fiber samples were mounted on glass slides with water and were analyzed using the same microscope. Distinguishing characteristics were noted and compared to personal reference samples as well as Gettens's and Stout's *Painting Materials*.

III. Results

Visual Examination

Magnification revealed several indications of the object's manufacture. For example, the pebbled texture of the object's recto (painted side), and the smooth finish on the object's verso are more easily distinguished under magnification, as well as the delicate and deliberate lines in the sitter's face and costume, most notably around eyes and buttons (figure 2). Brush strokes in the brown background paint can be seen curving around the boy's shoulders. The brown paint appears to have been scumbled over the blue paint fields on the sides of the object. This handling of the brown paint contrasts with the dots of red and yellow in these areas.

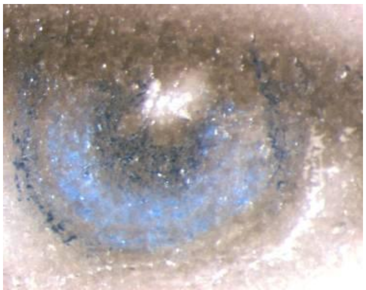

Fig. 2. Detail of the boy's proper left eye, 40x.

Ultraviolet Examination

The opaltype examined for this study exhibited the same dull violet color in long wave illumination and a rose color in short wave illumination as those in Tragni's report. The paint fluoresces bright yellow in the sitter's clothing and background in both long wave and short wave illumination, and a blue, fluorescing layer can be seen around the edges. The areas containing flesh tones do not fluoresce but appear deep blue or purple as a result of the glass support. It can be inferred that this brightly fluorescing material seen in cross section 1 is only found at the edges. Jennifer Jae Gutierrez found similar results when observing two 1929 opaltypes with ultraviolet fluorescence (Mentzer 2003, 5). Two small areas on the top and bottom of the metal frame fluoresce orange in longwave illumination. The cover glass did not fluoresce in longwave illumination, but appeared bright white in shortwave illumination. The backing stand did not exhibit any notable fluorescence in either longwave or shortwave illumination.

Infrared Reflectography

Silver does not absorb in the IR region of the electromagnetic spectrum, and therefore does not appear in the reflectogram. However, certain pigments used in the opaltype's hand-coloring absorb radiation in wavelengths roughly between 750nm and 1mm, and therefore appear dark in the reflectogram. The sitter's hair appears especially dark, along with the background (most notably at the left and right edges), and portions of the sitter's costume. Because the glass is transparent in IR, the pigments can also be seen in the image of the verso (figure 3).

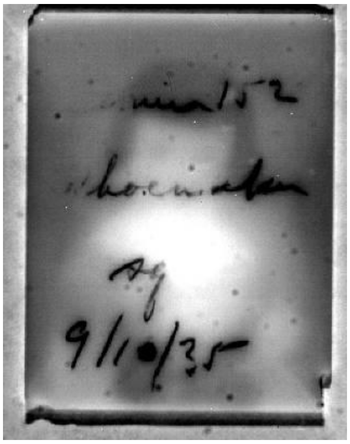

Fig. 3. Opaltype verso in IR

Cross-Sectional Analysis

In visible light and ultraviolet illumination at 200x magnification the cross section exhibited four layers: the glass substrate, a relatively thick (about five times thicker than the image-bearing layer) and bright, blue-fluorescing layer, a thin binder layer containing silver particles (the image material), and a dark paint layer. When the opaltype is examined under long wave ultraviolet illumination this fluorescing layer can be seen around the edges under the paint layer but does not apparently exist evenly under the entire image layer. Stains for oils (Rhodamine B) appeared positive in the paint layer in both cross sections and for proteins (Alexa488) in the image-binder layer and the larger layer beneath.

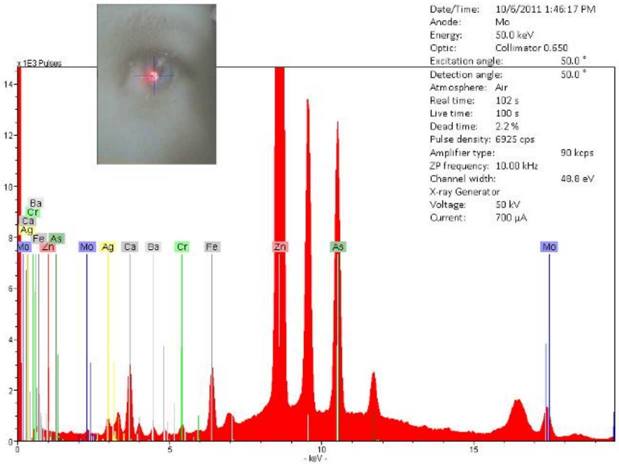

Fig. 4. XRF spectrum from the boy's proper left eye; peaks shown include arsenic (As), barium (Ba), chromium (Cr), iron (Fe), and zinc (Zn). Molybdenum appears in the spectrum as the source of radiation.

XRF

A summary of the elements found using XRF is in Table 1. Areas chosen for analysis included the verso of the glass, high and low image densities, and at least one sample from every visible color. Calcium (Ca) and arsenic (As) appear in all spectra taken from the opaltype.. Silver (Ag) was also found in all of the spectra taken from the image side of the opaltype. The cover glass spectrum showed peaks for lead (Pb), calcim, and arsenic. Figure 4 shows the spectrum taken from the boy's left eye.

Location	Elements found	Location	Elements found
Glass verso, center, no pigment	**Ca, As, K**, **Ti**, Fe, **Zn**	Left edge (background), blue, red, and yellow pigments	Ca, As, Ba, Cr, Fe, Zn, Ag, **Hg**
Proper left eye, blue pigment	Ca, As, Ba, **Cr**, Fe, Zn	Proper left cheek, flesh tones	Ca, As, Si, Ba, Fe, Zn, Ag
Lower lip, red pigment	Ca, As, K, Ba, **Cr**, Fe, Zn, Ag		
Proper left arm (clothing), flesh tone	Ca, As, K, Ba, **Cr**, **Co**, Fe, Zn, Ag	Cover glass	Ca, As, **Pb**, Fe, Si
Forehead, flesh tone	Ca, As, K, **Fe**, Zn, Ag	Frame - Upper right corner	**Cu**, **Zn**, Fe
Hair highlight, yellow pigment	Ca, As, Si, **Ti**, **Fe**, Zn, Ag	Frame - Upper edge center	**Cu**, **Zn**, Fe, Sn, **Au**
Hair shadow, yellow pigment	Ca, As, **Fe**, Zn, Ag	Back-mat/Stand	Ca, Ba, Cu, Zn, Fe

Table 1. Elements found using energy dispersive XRF; major elements are in bold.

SEM-EDS

Table 2 summarizes the elements found in cross section 1 using SEM-EDS and the energy-dispersive x-ray fluorescence spectrum taken from the SEM microscope can be seen in figure 6. A false color x-ray map of the major elements found in Cross Section 1, which was taken from the detached fragment which contained some earth-toned paint found in the background, is shown in figure 5.

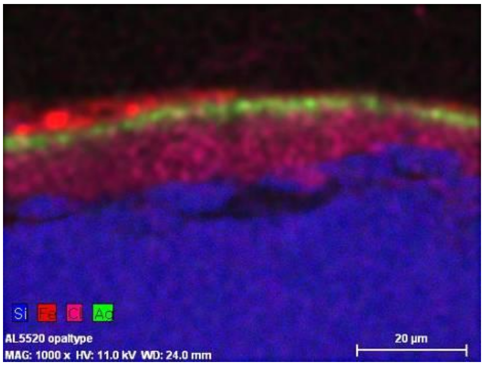

Fig. 5. Cross section 1 at 1000x, elemental map showing, from bottom to top, layers of silicon, chlorine, silver, and iron.

Location	Elements Found
Paint	As, Ca, F, **Fe**, Zn
Image-layer	**Ag**, S
Fluorescent layer	**Cl**
Glass support	Al, **As**, **Ca**, **F**, **K**, O, Si, **Zn**

Table 2. Elements found using SEM-EDS on cross-section 1; major elements are in bold.

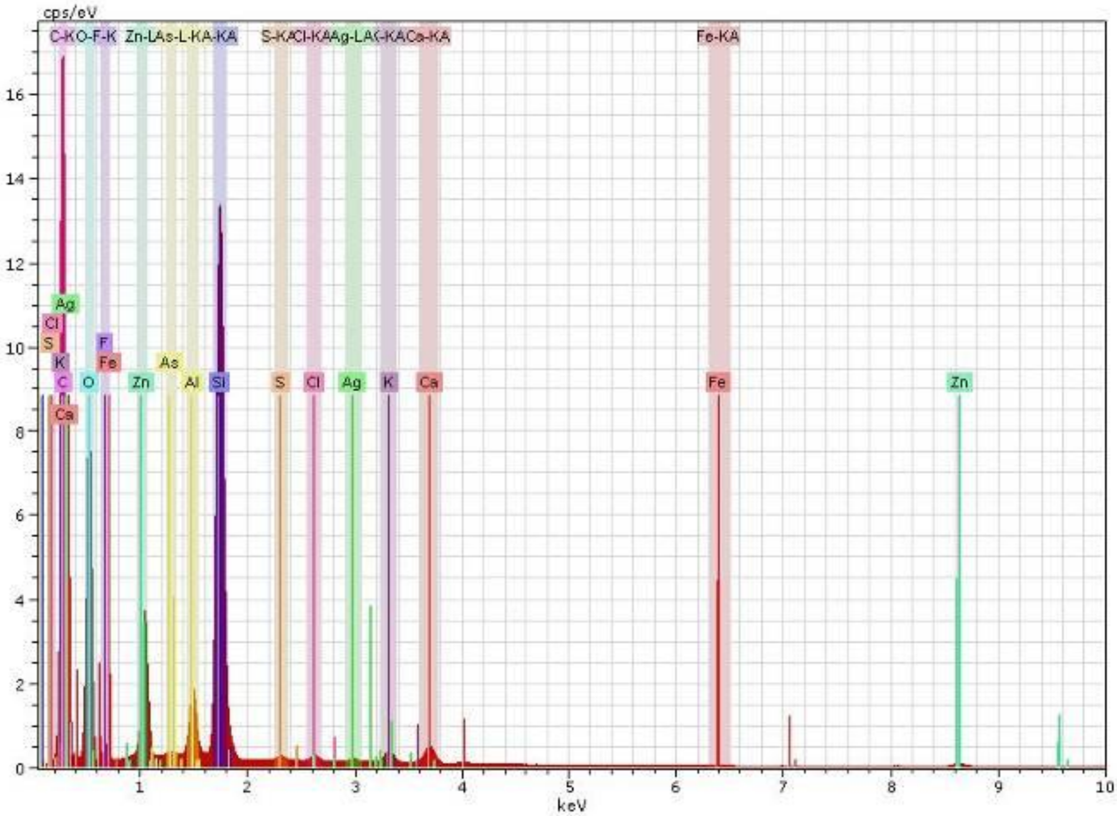

Fig. 6. XRF spectrum of Cross Section 1(taken from the fragment with earth-toned paint found in the background) obtained using the scanning electron microscope; elements present include Ag, As, C, Ca, Cl, F, Fe, K, O, S, and Zn.

Raman Spectroscopy

Raman spectroscopy was helpful in identifying a handful of pigments used in the opaltype's hand-coloring. Vermilion was identified in the red areas of paint in the background, showing peaks at 252, 282, and 343 cm^{-1} clearly (figure 7). Also found in the spectrum taken from both the pigment samples from the background were peaks at 2102 and 2154 cm^{-1} which indicate Prussian blue (figure 8). The spectrum obtained from the boy's proper left arm exhibits peaks at 224, 291, and 407 cm^{-1}, which correspond with Raman spectra of synthetic iron oxides (such as Mars red and Mars orange) (figure 9). The spectrum obtained from the boy's lower lip most closely resembles the spectrum of PR83: Corbrite Madder Lake, a hydroxyanthraquinone, with peaks seen at 484, 1191, 1294, 1328, and 1481 cm^{-1} (figure 10). Only one peak in the spectrum obtained from the pigment sample from the boy's blue clothing corresponds to lazurite or ultramarine: 548 cm^{-1} (figure 11). This peak does not correspond to other blue pigments in SRAL's spectral libraries such as the RRUFF database.

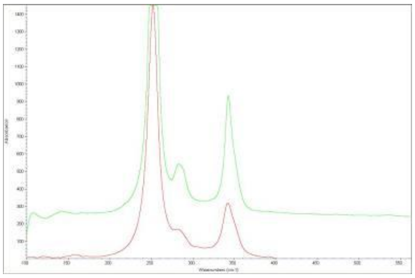

Fig. 7. Red pigments in background (top) showing a match for vermilion (bottom).

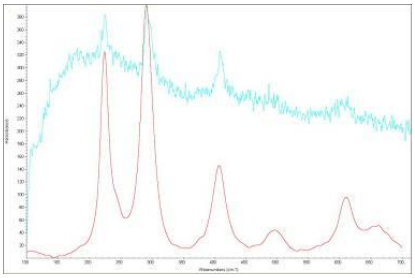

Fig. 9. Yellow pigments in boy's arm (top) showing a match for iron oxides (bottom).

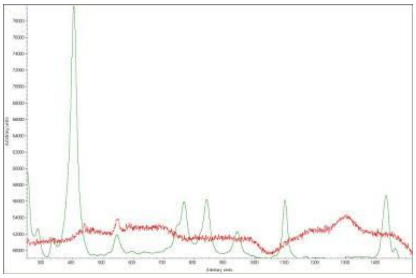

Fig. 11. Blue pigments in the boy's clothing (top) showing a match for ultramarine (bottom).

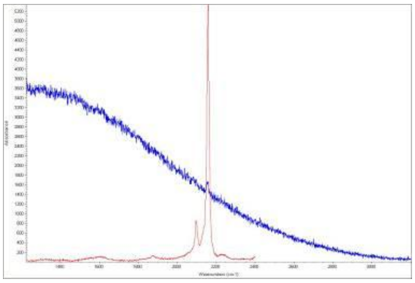

Fig. 8. Blue pigments in background (top) showing a match for Prussian blue (bottom).

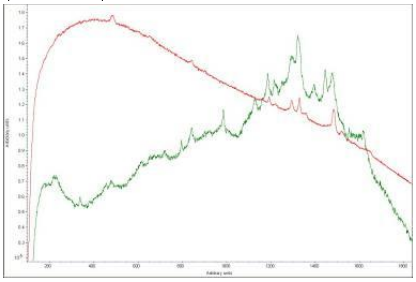

Fig. 10. Red pigments in boy's lips (bottom) showing a match for madder lake (top).

FTIR

Analysis of FTIR 1, taken from the same edge fragment as Cross Section 1, revealed a protein with a broad peak near 3300 cm^{-1} (N-H stretching), peaks at 1650 and 1550 cm^{-1} (N-H scissoring) and 1240 cm^{-1} (C-N stretching) (figure 12). The paint included in the sample was too thick for analysis using transmitted FTIR, so additional spectra were collected from the background scrapings taken for PLM analysis (PLM 3 and 4). Both spectra contain a peak near 2100 cm^{-1} which is characteristic of the C=N bond in Prussian blue, as well as peaks in the 1000 cm^{-1} to 1200 cm^{-1} range that are characteristic of silicates, and peaks near 2930 cm^{-1} and 2850 cm^{-1} (C-H stretching) that suggest the presence of an oil likely the binder for the hand painting.

These spectra also show peaks between 1300 cm^{-1} and 1750 cm^{-1} that correspond to cobalt dryers (figure 13).

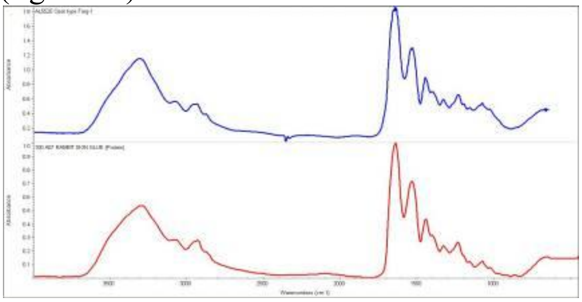

Fig. 12. Protein in the binder layer (top) characterized by FTIR library match (bottom).

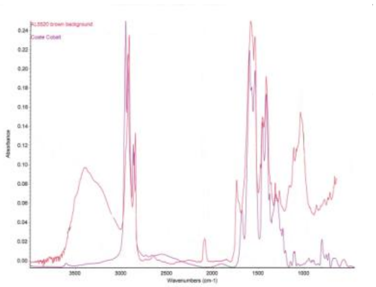

Fig. 13. Cobalt dryers found in the background paint sample.

GC-MS

GC-MS analysis of the scrapings from the background paint revealed a very faint signal for oil, which is more likely a contaminant than a positive result for the presence of an oil binding media.

NIR-FORS

The spectra obtained using NIR-FORS did not reveal significant information to derive the presence of any particular pigment or colorant used in the opaltype's manufacture.

PLM

PLM successfully characterized pigments used to color the opaltype and fibers in the back-mat by examining their morphological characteristics (color, shape, and opacity) and refractive index in plane-polarized light (ppl) and birefringence and extinction in crossed-polarized light (xpl). Analysis of the background samples confirmed the presence of iron oxides (red and yellow), as well as a carbon black pigment. Analysis of the sample from the costume revealed the presence of an isotropic, synthetic ultramarine in a matrix of white pigment particles which are most likely zinc due to their cool gray-brown tone in xpl and black masses in ppl. The velvet textile and the red ribbon on the back-mat are both cotton, while all three paper fiber samples revealed bast-fibers (i.e. linen) and soft wood pulp.

IV. Discussion

Opal Glass Support

The results of ultraviolet illumination, XRF, and SEM-EDS analysis show that the opaltype examined for this study contains the opacifying agents sodium fluoride and alumina, both usually found in opal glasses. It also contains arsenic which is often found in the presence of lead in opal glasses although lead is absent in this glass. Arsenic is used both as an opacifying agent and also as a fining agent to reduce the formation of bubbles in a glass. SEM-EDS helped confirm that aluminum, arsenic, calcium, fluorine, potassium, and zinc in the glass substrate are present in greater proportion than other layers of the object, such as a subbing layer or the paint layers. The composition of this opal glass is a complicated formula that could be better understood with X-ray diffraction (XRD), which would provide phase information of the inorganic elements in the glass.

Photographic Process
Silver was found in areas of high image density, and FTIR confirmed the presence of a protein. A silver gelatin process is in keeping with the trends during this opaltype's date of manufacture. However, the presence of the bright fluorescing layer remains a confounding element in this object. Proteins have a bright blue fluorescence, but the significant amount of chlorine found by SEM-EDS in this layer this gives little to no indication of its function in the object's manufacture. Dilute albumen and gelatin were often used as subbing layers on opaltypes but one would expect a subbing layer to be very thin in comparison to the other image-forming layers (Egunnike 2005, 14). Because Cross Section 1 was taken from a fragment that was already detached, it is also difficult to relay its information to the entire object. It appears that the fluorescence does not occur throughout this proteinaceous layer, but is only found around the edges, possibly due to natural aging where the layer has been exposed.

Paint and Pigments
The two most common photograph-coloring media were watercolors and oil, and analysis of the binding medium on this opaltype strongly points to oil. Although the results from GC-MS analysis were too faint to be conclusive, the positive staining with Rhodamine B in the cross-sections and the presence of cobalt driers and oil in FTIR analysis are all indicative of an oil-based medium. Without a larger sample for GC-MS, the origin of the oil cannot be discerned (i.e. linseed, etc.). All of the pigments found (iron oxide, Prussian blue, lamp black, zinc white, synthetic ultramarine blue, and madder lake) are all consistent with photograph coloring literature from the nineteenth and early twentieth centuries. This evidence, and the lack of any contemporary dye material from the early twentieth century, may also suggest that the paints used on this object were sold by a photographic supplier as a kit for both amateur and professional use. The use of two different blue pigments for the clothing and the background is of particular interest and may suggest that two different blues were used to color the sitter's eyes, which were too delicate for sampling (see figure 1). FORS was primarily attempted to identify or characterize the blue pigments in order to reduce the need for sampling. However, the absence of evidence for the presence of the blue pigments with FORS may be due to the high tinctorial power of blue pigments and therefore their relative lack of abundance. This may be an unreliable technique for detection of blue pigments in hand-colored photographs and PLM proved to be a more conclusive technique in this study. This result should not be discouraging: the use of non-destructive techniques for the investigation of hand-colored photographs should be studied in greater depth, especially for photographs that do not lend themselves to sampling.

V. Conclusions

The analyses of this object suggest that, although it was intended for a private audience, this *kind* of object was intended for *many* private audiences. In other words, the manufacture of this photograph, however delicate and precious it may seem, was made to save expense with common materials, particularly the silver gelatin photographic process on the fluorinated, opaque glass. Even though color photographic processes were available to the public in the 1930s, hand-coloring was still popular until the dyes in chromogenic prints were finally made more stable in the 1960s. The pigments found in paint on this photograph comply with traditional photograph-coloring materials and may have possibly been sold as a kit for both professionals and amateurs.

More hand-colored opaltypes and painting materials of this era should be studied in greater depth to produce more conclusive results about the niche into which this object fits.

VI. Acknowledgements

This technical study would not have been possible without the assistance of the staff at Winterthur's Scientific Research and Analysis Laboratory (SRAL), University of Delaware staff, and visiting scholars. I sincerely offer my gratitude to the following individuals for their dedication and hard work: Dr. Joseph Weber (Associate Professor, WUDPAC), Dr. Jennifer Mass (Senior Scientist, Winterthur Museum), Catherine Matsen (Associate Scientist, Winterthur Museum), Dr. Caitlyn O'Grady (Mellon Fellow, WUDPAC) and Dr. Chris Petersen (Consulting Scientist, Winterthur Museum) for all of their assistance with the technical analysis involved in this study. Thanks are also due to Barbara Lemmen (Head Photograph Conservator, Conservation Center for Artifacts and Historic Artworks, Philadelphia) for her loan of her privately owned opaltype and Melanie Gifford (Research Conservator, National Gallery of Art) for her helpful interpretation of pigment samples. I would especially like to extend my thanks to my major supervisor Jennifer Jae Guiterrez (Assistant Professor, WUDPAC), Bruno Pouliot (Objects Conservator, Winterthur Museum), and Debra Hess-Norris (Chair, WUDPAC) for suggesting this topic and all of their guidance and support with this project.

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Fluorescence Fails: the Color of UVA-Induced Visible Fluorescence of Tintype Varnishes does not Discriminate between Varnish Materials

Corina E. Rogge and Krista Lough

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Abstract: In order to determine if the commonly used technique of UVA-induced visible fluorescence could accurately identify varnish materials, a study collection of over 200 tintypes with known varnish materials was digitally imaged. The CIE L*a*b* values of the fluorescence in the lightest light and darkest dark areas of the images were obtained and showed that there was no correlation between resins present and the color of the fluorescence, even for quite disparate materials such as shellac and dammar. False color reflected UVA images also failed to differentiate resins. Thus, this commonly used examination technique should not considered a reliable identification method.

Introduction:

The tintype, also known as the melainotype or ferrotype, was the most popular type of photographic image in the United States of America from the 1860s to the early 1900s, due to their low cost and durability (Shimmelman 2007). This status was additionally driven by the social imperatives of the American civil war and the increased purchasing power of the middle class who sought to document their lives (Fig. 1a). Thus, tintypes provide a glimpse into the lives of everyday citizens and are of historic and sociological interest.

Tintypes were made using the wet collodion method first developed by Frederick Scott Archer (Archer 1851), but instead of glass the support material was a japanned metal plate (Smith 1856). In their final state tintypes are multilayered composite structures; the metal support plate was japanned on one side, with the colored japanning layer providing the darks of the final image (Fig. 1b-c). The plate manufacturers also applied a protective varnish

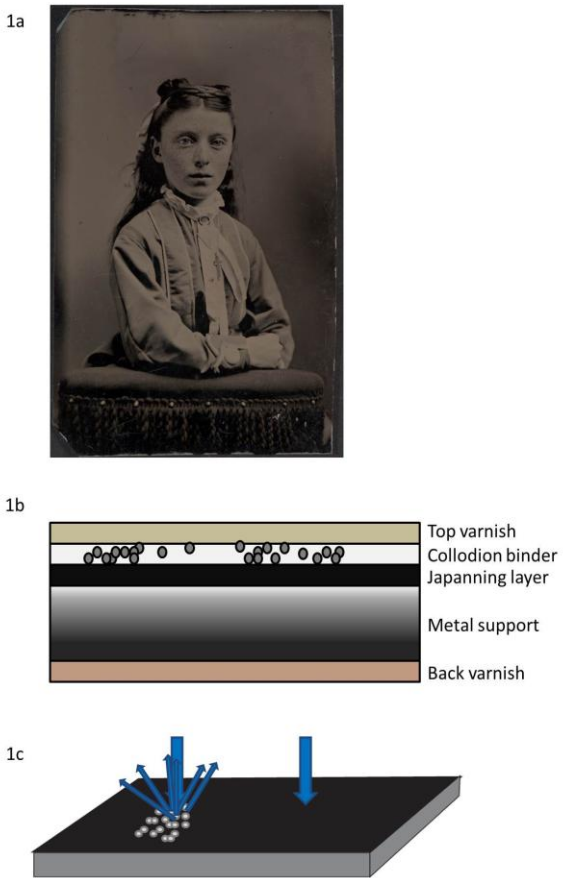

Fig. 1. (a) a 1/6 plate tintype from the study collection; (b) the layer structure of a tintype, image particles are indicated in the collodion layer; (c) darks are caused by the absorption of light by the exposed japanning layer while highlights are caused by diffuse reflectance off the silver image particles.

to the verso of the plate to help prevent rusting of the support (Shimmelman 2007). The artist would purchase these plates from photographic supply houses, and then apply the collodion binder as well as a protective top varnish layer to help prevent physical damage and oxidation of the image.

The popularity of tintypes led to the publication of 'how to' monographs, such as *The Practical Ferrotyper* by A.P. Trask (Trask 1872), which provided instruction in the mechanics of taking tintypes, in how to create pleasing portraits, and in running a commercially successful studio. The most variable step of the photographic process was the artist-applied top varnish: some authors recommended that the artist make their own varnish, while others recommended the use of commercially available varnishes from photographic supply houses (Rogge 2013). These recommended varnishes contain a wide range of components, with different solubilities and solvent sensitivities that should be handled differently by conservators, so identifying the top varnish used in a given tintype is a critical step in its treatment.

Many conservators use UVA light in the examination of artifacts and it is commonly accepted that the color of the visible fluorescence can help identify varnish materials (Rivers 2003; Tragni 2005; Grant 2010; Stoner 2012). However, discussions with photograph conservators suggest that misidentification of varnish materials based upon fluorescence color is common and in some cases has led to treatment issues. A previous study utilizing pyrolysis-gas chromatography mass spectrometry (py-GC-MS) to identify the components in the top varnishes of a study collection of tintypes found a wide range of components, some of which were distinct from literature recipes (Rogge 2013). 24% of the varnishes had materials specifically recommended for tintypes, 44% of the varnishes had materials recommended for other wet-collodion images, and the remaining 32% of the tintypes were mostly varnished with mixtures of shellac and *Pinaceae* resin, which likely represent commercially available varnishes. This corpus of diverse and definitively-identified varnishes made an ideal collection to assess whether UVA-induced visible fluorescence provides an accurate, non-destructive way to determine varnish identities. Accordingly, digital images of the visible fluorescence of the study collection tintypes were obtained and processed in Adobe Photoshop® to extract CIE $L^*a^*b^*$ values for the lightest light and darkest dark areas, which were compared to the varnish compositions. False color reflected UVA imaging was also explored as another possible means for non-contact, non-destructive identification of varnish materials. Both methods show poor correlations between image colors and varnish composition in this collection of 221 tintypes. The failure of these methods to identify varnish materials indicates that they cannot be used as reliable analytical tools for tintypes, and the use of more definitive analytical techniques such as FT-IR or GC-MS is necessary.

Materials and Methods:

Objects: A study collection of 221 unprovenanced, undated tintypes ranging in size from gems (19 x 27 mm) to 1/6 plates (64 x 89 mm), was purchased from local and online vendors. Based upon the clothing of the sitters they are presumed to date from the 1860s to early 1900s.

Digital Imaging:

Normal illumination: UV-VIS-IR modified Nikon D700 camera (36 x 23.9 mm CMOS sensor) with a 60 mm 1:4 UV-VIS-IR apo macro lens equipped with a PECA 918 filter. The camera was white balanced using a neutral grey card and the camera settings were as follows: ISO 200; aperture f/11; shutter speed 1/10 s; exposure adjustment -0.2. The tint and temperature were adjusted in the RAW (NEF) format to -34 and 2050, respectively. Illumination was provided by two Cole Palmer single light guide fiber optic lamps, EKZ 30W/10.8V/3100K (MR-16) and a Leica twin light guide fiber optic EJA 150W/21V/3400K (MR-16) and the irradiance at the object was 267 footcandles.

UVA-induced visible fluorescence imaging: digital photographs of the tintypes were taken with a Nikon D700 camera (36 x 23.9 mm CMOS sensor) with a Nikon AF Micro Nikkor 105 mm 1:2:8 D lens equipped with PECA 918 + 2E (gelatin) filters. The camera settings were as follows: ISO 200; aperture f/8; shutter speed 1.6 s; no exposure adjustment. The white balance was set to shade and the tint and temperature were adjusted in the RAW (NEF) format to +35 and 10000, respectively. Radiation was provided by two UV Systems Inc. Superbright II 3000 series LW lights with primary wavelengths of 370 nm and the irradiance at the object was 516 W/m^2. The lights were positioned at a 32^o angle on foamcore supports in order to provide an even wash of light across the image surface; this method was adapted from one developed by J.J. Chen (2012) for documentation of UVA-induced visible fluorescence.

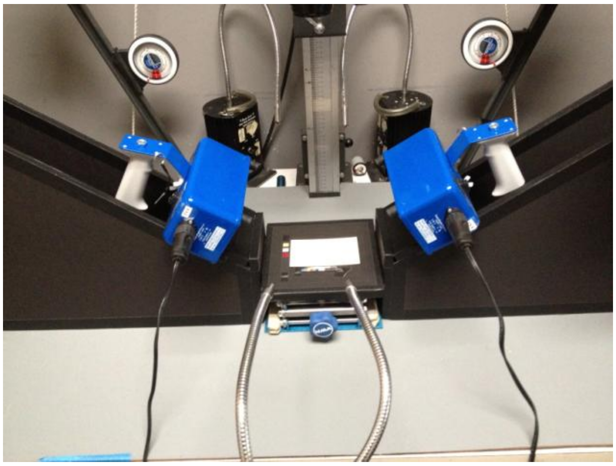

Fig. 2. Lighting set up for photographic documentation of UVA-induced visible fluorescence, the fiber optic lights for normal illumination are also shown.

Reflected UVA: digital photographs of the tintypes were taken with a UV-VIS-IR modified Nikon D700 camera (36 x 23.9 mm CMOS sensor) with a 60 mm 1:4 UV-VIS-IR apo macro lens equipped with B+W 403 (18A) + BG38 (B+W 2mm thick screw-in) filters. The camera settings were as follows: ISO 200; aperture f/11; shutter speed 2.0 s; exposure adjustment +0.30. The white balance was set to shade and the tint and temperature were adjusted in the RAW (NEF) format to +2 and 7300, respectively and the saturation was set to -100. Radiation was provided by two UV Systems Inc. Superbright II 3000 series LW lights with primary wavelengths of 370 nm and the irradiance at the object was 536 W/m^2.

Image Analysis:

Fig. 3. A selection of tintypes displaying different induced fluorescence colors under UVA light.

CIE $L^*a^*b^*$ Analysis: Tiff images were opened in Adobe Photoshop®. A 3 mm selection circle was used to select and copy three areas of the lightest lights and three areas of the darkest darks of the images to a new layer. The blur tool, set at 100% strength and a size of 6 pixels, was used to homogenize the selected swatches by sweeping the brush in a circular fashion from the center of the swatch outward. The color sampling tool set to a 5x5 pixel sample size was then used to take three reading from each swatch, and the CIE $L^*a^*b^*$ valued were recorded.

False color UVA-induced visible fluorescence analysis: Tiff images were opened in Adobe Photoshop® and the reflected UV image was converted into grayscale. The contrast of this image was optimized using Auto Levels, bringing the N8 patch on the color chart to 120 RGB, and this modified image was saved as a Tiff. The visible light image was then opened and the following channel substitutions were made: G to R; B to G; and UV grayscale to B.

Py-GC-MS Analysis:

Sampling: Samples of the varnish layers of the tintypes were obtained by scraping the surface with a 0.5 mm tip microchisel (Ted Pella) or #15 scalpel blade under a stereo-microscope. Care was taken to ensure that the japanning layer was not co-sampled.

Pyrolysis instrumentation and method: 3-5 μg samples were placed into a 50 μL stainless steel Eco-cup (Frontier Laboratories) and 3 μL of a 25% methanolic solution of tetramethylammonium hydroxide (TMAH) was introduced for derivatization (Heginbotham 2011). After 3 minutes an Eco-stick (Frontier Laboratories) was fitted into the cup, and the cup was placed into the pyrolysis interface of a Frontier Lab Py-2020D double-shot pyrolyzer where it was purged with He for 3 minutes. Samples were pyrolyzed using a single-shot method at 550 °C for 6 seconds and then passed to the GC-MS through an interface maintained at 320 °C.

GC-MS instrumentation and method: The pyrolyzer was interfaced to an Agilent Technologies 7820A gas chromatograph coupled to a 5975 mass spectrometer via a Frontier Vent Free GC/MS adapter. An Agilent HP-5ms capillary column (30 m x 0.25 mm x 0.25μm) was used for the separation with He as the carrier gas set to 1 mL per minute. The split injector was set to 320 °C with a split ratio of 50:1 and no solvent delay was used (Heginbotham 2011). The GC oven temperature program was 40 °C for 2 minutes, ramped to 320 °C at 20 °C per minute, followed by a 9 minute isothermal period. The MS transfer line was at 320 °C, the source at 230 °C, and the MS quadropole at 150 °C. The mass spectrometer was scanned from 33-600 amu at a rate of 2.59 scans per second. The electron multiplier was set to the autotune value.

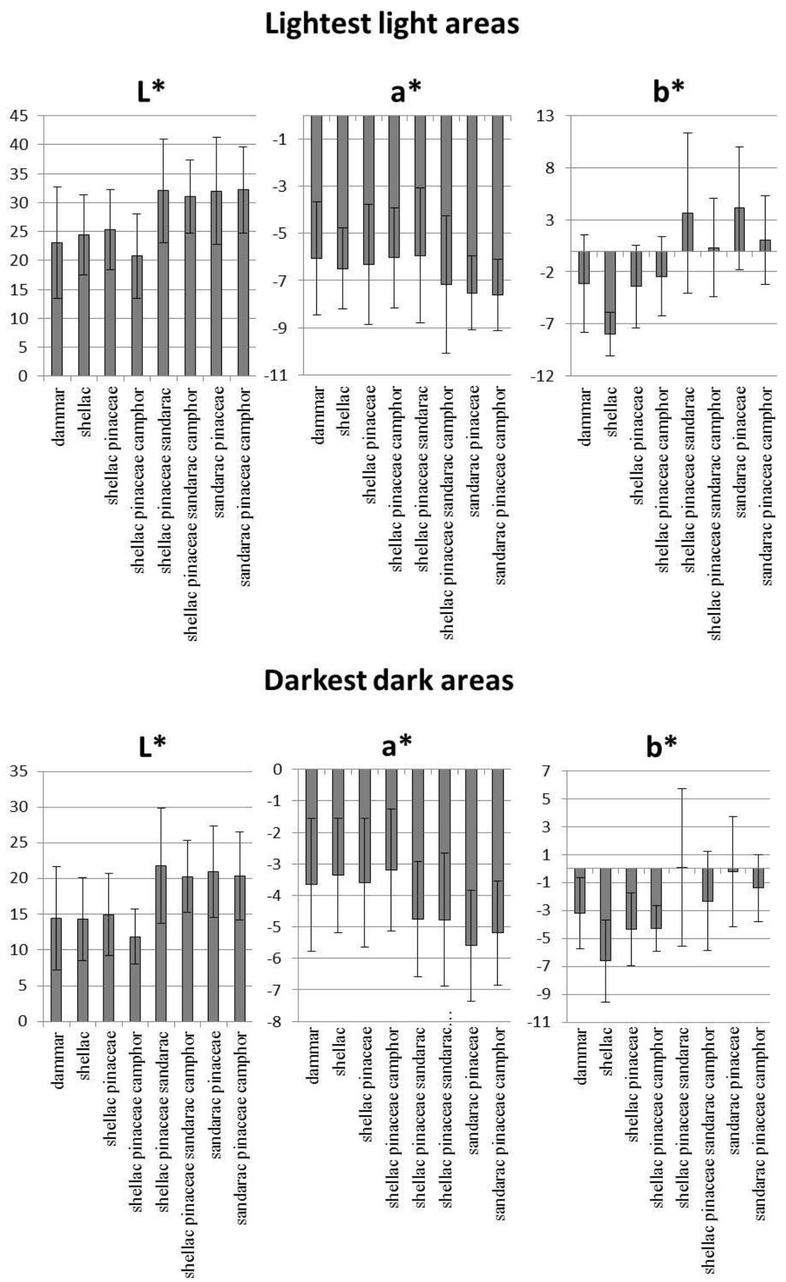

Fig. 4. CIE L*a*b* values of the lightest light (top) and darkest dark (bottom) areas of the digital images of the UVA-induced visible fluorescence of tintype varnishes.

Data analysis: Sample identification was aided by searching the National Institute of Standards and Technology (NIST) MS library, and by comparison to pyrograms and mass spectra of reference materials (Kremer Pigmente) and published literature. Specific marker compounds searched for have been previously published by Rogge (2013).

Results:

The tintypes displayed a wide range of fluorescence colors including blue, yellow, orange or white under UVA light (Fig. 3). However, color sampling of the lightest light and darkest dark areas of the digital images of the UVA-induced visible fluorescence failed to show any correlation between the CIE L*a*b* values of the fluorescence and the varnish components (Fig. 4). All varnishes exhibit similar ranges of L* and a* values in the lightest light and darkest dark areas of the image. Sandarac containing varnishes have a more yellowish tone in the lightest light areas indicated by the positive b* values, but the correlation is not significant enough to permit positive identification of this material, and this difference is not present in the darkest dark areas.

Fig. 5. Two tintypes varnished with a combination of shellac, sandarac and *Pinaceae* resin. Only the one on the left displays the orange fluorescence commonly expected of shellac.

Despite the large percentage of the collection that contains shellac in the varnish layer (59 %), only two tintypes displayed the orange color typical of the insect resin (Fig. 5). Instead, most of the varnish materials containing shellac fluoresced a bluish-green, as indicated by the negative a* and b* values. This suggests that the tintypists were using decolorized shellac to minimize the typical yellowish tonality of the varnish. During the time of these tintypes' manufacture shellac was most commonly decolorized by bleaching with chlorine gas or sodium hypochlorite or by passage through an adsorbent material such as charcoal (Sutherland 2010). The chlorine bleaching process results in formation of trace levels of chlorinated compounds that are detectable by mass spectroscopy (Sutherland 2010); however these compounds were not detected in the shellac varnishes on the study collection tintypes. This may be due to the concentrations of these marker compounds being below the detection limit of the instrument, or due to a deliberate choice on the part of the artists to use carbon decolorized shellac. Literature reports on the early production of bleached shellacs suggest that these become insoluble with age and were unsuitable for use on photographic materials, for instance H. Greenwood (1882) wrote of chlorine bleaching saying "This process, though it produces a pale resin of great value for many economical purposes, causes the resin to lose many of those properties that specially fit orange lac for use in photographic varnish." And "Experimenters with "bleached," or as it is often called, "white lac," must know that unless it be properly stored it practically loses its solubility in spirit of wine…" While Nash (1867) reported on adverse reactions of chlorine bleached shellac with silver image material: "…I studiously avoid the use of chlorine, phosphatic compounds or chromates, as any of these coming into contact with silver or its salts enter readily into combination, forming chloride, phosphates, and chromates of the metal; and solutions of shellacs or gums treated with any of the above chemicals will, to the most casual observer, be seen to be an injury to a print, or in fact in any instance where silver is present." Thus, contemporary photographers were well aware of the importance of varnish quality and may reasonably be supposed to have deliberately used non-chloride containing photographic grade materials.

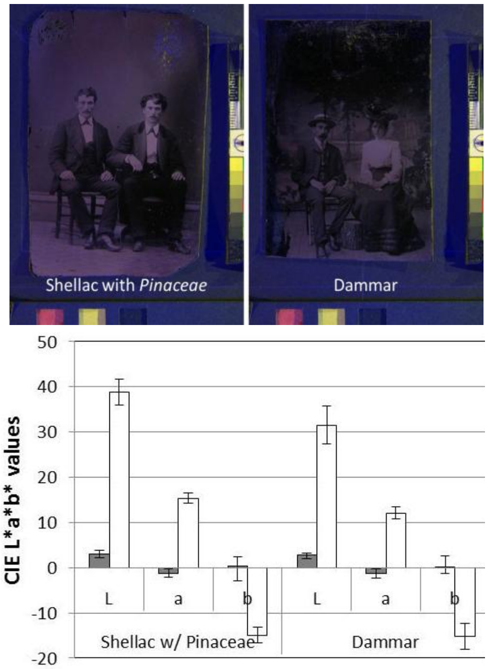

Fig. 6. Top: False color reflected UVA images of tintypes varnished with shellac and *Pinaceae* resin (left) or dammar (right). Bottom: average CIE $L^*a^*b^*$ values for the lightest lights (white) and darkest darks (grey) of the images above. The false color images have very similar tonality despite the presence of completely different varnish materials.

False color reflected UV photography (FCUV) is a method that combines a reflected UVA image with two visible light channels, and offers a potential method to differentiate between materials similar in appearance (Warda 2011). This technique was first developed in 2004 by Aldrovandi (2004) for non-destructive analysis of pigments and has since been applied to easel and wall paintings (Albrovandi 2005), works of art on paper (Coccolini 2010), and textile dyes (Conti 2008), but analysis of resinous materials has not yet been reported. In order to determine if this method would offer a means to differentiate between the different varnish materials, a subset of tintypes that had different varnish materials but similar UVA-induced visible fluorescence colors was chosen and imaged. Figure 6 shows FCUV images of two tintypes, one varnished with shellac and *Pinaceae* and the other varnished with dammar, which are nearly identical color; thus, this method too fails to distinguish between insect and plant resin materials.

Fig. 7. Normal (left) and UVA-induced visible fluorescence (right) images of a tintype. The image on the right clearly shows how the presence of a paper holder altered production of fluorophores.

The failure of fluorescence to distinguish dammar, shellac and sandarac is likely due to a variety of causes. Fluorophores in materials can be initially present in the material or can form upon aging; shellac is highly fluorescent as obtained from the insect (Larsen 1991), but many plant varnishes display increased fluorescence upon aging (de la Rie

1982b), which is often used to detect modern overpaint on easel paintings (de la Rie 1982a). Decolorization can remove the fluorophores initially present (Sutherland 2010), and may also influence the type and quantity of fluorophores created upon aging. Aging conditions may also influence the types of fluorophores produced. For instance, many tintypes were originally housed in carte de visite sized paper holders although when purchased the tintype shown in Figure 7 did not have such a case. However, the UVA-induced visible fluorescence image of this tintype shows a difference in fluorescence between the edges of the tintype and the central portion and clearly delineates the shape and size of the window of the now missing holder; the window area is significantly more yellow in tone than the areas that were once covered. The storage and display history of this object are unknown, and the difference in fluorescence could result from different levels of light exposure, materials present within the mount, or both, but it is evident that the life of an object can dramatically influence its fluorescence color.

Conclusions:

Fluorescence of varnish materials is not indicative of the type of resinous materials present. Di-, tri-, and sesquiterpenoids all display a range of colors under UVA radiation and thus the color of UVA-induced visible fluorescence should not be considered an analytical tool capable of identifying varnishes present.

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The Atlas of Analytical Signatures of Photographic Processes: Its Past, Present, and the Future

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Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand

Abstract:

The idea for the Atlas of Analytical Signatures of Photographic Processes precipitated from a November 2000 George Eastman House expert meeting of photograph conservators, conservation scientists and historians of photography that identified a pressing need for the development of an advanced, more objective methodology for the identification of photographs and photographic material as one of the most important topics of the conservation science field for the photograph research community. GCI scientists prepared the ground for the Atlas work by reviewing, modifying and optimizing the methodology of X-ray fluorescence spectrometry (XRF), Fourier Transformation Infrared Spectrometry (FTIR) and Digital Microscopy for its use in the scientific and analytical investigation of photographs. A critical review of historical literature sources related to the technical history of photography allowed for the identification of over 130 photographic processes that were actively researched and used during the so-called “chemical photography” era. The most challenging part of the Atlas project was, and still is, the locating of well documented and correctly identified samples of important process variants, rare photographic processes and samples of post-processing treated photographs. Only when identifying, confirming and re-confirming recorded analytical signatures were GCI scientists able to describe the morphological qualitative and quantitative signatures typical for each photographic process. Including examples of interpreted XRF and ATR-FTIR spectra for each photographic process, process variant and post-processing treated photograph provides important guidance for conservators and conservation scientists unfamiliar with a particular photograph or photographic process in question when solving difficult and confusing process ID cases. Scheduled to be published in an advanced electronic form the Atlas will serve both as a tool for the systematic investigation of photographs and photographic collections and also as a quick reference for solving targeted ID questions. This paper will provide insight into the multifaceted research towards the publication of the Atlas.

Introduction:

A major goal of the November 2000 expert meeting at the George Eastman House was to discuss and specify research priorities for the scientific research of photographs and photograph conservation and to, even when indirectly, help to delineate several possible directions for, at that time, the new and developing conservation research program at the Getty Conservation Institute. After two days of discussions the need for a new, scientifically based, advanced methodology for the identification of photographs and photographic processes ended up on top of a virtual pyramid of discussed ideas and research topics. That research area also corresponded well with previously developed expertise of GCI scientists in the application of modern scientific and analytical methods in the analysis and scientific studies of paintings, stone and metal objects and previously conducted targeted studies of photographs.

The idea for the Atlas of Analytical Signatures itself precipitated from a visit to the Logical Image Inc. research facility in Rochester. Working in the dermatology field on site, dermatologists and image scientists created an atlas of dermatologic diseases. A need for such an atlas started to be acute with a heavy increase in international travel and with the import of dermatologic diseases that are very rare in the US and that most practicing dermatologists have had little opportunity to see or diagnose.

That situation is very close to the current situation in the research, conservation and preservation of photographic heritage. Most conservators of photographs, curators and collection managers are well trained in recognizing major and common types of photographic processes but are very hesitant when dealing with unusual or rare photographic processes that do not have clear visual or microscopic signatures to identify them or differentiate them from more common photographic processes. That situation is even more complicated by the fact that often older registrar information attached to collections of photographs often does not contain information on the photographic processes used to create photographs. Even when some process information has been attached to individual photographs in the past, it is not certain that the process information is accurate or complete.

What makes the process identification important for all photograph heritage professionals is that photographs, even when looking rather simple, usually have a complicated chemical and physical internal structure and without understanding the details of the environmental, chemical and light stability of all of the chemical elements and compounds that make up a photograph it is difficult or impossible to specify safe conditions for exhibition, long term storage or active conservation treatment of photographs.

The GCI's research towards the Atlas of analytical signatures started with a "technology transfer" of existing analytical methods already used in the analysis of museum objects and collections and testing and modification of other research methodologies for specific needs of the analysis of photographs. The GCI scientists also developed several new analytical methodologies and analytical procedures to answer some specific problems related to the identification and analysis of photographs.

Once all needed analytical methodologies were developed and tested GCI scientists embarked on a systematic analytical survey of photographic processes. Our visual, microscopic and analytical investigation of thousands of photographs from the GCI's Study Collection and collection of a number of important museum collections of photographs (J Paul Getty Museum, Harry Ransom Center at the University of Texas at Austin, George Eastman House, National Media Museum, Société Française de Photographie, etc.) has shown that the visual observation of a well trained eye can easily identify about 50% of photographic processes with a very high level of accuracy. Using a high power loupe or a quality stereomicroscope to examine the image microstructure and visible layering structure of photographs increases the number of photographic processes that can be securely identified to about 80% of all photographic processes. Non-destructive or noncontact scientific analysis of photographs plays a very important role in providing very objective data that can be used to validate the results of both visual and microscopic study of photographs and in the identification of the about 20% of remaining photographs that are difficult or impossible to fully identify using their visual or microscopic signatures (Fig. 1).

Fig 1. Different analytical tools and the GCI reference collection used by GCI scientists when studying and identifying photographic processes.

Our practical experience, when using our analytical tools and Atlas data when identifying photographs, has showed us that we are able to identify very close to 100% of difficult identification problems. Some of the unresolved ID cases for photographs are mounted in such ways that we have limited analytical access to the image layer. There are also some variants of photographic processes that have almost identical chemical compositions that are beyond the limits of today's non-destructive analytical technology (low concentration of some trace elements in photographic negatives, dye concentration and layer thickness of modern color material, presence of some light elements such as lithium and boron and fluorine in photographic materials). We are very positive that the future development in the sensitivity and resolution of instrumental methods of analysis will allow for even more precise and detailed analysis of photographs and photographic material.

Photographic Processes and Process Variants

In our published articles, lectures and when explaining our research project to visitors of our laboratories we often talk about more than 130 different photographic processes that have been invented, developed, abandoned or replaced since the dawn of photography in early years of the 19^{th} century. This number is based on our in-depth review of photographic literature and several already published books on photographic processes and their identification (Krivanek 1953; Coe and Haworth-Booth 1983; Reilly 1986; Nadeau 1989; Cartier-Bresson 2007; Lavedrine 2009). The number 130 is more an arbitrary number of the most important and the most common photographic processes. We are well aware that to specify a precise number of photographic processes would be very difficult or impossible and that it is often even difficult to specify what is a true photographic process and what is just a process variant. Figure 2 illustrates just a small number of different photographic processes collected and studied by the GCI Photo Project team that are now an integral part of the GCI Reference Collection / Study Collection of Photographs and Photographic Processes.

Fig. 2. The GCI Reference Collection – A small example of our extensive study collection of photographs and photographic material.

The Current Structure and Organization of the Atlas

Our goal, when developing the organization and structure of the Atlas was to achieve a high level of consistency between individual Atlas chapters that would allow a reader familiar with one part of the Atlas to feel comfortable when moving between all of the Atlas' individual parts. We also wanted to allow for a relatively easy format change between the current and future versions of the Atlas and for easy modification of existing material or for addition of new chapters and the addition of new data, images and spectra and references. The following is a description of the information that makes up each chapter in the Atlas.

Chapter Title

Titles of all individual chapters of the Atlas are based on the common English name of the photographic process used by today's photograph historians and conservators of photographs. When available or known other English synonyms are also included. Both German and French names of the process are also included together with notes, if needed, on difference between the use and meaning of individual terms (for example: tintype, melainotype, ferrotype, etc.).

Invented by…

When well known the name of the inventor and a known or generally accepted date of invention or known first publication of the process is stated.

Historical Background

Each process chapter has brief historical background information related to the invention or discovery of the process as well as important data on further developments, improvements and modifications of the process, its manufacturing and all available data that would allow for the establishing of exact or estimated "terminal dates" for the use or manufacturing of photographic materials. In some cases a simple or more complex graphical historical timeline is included that allows for quick orientation in the historical aspect of the given photographic process (Fig. 3).

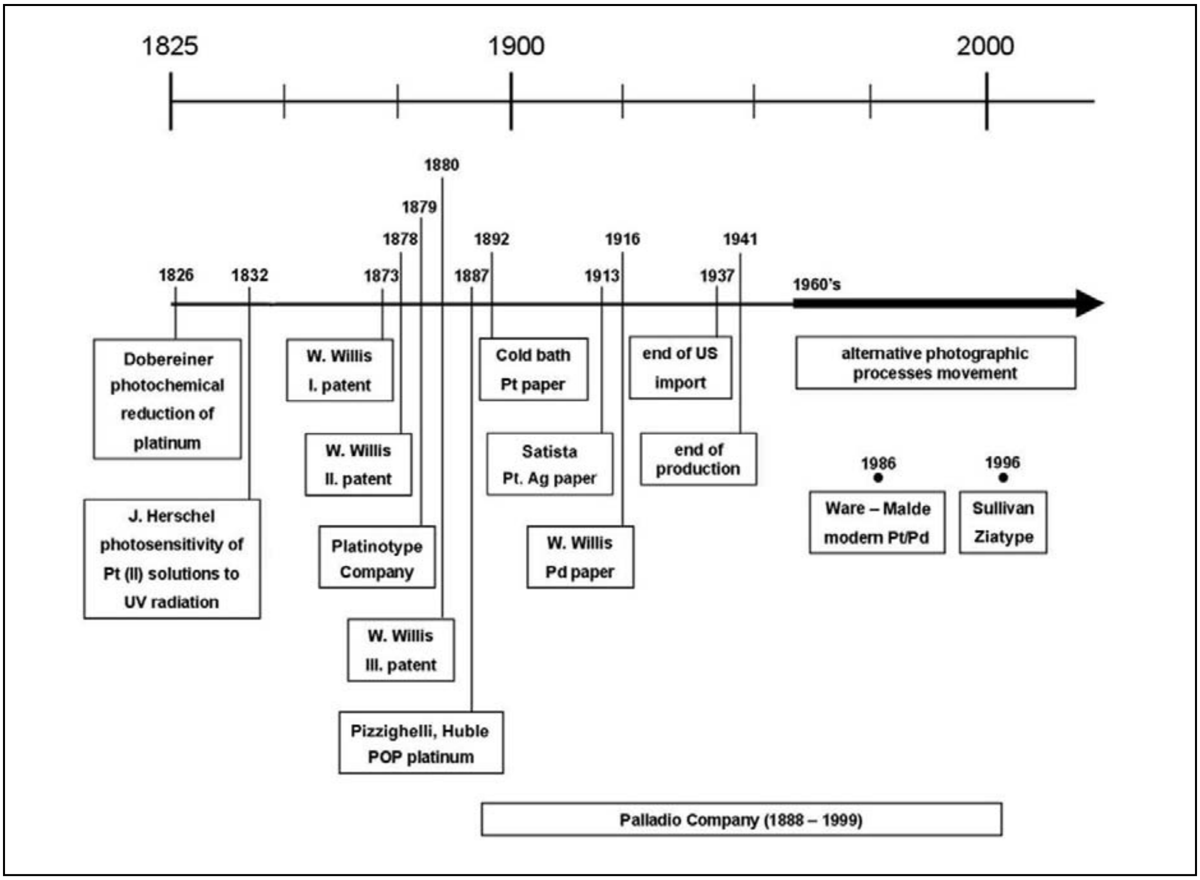

Fig. 3. Timeline of the Platinotype process.

Process Description

The knowledge of all chemicals used to prepare or manufacture photographic material and used during processing or potential post processing of photographs and the knowledge of all individual steps and procedures used to prepare and process photographs is very beneficial when analyzing photographs and interpreting analytical results. The use of some chemicals, directly or indirectly used when making or processing photographs, might leave some detectable traces of material within the processed material that can be used as chemical markers of the photographic process (the presence of iron even in well cleared platinotype photographs, the albumen subbing layer of silver gelatin based glass negatives, the presence of a titanium dioxide filled polymer in RC photographic paper, etc.).

The process description included in the Atlas is based on the most common and highly used procedure known in the photographic literature. Some more complicated process sequences (e.g., different versions of carbon processes) are graphically depicted.

Noted Photographers Using the Photographic Process

A short list of well known photographers that are known for using the process is included. This might be useful for a reader when looking, in literature or on the web, for visual signatures of a process that can be used to aid in the identification.

Important Variants of the Process

A number of photographic processes were often further developed or modified by other researchers. For example the platinotype process was changed and improved several times by its inventor, and further modified by others. The Palladiotype variant of the platinotype process was developed to deal with restrictions on the use of platinum during WWI and the Satista platinum-silver hybrid process was developed in response to the rising platinum prices. Glycerin developed platinotype photographs allowed for localized development of the image according to the fashion of the time. During the revival of the platinotype printing process in the 1960's and 70's artist started to use mixed platinum-palladium chemistry. Several new modifications of the platinotype process were introduced in later part of the 20th century (e.g., Ziatype). When the chemistry of individual variants of a particular photographic process differs substantially, instrumental methods of analysis can be used to identify not only the photographic process but the particular variant of the process as well.

Important Patents

A large number of photographic processes were patented and described in photographic patent literature (Foley 1979; Schimmelman 2002; 13]. The patent literature provides some important data related to many different photographic processes but reading and interpreting patent literature is often difficult and sometimes rather confusing. Contemporary patent literature and patent search sites provide, too often, too many patents with small variants in process chemistry or material processing to be beneficial in photograph ID studies. Only the key patents for each photographic process, if any, have been included in the Atlas.

Photographic Process ID Tools

Each chapter of the Atlas contains information on all important visual characteristics of a photographic process or useful hints that can be used to aid the process identification. Some examples include how the RC photographic paper feels between fingers; that the typical topography of carbon prints can be observed under raking light or that localized darkened areas of older platinotype prints may indicate the use of the glycerin development method (Fig.4).

Microscopic Signatures

The microscopic signature part of each chapter of the Atlas contains several microscopic details recorded from a typical example of a photograph of the particular photographic process. Recorded under a range of different magnifications the microscopic images can be used directly for process identification based on a side by side image comparison. When useful for process identification, some typical examples of photograph damages (e.g., emulsion abrasion of glossy collodion photographs) are also recorded and provided as identification tools. Microscopic images also show images areas (usually photograph edges or corners that might help to identify the layered, internal structure of the photograph). When available some SEM images (even though these are not non-destructive) are included to demonstrate or explain the image layer structure that might be typical for a given photographic process (Fig. 5).

Fig. 4. Some typical visual characteristics (signatures) of photographic processes.

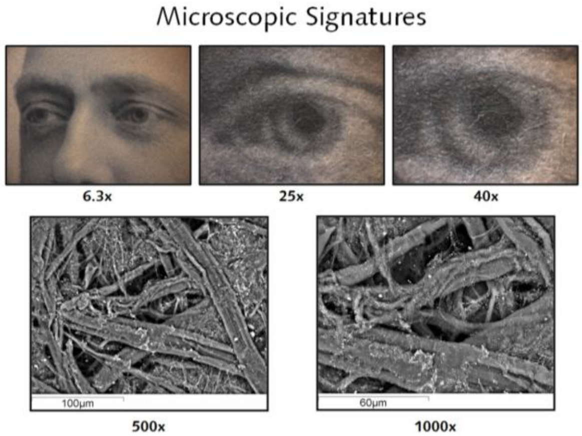

Fig. 5. Typical Microscopic Signatures of Photographic Processes.

XRF Analytical Signatures

The XRF analysis of photographs provides important information on the presence or absence of about 25 different chemical elements that have been identified by GCI scientists when analyzing thousands of historical and modern photographs (Stulik and Kaplan 2012). Besides the simple presence or absence of certain chemical elements the simultaneous presence of several elements in a photograph provides very important information that can be used when identifying a photographic process (e.g., the simultaneous presence of both platinum and iron and the absence of silver would strongly indicated that the analyzed photograph belongs to the platinotype category of photographs. XRF spectra recorded both at the maximum image density (D-max) and minimum image density (D-min) areas of the photograph and sometimes also spectra recorded from the back of an unmounted photograph and mounting board or mounting substrate might be used to understand both the elemental composition and sometimes also the layering sequence within a photograph or mounted photograph package (Fig. 6).

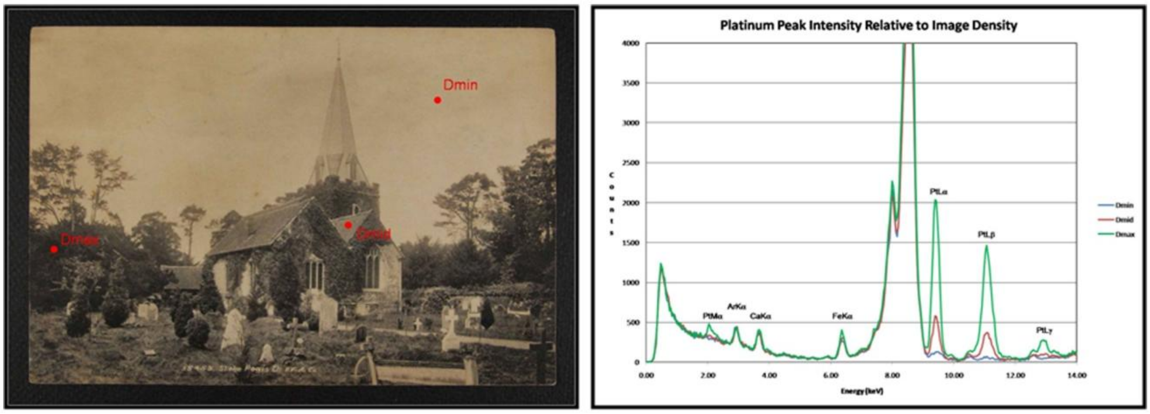

Fig. 6. XRF analytical signatures showing a difference between spectral intensity of key elements in the D-max and D-mid and D-min areas of the photograph.

FTIR Analytical Signatures

The identification of the organic components within an analyzed photograph is a very important step when identifying photographs. Organic material (gelatin, albumen, collodion) are major binders of imaging metals and compounds within the image layer of a photograph. Paper and organic polymers (cellulose nitrate, various cellulose acetates, polyesters, etc.) are important components of both negative and positive photographic materials. Identification of a polyethylene layer on the back of a B&W or color photographic paper allows one to identify a modern RC photographic material. Many different organic coatings and varnishes have been used during the almost 200 years of photography in order to protect the image layer against environmental effects or to modify its appearance (glossy, matte, semi-matte, etc.). More detailed and semi-quantitative analysis of photographs can also provide some important information on the presence of external or internal sizing material within a paper substrate of a photograph. By sampling several layers of a photograph ATR-FTIR analysis can also provide some information on the internal layering structure of a photograph (e.g., simultaneous detection of paper substrate, albumen in the image layer and thin organic varnish of many 19th century albumen photographs).

ATR-FTIR analytical signatures

Peak Location (approximate)	Identification
3330 cm^{-1}	OH – free
2900 cm^{-1}	C – H, CH_2, CH_3 stretching
2850 cm^{-1}	C – H, CH_2, CH_3 stretching
1635 cm^{-1}	adsorbed water
1420 cm^{-1}	C – H
1315 cm^{-1}	C – H
1200 cm^{-1}	C – OH; C – CH
1155 cm^{-1}	ring breathing
1105 cm^{-1}	C – O – C glycosidic
1050 cm^{-1}	C – OH (2° alcohol)
1025 cm^{-1}	C – OH (1° alcohol)
895 cm^{-1}	C – O – C in plane

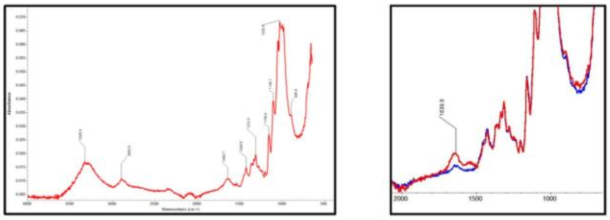

Fig. 7. ATR-FTIR analysis of a photograph showing a portion of a spectra interpretation table from the Atlas.

All modern FTIR instrument in conservation laboratories use different commercial spectra libraries when aiding analysis and interpretation of FTIR results. Most of these industrial spectra libraries contain information on a large number of different single species and pure organic materials and such spectra libraries have limited use in conservation science practice which, usually, deals with the analysis of impure and often well aged and deteriorated organic materials and material mixtures. This was the main reason why conservation scientists at the Getty Conservation Institute initiated the work on an art conservation library of infrared spectra that later morphed into the current IRUG spectra library (IRUG 2013). Even the IRUG library of FTIR spectra is limited when dealing with the identification of the complex, multi-component layered structures of many photographs and photographic materials. FTIR spectra included in the Atlas typical for all of the main photographic processes and many process variants will aid greatly in the FTIR analysis of photographs (Fig. 7).

Other Analytical Signatures

The analytical methodology covered in the Atlas focuses namely on utilizing non-destructive methods of analysis that do not require any physical sampling. There are many instances, in conservation science investigations, when small samples of analyzed objects are available for analysis and some other (very often more sensitive) methods of chemical analysis can be used (e.g., the analysis of traces of iron based developer on micro flakes of collodion emulsion found on the bottom of a negative container or sample of varnish material flaking from the back side of a photograph). Some information on other analytical methods for further and more detailed analytical investigation of photographs is also included in the Atlas.

Post Process Treated Photographs

Many existing photographs have been post process treated (a treatment that is not an integral part of the photographic process). In many cases such a treatment was done as part of the processing of a photograph or it could have been done later on. Some examples of post-processing treatment include the archival selenium toning of photographs or varnishing of photographs for an exhibition. The identification of the post-process treatment of photographs provides valuable insight into the darkroom technique of a photographer, photograph printing laboratory or studio (Fig. 8).

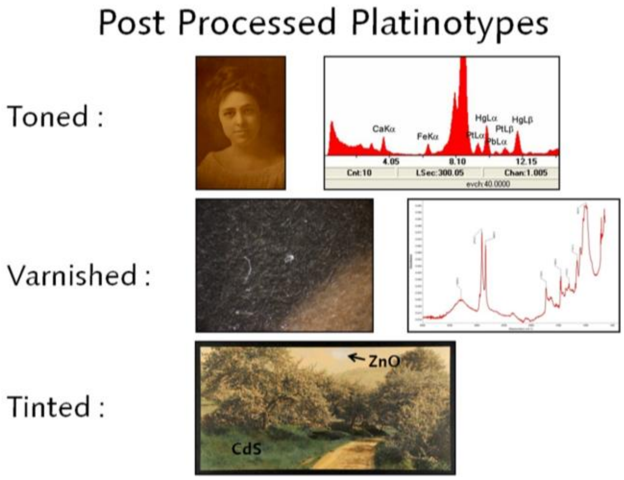

Fig. 8. Examples of various post-process treatments of photographs.

Identification Table

Identification tables included at the end of each individual chapter of the Atlas might be the most important tools for the advanced identification of photographs and photographic processes. The identification tables provide summaries of all visual, microscopic and analytical clues obtained during the investigation of a photographic process and allow one to compare these clues with other photographic processes and process variants that are easily or often misinterpreted during process identification. Tables indicate both key and supporting clues needed to identify and confirm the identification of a particular photographic process or a photograph (Fig. 9).

Tonality	Process	Surface Coating	Paper Fibers	Pt	Pd	Fe	Hg	Ag	Au	Ba	Cellulose	Gelatin	Collodion	Others
black	platinotype	-	X	X	-	X	-	-	-	-	X	-	-	-
	Pt / Pd	-	X	X	X	X	-	-	-	-	X	-	-	-
	varnished Pt	X	X	X	-	X	-	-	-	-	-	-	-	X*
	matte collodion	X	-	<X	-	(X)	-	X	<X	X	-	-	X	-
	Gevaluxe	-	X**	-	-	-	-	X	-	(<X)	X	-	-	-
	Satista	-	-	X	-	X	-	X	-	-	-	<X	-	-
	palladiotype	-	X	-	X	X	X	X	-	-	X	-	-	-
brown	hot dev. Pt	-	X	X	-	X	-	-	-	-	-	-	-	-
	Pt / Pd	-	X	X	X	X	-	-	-	-	X	-	-	-
	Hg toned Pt	-	X	X	-	X	X	-	-	-	X	-	-	-
	matte collodion	X	-	<X	-	(X)	-	X	X	X	-	-	X	-
	silver gelatin	X	(X)	-	-	<X	-	X	-	(X)	-	X	-	-
	kallitype	-	X	-	-	X	-	X	-	-	-	-	-	-
	tannin toned cyano	-	X	-	-	X	-	-	-	-	X	-	-	X***
	U toned Pt	-	X	X	-	X	-	-	-	-	X	-	-	X†
	Ziatype	-	X	-	X	X	-	-	(X)	-	X	-	-	X#

X – present
\- – absent
(X) – may be present
X* – often wax or linseed oil
X** – unique image structure under a microscope
X*** – presence of a very characteristic CN spectral peak

Fig. 9. The Identification table for a family of platinotype and platinotype-like photographic processes.

The Targeted Audience for the Atlas

The Atlas was developed, planned and written for practicing photograph conservators, conservation scientists and curators and managers of collections of photographs who might need to identify more unusual photographs. The Atlas would also aid individuals studying the darkroom techniques of a photographer's work or changes in his or her darkroom techniques due to different available photographic technologies or the outside influences of other photographers. Students of photograph conservation will also benefit when from the Atlas as an information resource on past photographic processes, their chemistry and identification.

Not all photograph conservators or curators have easy access to a well equipped conservation science laboratory and staff with an in-depth knowledge of the technical and chemical aspects of photography. At the same time, many photograph conservators or curators have access to art conservation laboratories experienced in analyzing paintings or other objects along with conservation scientists well familiar with XRF or FTIR analysis but often without experience in the analysis and interpretation of analytical data obtained from the analysis of photographs. Many local or accessible universities or industrial laboratories may have well equipped analytical laboratories and scientists proficient in the general aspects of chemical analysis but without any experience and knowledge needed to successfully interpret analytical data obtained from analysis of photographs.

The main purpose of the Atlas is to help a conservator and curator formulate analytical questions related to a particular photograph and at the same time to assist a scientist that is not familiar with analysis of photographs when interpreting the analytical data with examples of well characterized and identified photographs for needed spectra matching or comparison. The Atlas also contains a number of interpretation tables that provide help when dealing with photographs of similar analytical signatures, with the identification of overlaps of spectral peaks and with warnings against potential misidentifications or misinterpretations of analytical results.

By combining the individual expertise of a conservator or curator with the analytical expertise of a scientist and utilizing the Atlas as a communication tool between very different professional specializations, many difficult photograph identification problems can be successfully solved.

General Guidelines for the Use of the Atlas when Identifying Photographic Processes:

There are several working strategies on how to use the Atlas when identifying photographs or photographic processes.

- Collect all visual and microscopic signatures of a given photograph. If you are still not sure what photographic process you are dealing with try to identify the imaging metal or imaging compound in a given photograph using XRF spectrometry. The XRF analysis will provide you with information not only on imaging material but also on the presence of toning metals and on inorganic elements contained in the substrate of the photograph.

- Using FTIR spectrometry attempt to detect and identify the presence of an organic binder in the photograph. Beware that the top layer of the photograph might be coated with an organic coating or varnish that might shield the analytical signal from the organic binder!

- Compare all of the collected visual, microscopic and analytical signatures for a photograph in question with the interpretation tables located at the end of each process chapter which may pertain to the work in question. Work first with all interpretation tables that contain a combination of the imaging metal and organic binder detected in the photograph under question. This comparison will help to narrow down your search further.

- Compare all visual, microscopic and analytical signatures of a preselected group of photographic processes (those containing identical imaging metals and organic binder), looking for the best signature match between the photograph in question and a set of photographs with similar signatures.

- In most of the cases the above described procedure yields an accurate and reliable identification of a photograph or a photographic process. If even after recording and interpreting all signatures the nature of the photographic process is still not certain, there might be a need for using methods that would require micro-sampling to resolve the remaining identification issues. These steps should be very rare and they should not be taken without the approval of a conservator and curator or without consultation with experts in advanced methods of photograph identification.

How will the Atlas and its content be further developed, updated and expanded?

We are expecting that the Atlas will be "live material" that will be periodically modified and upgraded whenever new quality data on signatures of photographic processes will be well researched and confirmed.

The Atlas is projected to be available first in PDF form (Stulik and Kaplan 2013). At the same time we are developing its e-book (iBook) version with enhanced functionalities that would greatly aid a reader or researcher when using the Atlas in their everyday work. Including high resolution images within the iBook version of the atlas, downloaded on today's widely used iPad platform would allow the reader to enlarge all individual images within the Atlas as needed for detailed inspection or comparison with observed or recorded images (Fig. 10). The same type manipulation will be available when working with XRF spectra (Fig. 11).

Fig. 10. Finger assisted manipulation of high resolution images of the Atlas.

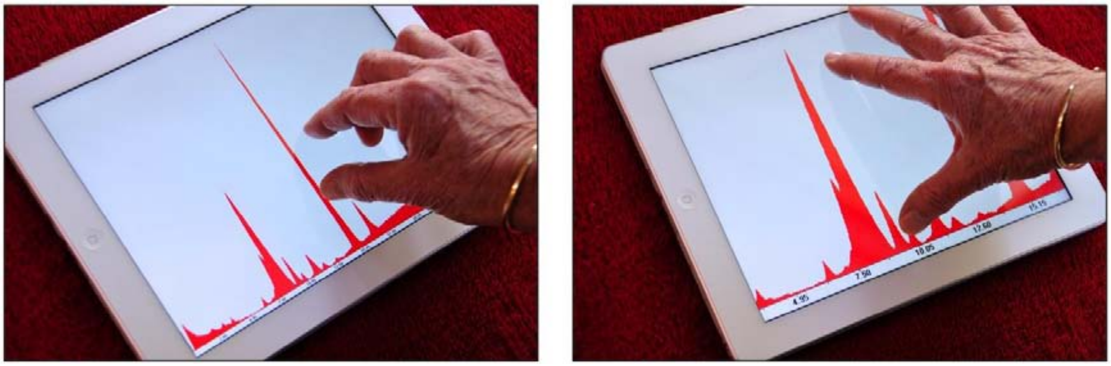

Fig. 11. Horizontal and vertical expansion of an XRF spectrum allows for easier reading and interpretation of analytical results.

Both XRF and FTIR spectra will also provide functionalities that will aid when reading spectra included in the Atlas. Touching a given spectral peak will provide information on chemical elements (XRF) or chemical compounds (FTIR) associated with it, provide warning on potential spectral overlaps and explain different spectra features in the light of the chemistry and internal structure of a photographic process (Fig. 12).

Fig. 12. The interpretation aid shows a typical assignment of a selected spectral peak together with potential spectral interferences.

We have also already started to prepare the ground for the future development of the Atlas. Using advanced methods of photography tailored, computer aided, library searches, chemometric tools and dedicated expert systems (Cartwright 2008) will allow for machine aided interpretation of analytical results and photographic process identification (Fig. 13).

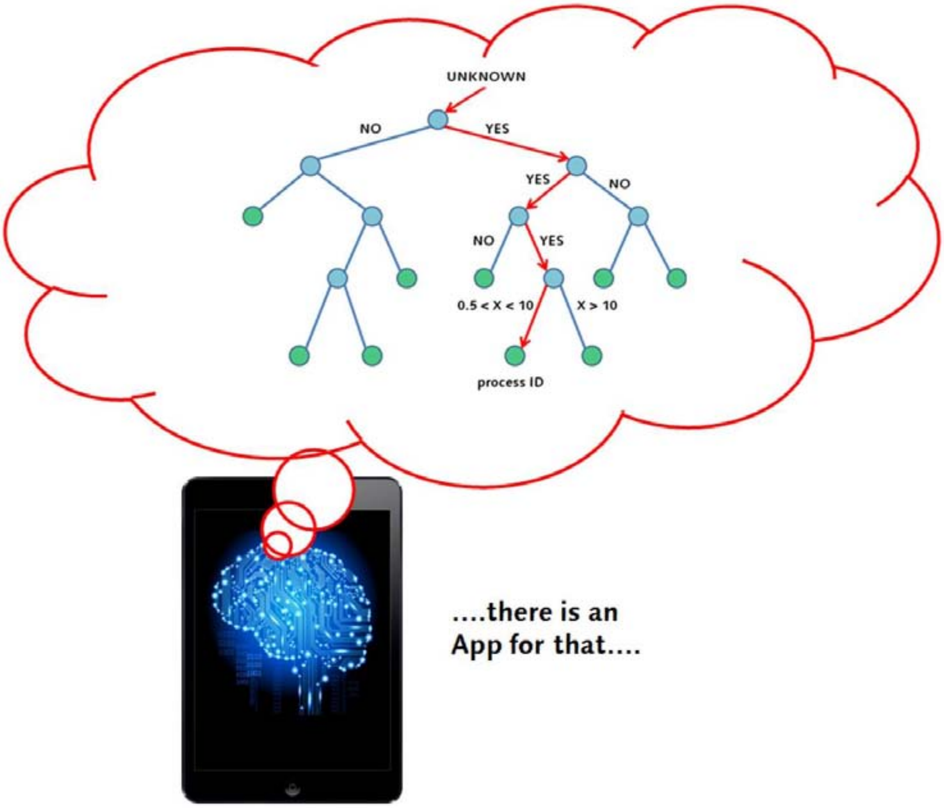

Fig. 13. A vision of computer assisted photograph process identification.

We hope that once all the current uncertainties related to different formats, standards and platform availabilities will be resolved that the Atlas will also be available in additional, fully functional tablet and/or mobile platform versions.

The electronic form of the Atlas should allow for easy additions, corrections and amendment of its content.

The most important and the most difficult part of our Atlas project has been and always will be the identification of well characterized and well identified examples of photographs and photographic processes. Our experience has shown that this part of the project is even more difficult than we could have imagined. Most photographic material in many museums, archives, libraries and private collections is not well identified and in some cases incorrectly identified. Photographs or photographic processes that were not well identified are practically "invisible" to search inquiries of registrar databases or collection records.

Our project experience also shows that the most valuable information leading towards the identification of unusual or uncommon photographic processes in collections is via the personal memory of collection managers, curators, conservators or registrars with an in-depth knowledge of their collections who often remember unusual photographs or photographs that need further investigation.

We hope that besides the continuous, long term support of our current project collaborators our Atlas work and research will generate interest and support from other researchers interested in old or unusual photographic processes. We hope that these researchers will help us locate well identified examples of different photographic processes that should be included in our further analytical investigation. With input and active collaboration of other researchers, the Atlas can be a very important resource of information and analytical data on different photographic processes that will serve the entire photograph research and conservation community well into the future.

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Carbon Isotope Analysis of Waxed Paper Negatives

Elyse Canosa, Gregory W.L. Hodgins, and Gawain Weaver

Presented as a poster at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Abstract:
Early photographic technology was well documented; because of this it is possible for modern photographers to replicate historic processes, such as the waxed paper negative process. It may be difficult to visually discern if a paper negative is modern or historic, making analytical tools useful in such endeavors. We hypothesized that radiocarbon isotope analysis acts as a means to distinguish paper negatives made with modern materials from those made with genuine nineteenth century materials. Photographs are unconventional objects to date using radiocarbon isotopes. The dating process is inherently complicated due to the multi-component nature of photographic materials. In order to achieve a complete interpretation of radiocarbon results from a given waxed paper negative, its major components (paper and wax) must be separated and dated individually. Preliminary experiments were performed on samples of modern paper coated with modern wax to devise a protocol for separating the wax layer from the paper layer. Such experiments allowed us to determine the efficiency of the protocol and the amount of sample necessary for analysis. After establishing two successful wax extraction methods, both protocols were applied to a waxed paper negative sample of unknown age. Radiocarbon measurements were then individually performed on the wax and paper components. Analysis of a negative sample prior to extraction, and analysis of the bare paper support did not show radiocarbon levels indicative of modern (post-1955) material. Radiocarbon measurements of the extracted wax component were unexpectedly low, suggesting that it is either composed of old (14^{th} – 16^{th} century) wax, or is a mixture of beeswax and a material containing no traceable radioactive carbon isotopes, such as paraffin wax. While the established protocols were performed on a single negative, it is the intent of this project to apply them to any waxed paper negative.

Introduction:
Radiocarbon analysis of organic materials is a useful tool to determine a range of dates for a sample of unknown age. These materials are generally plant or animal remains older than a few hundred years. Photographs, while they are composed of both plant- and animal- based materials, are very young on the radiocarbon spectrum, and are very complex due to their layered structure. Each photograph component (paper, binder, etc.) may have been collected or fabricated at a different time, providing a potential mixture of ages and thus complicating radiocarbon data analysis. Due to this unique structure, each photographic layer must be separated and dated individually. It should be noted that the process of radiocarbon dating is destructive, only requiring a small sample, but can provide useful age authentication information about objects that other methods of analysis cannot. This project focuses on waxed paper negatives, which generally only consist of paper and a thin layer of wax. Popular during the mid nineteenth century, waxed paper negative production was not part of a commercial industry and therefore varied slightly in terms of composition depending on the photographer. The chemistry, materials, and techniques of these historic photographic processes were often recorded in detail, thus

modern replications of historic waxed paper negatives are not uncommon. These modern replicas may be taken for historic negatives, a possibility which presents difficulties for collectors interested in the historic medium. In this study, procedures are established to separate the two main components of waxed paper negatives, using modern materials to emulate the thickness and consistency of historic negatives. A single negative of unknown age was provided on which to test the procedures and analyze using radiocarbon isotopes. Unnaturally high levels of radiocarbon detectable in plants and animals living after 1955 (known as bomb carbon), acted as a means to differentiate between a photograph made of modern (post-1955) materials and a photograph made of historic materials. This article presents a summary of work from a previously published article. To access the full data and analysis, please refer to Canosa et al. 2013.

Bomb Carbon

Around the 1950's, the natural content of atmospheric radioactive carbon was offset by the detonation of thermonuclear devices. Nuclear weapons testing began in the mid 1940's, peaked during 1961 – 1962, and reduced since 1964 due to a weapons testing ban. Such detonation greatly increased the amount of radiocarbon in the atmosphere in a short period of time, which then tapered off after testing ceased. This spike and the subsequent characteristic decline was (and still is) recorded to produce what is known as the "bomb curve". Any object made of materials after 1950 will have noticeably different radiocarbon content than an object made from nineteenth century materials.

Experimental:

Preliminary Extraction Method

Preliminary extraction involved paper and wax layer separation using samples of modern paper coated with modern beeswax. These tests were used to determine the optimum conditions for component separation. The first test involved separating the wax layer from the paper layer by melting the wax and absorbing it into a carbon-free silica absorbent. The presence of the absorbent does not affect radiocarbon analysis of the extracted wax. It was calculated that approximately 46% of the wax was transferred into the absorbent during the melting process. The second test involved separating the wax layer from the paper layer by dissolving the wax in hexane. Hexane is a petroleum-based solvent with no noticeable remaining radioactive carbon, and was found to not affect radiocarbon analysis of the extracted wax. It was found that hexane extraction was more efficient than melting, removing approximately 63 wt% of the wax layer.

Waxed Paper Negative Extraction Method

A section was removed from the corner of the actual waxed paper negative measuring 10.5 cm by 0.3 cm. The removed section was subjected to two separate wax extractions to create two separate wax samples for radiocarbon dating. The first extraction was performed by melting, and the second was performed by hexane dissolution. The remaining paper base was subjected to several Soxhlet extractions to remove any residual wax, eliminating the possibility of wax contamination. It should be noted that this sample size provided enough extracted wax for proper radiocarbon analysis, and could probably be reduced depending on the thickness of the wax layer on a given negative.

Results and Discussion:

The bare paper substrate of the separated negative was divided into two separate samples and measured twice for radiocarbon content. The radiocarbon age ranges resulting from both paper measurements were consistent with nineteenth century radiocarbon data. It can therefore be said with certainty that the paper base of the negative was not fabricated after 1950, due to the lack of bomb carbon. The extracted coatings did not provide results indicative of bomb carbon, nor did they provide results indicative of nineteenth century carbon, surprisingly. Figure 1 shows the multi-plot for the wax coating extracted from the negative of unknown age (Bronk Ramsey 2012; Reimer et al. 2009).

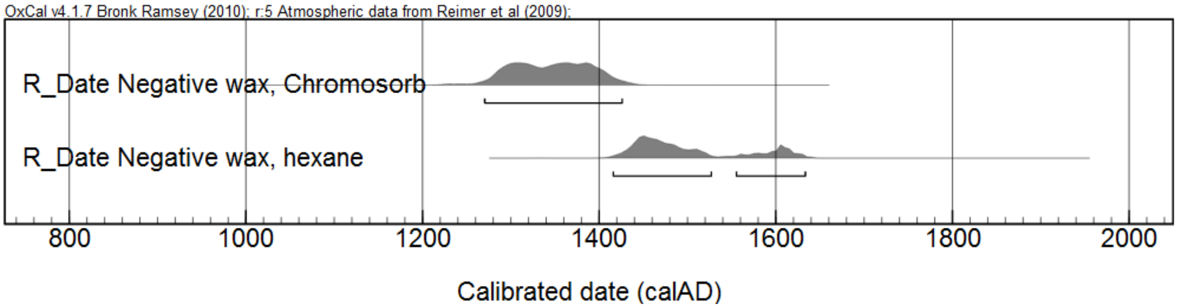

Fig. 1. Multi-plot for two samples of the extracted negative coating. Both indicate ages much older than the expected 19th century values. This could be due to the presence of petroleum-based materials.

While the radiocarbon results from the extracted negative coating were far older in age than expected, a few possibilities might explain the data. Analysis of the negative by FTIR indicated the presence of a natural wax coating. It is possible that a petroleum-based wax such as paraffin wax was also present in the coating. Traces of paraffin are unlikely to be noted on an FTIR spectrum if a natural wax such as beeswax is also present. If a radiocarbon-free material (such as paraffin) is mixed with a material containing radiocarbon (such as beeswax), a noticeable depression in the overall radiocarbon content of the mixture will occur, giving it an apparent older age. Introduced to the public in the mid-nineteenth century, petroleum-based waxes could either have been incorporated into the wax layer during negative production, or during a later conservation treatment.

The presence of paraffin or some other petroleum-based wax is currently a theory, which could potentially be proven or disproven through the use of gas chromatography - mass spectrometry on the extracted negative wax. Also, the possibility of contamination by other materials should not be entirely overlooked. It is possible that genuinely old wax was used as a coating material, either by a nineteenth century photographer or a modern photographer. Because of its chemical structure, beeswax is a very stable material. It is also highly resistant to bacterial attack and therefore does not significantly deteriorate over time (Nelson et al. 1995). Radiocarbon measurement alone could not resolve such a scenario.

Conclusions:

This study showed that radiocarbon analysis of waxed paper negatives is possible by extraction of the wax layer through melting or dissolution. Further research could involve testing a number of solvents for extraction efficiency, and thus reduction of necessary sample size. The extraction results indicate that there is no evidence of bomb carbon in the wax or paper layer of the sample negative. There is no proof to say that the negative is modern, but it still cannot be determined with certainty that it is of nineteenth century origin due to potential interference from petroleum-based materials. Research using GC-MS may provide some further evidence towards the coating composition and origin. The modern materials used in this study acted as good representations of common materials used in waxed paper negatives, and the actual negative was of a common thickness and wax distribution. One must also be aware of the potential for additives, which should be addressed on a case-by-case basis. Overall, the extraction protocol devised for radiocarbon isotope analysis of this particular paper negative is applicable to a majority of historic paper negatives. The most important factor for a collection or institution to consider is the destructive, lengthy, and expensive nature of carbon isotope analysis. Nevertheless, carbon dating can be an incredibly useful tool for authentication when other methods of analysis cannot provide significant evidence.

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We would like to acknowledge the NSF-Arizona AMS Laboratory, and the Arizona State Museum Conservation Laboratory for use of their facilities throughout the extent of this project. Also a large thank you to Dr. Nancy Odegaard, Dr. Pamela Vandiver, the University Spectroscopy and Imaging Facilities (USIF) at the University of Arizona for providing SEM images, Diana Sammataro and the Carl Hayden Bee Research Center for beeswax samples, Kim Flottum for beeswax samples, and Jae Gutierrez and the University of Delaware Art Conservation Department for nineteenth century paper samples.

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Abstract: Poitevin's Precious Plates
Current Research at the Rijksmuseum

Martin Jürgens

Presented at the poster session of the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Sixteen small, metal plates were donated to the Print Cabinet of the Rijksmuseum many years ago. The donor vaguely associated them with Alphonse Poitevin, the 19th century engineer who is known for his pioneering work with bichromated gelatin processes, among many other experimental photographic and printing techniques. This intriguing detail sparked an ongoing research project into the plates' history, materials, and original function. At first glance, the plates are not much to look at; they appear to be experimental rejects: from paper-thin copper sheets to mechanically damaged daguerreotype plates. However, close examination of the plates and extensive research in collections of French institutions has shown that at least two of the Rijksmuseum plates hold partial images, and that precisely these images were used by Poitevin in the 1840s for his experiments on converting daguerreotypes into intaglio printing plates. The plates are currently assumed to stem from one or all three of Poitevin's early processes: gravure photochimique (1842-48), gelatin transfer (1851), and/or helioplastie (1855). Research to date has included chemical analysis by XRF and SEM-EDX, surface analysis by Hirox microscopy, and study of the literature. More technical analysis is in preparation. The long-term goal of this project is to determine the nature and original function of these plates and then to re-create the processes, thereby gaining the knowledge to accurately identify similar plates in other collections.

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The Last Full Measure: An Exhibition of American Civil War Photographs from the Liljenquist Family Collection at the Library of Congress

Alisha Chipman and Dana C. Hemmenway

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand

Abstract

From April 12, 2011 through August 13, 2011 the Library of Congress presented a major exhibition highlighting items from the Liljenquist Family Collection of Civil War Photographs. The exhibition, titled *The Last Full Measure*, consisted of 379 cased and framed ambrotype and tintype portraits and was meant to serve as a memorial to all the soldiers who lost their lives while fighting in the American Civil War (1861-1865). The photographs were arranged in a patchwork quilt-like manner and displayed in six floor-standing cases. The display platforms were set at a pitch of 65 degrees to allow for greater visibility. This exhibition design, while unique and visibly pleasing, posed a great challenge to the Conservation Division. A stable mounting solution had to be found in order to secure approximately 63 objects laid out in nine to ten horizontal rows per display case. In addition to consulting on the mounting design, representatives from the Conservation Division examined, stabilized, treated, mounted, and installed the objects in a timely manner in order for the exhibition to open on its symbolically important opening date; the 150th anniversary of the beginning of the Civil War. This paper provides an overview of the exhibition and the many challenges while highlighting innovative approaches to conservation treatment and exhibition display.

Introduction

In 2010, the Prints & Photographs Division (P&P) of the Library of Congress (LC) acquired the Liljenquist Family Collection of Civil War Photographs. The collection consisted of over 700 ambrotype and tintype portraits depicting Union and Confederate soldiers and their families. Unknown local or itinerant photographers took most of the images just before the soldiers were sent to the front or while they were stationed at regimental encampments. Tom Liljenquist, a jeweler and resident of McLean, VA, and his three sons had been actively collecting Civil War-era photographs for over 15 years. The items in their collection were purchased from a variety of sources including antiques shops, eBay, estate sales, fellow collectors, and civil war shows. The donation of the Liljenquist Family Collection to the Library of Congress arrived on the eve of the Civil War's sesquicentennial. Fittingly, the library, in close collaboration with the Liljenquist family, planned a major exhibition highlighting items from the collection to open on April 12, 2011, the 150th anniversary of the beginning of the Civil War.

The exhibition, titled *The Last Full Measure: Civil War Photographs from the Liljenquist Family Collection*, consisted of 379 cased and framed ambrotype and tintype portraits and was meant to serve as a memorial to all the soldiers who lost their lives while fighting in the Civil War. More than 620,000 soldiers perished during this four year long battle. Accordingly, the exhibition contained images of 360 Union soldiers – one image for every 1,000 that died - and 52 images of Confederate soldiers – one for every 5,000 casualties. The photographs were displayed in six cases: five containing images of Union soldiers and one of Confederates. Liljenquist's sons, Jason and Brandon, were the initial creators of the exhibition's design for the presentation of the objects in a patchwork quilt-like manner. Their intention for this design was to "evoke memories of the past, family ties, and unity" (Library of Congress 2011, 4). Prior to the donation of the collection, the boys worked out their preliminary designs for the exhibition by laying items out on the kitchen table and striving for an aesthetically appealing image of unity, form, and color. This design became an essential component of the exhibition. In order to accommodate for the Liljenquists' design and to allow exhibition visitors to be able to adequately see all of the images, the library planned to use cases with a base platform set at a 65-degree angle.

Fig. 1 Brandon Liljenquist with items from the Liljenquist Family Collection. http://www.loc.gov/rr/print/coll/633_lilj_measure.html

The exhibition design, while unique and visibly pleasing, posed a great challenge for the Conservation Division (CD). A stable mounting solution had to be found in order to secure approximately 63 objects laid out in nine to ten horizontal rows per case. In addition to consulting on mount design, representatives from CD had to examine, stabilize, mount, and install 379 objects in a timely manner in order for the exhibition to open on its scheduled and symbolically important date.

Dana Hemmenway, Senior Photograph Conservator, was the primary conservator and point of contact for this project. Alisha Chipman, Photograph Conservation Intern, assisted Dana in all aspects of the project and took responsibility for researching and carrying out the majority of the treatments. Kaare Chaffee, Lisa Moberg, Lynn Kidder, Jamie Schmeits, Tiffany Welch, Julie McInnis, Jaime Roberts, and Simonette della Torre assisted with the mount making and installation of the objects.

Conservation Review

Dana Hemmenway and Alisha Chipman examined every object in the exhibition prior to its approval for inclusion in the exhibition. The conservation review consisted of several meetings held over a period of several days. The review meetings were attended by Dana Hemmenway, Alisha Chipman, Carol Johnson, P&P curator in charge of the exhibition, and Cheryl Regan, Chris O'Conner, and Debra Derbeck of the Interpretive Programs Office (IPO), the office responsible for planning exhibitions at the Library of Congress. During the meetings, the conservators evaluated each object's stability. Those that were in stable condition were approved. The curator and the conservator made a note of which objects were in need of treatment prior to exhibition and it was arranged for these objects to be transferred to the conservation lab. One object, an ambrotype with a broken base glass, was not approved and a replacement object was identified. On the other hand, a cased object with a cracked cover glass was approved with hesitation because it was considered by the donor to be an essential and symbolic part of the exhibition. Special handling and transportation instructions were given and attached to this object's storage container.

All of the ambrotypes and tintypes reviewed were either in thermoplastic frames or cases made of paper, leather, or thermoplastic materials. Many of the plates were selectively hand-colored. The donor had altered several of the cased objects by placing the plate package on the left and the velvet pinch pad on the right. These alterations were carried out in order to make the patchwork quilt presentation design for the exhibition more appealing. After the exhibition, these cased objects were returned to their typical American layout with the plate appearing on the right side of the case.

Approximately 80 objects were identified as in need of conservation treatment during the conservation review process. The majority of the objects sent to conservation for stabilization treatment prior to exhibition had partially broken hinges, torn or flaking leather coverings, loose pinch pads, broken wooden cases, or cracked thermoplastic frames.

Creation of an Examination and Treatment Report Form

In preparation for treatment of a large number of objects, Alisha Chipman created a one-page (double-sided) combined treatment proposal and report form to be used for this project. The form contains checklist-style formatting for the examination, treatment proposal, and report sections as well as an area for annotating pre-drawn condition diagrams. This form allowed for quick and efficient treatment documentation. (See the appendix for a copy of the form.)

Research and Preparation for Treatments

In preparation for stabilization treatments of the Liljenquist objects, Alisha Chipman conducted research and testing on ethanol-reactivated tissues for hinge repair of cased objects, adhesives for consolidation of leather, and cleaning techniques for thermoplastic frames. A large number of the cased objects had partially broken hinges in need of repair, so a streamlined quick and efficient approach to hinge repair was sought. The use of pre-coated adhesive tissues was investigated. Since water could cause swelling, deformation, darkening and embrittlement of leather, especially in deteriorated leather, an ethanol re-activated tissue became the focus of testing.

Approximately 20 different adhesive-coated tissues were made for testing using a variety of support materials, adhesive combinations, and application techniques. Two medium-weight Japanese papers (Paper Nao), a Korean paper (Fides International), and an unspun polyester sheet were coated with Lascaux 498 HV, mixtures of Lascaux 498 HV and Lascaux 360 HV, and mixtures of Rhoplex™ AC-73 and Rhoplex™ AC-234. The adhesives were used undiluted and diluted with de-ionized water. A variety of application techniques were also tested to coat the tissues including; brushing the adhesive directly onto the paper, spreading the adhesive over polyester film before applying the paper, spreading the adhesive through a screen, and piping and spreading the adhesive between silicon release polyester film before placing the paper over the adhesive. Once the repair papers were made, those that had the most even, smooth, and consistent application of adhesive were chosen for further testing. Their strength, workability, and ease of reactivation with ethanol were tested by adhering samples directly to scrap pieces of leather. The repair papers were wet up with ethanol and quickly applied to the leather. Then they were burnished and weighted until dry. The following repair papers produced a strong and flexible bond with the leather: 3:1 Lascaux 498 HV:360 HV on RK17 Japanese paper, 1:1 Rhoplex™ AC-73:AC-234 on RK 17 Japanese paper, and 1:1:3 Rhoplex™ AC-73:AC-234:de-ionized water on RK 17 Japanese paper. The use of a 1:5 Lascaux 498 HV:ethanol mixture applied directly to the Japanese paper was also tested and produced an equally strong and flexible bond.

Fig. 2 Alisha Chipman testing ethanol re-activated repair tissues on leather.

After testing it was decided that either the pre-coated 3:1 Lascaux 498 HV:360 HV on RK17 Japanese paper or the in situ application of 1:5 Lascaux 498 HV:ethanol mixture to Japanese paper would be used for the hinge repair treatments. The decision to use two repair techniques allowed flexibility in the treatment approach depending on the condition of the objects' interior and exterior hinges. Both the interior and exterior hinges were never repaired on the same object as this would likely prevent the case from opening to the full, nearly 180 degree, angle which the exhibition design required.

Many of the thermoplastic frames were extremely dirty and in need of cleaning prior to exhibition. The design of the frames was intricate with many interstices where dirt had collected and accumulated. Prior to treatment several possible cleaning methods were tested on thermoplastic cases in Dana Hemmenway's study collection. The use of a soft brush, an air bulb, polyurethane cosmetic sponges, and cotton swabs, both dry and moistened with de-ionized water and saliva, were tested. The cleaning tests were performed under magnification and any abrasions or other damage made to the surface of the object was noted. All of the techniques tested proved safe. However, the most effective and time efficient method was the combination of a polyurethane cosmetic sponges to clean the frame overall followed with a brush to clean the difficult to reach interstices and an air bulb to clear loosened dirt and debris.

Stabilization Treatments

Approximately 80 objects were identified as needing conservation treatment during the conservation review process. The majority of these objects had partially broken hinges, torn/lifting/flaking leather, loose pinch pads, broken wooden cases, or cracked thermoplastic frames. Due to time restraints and the large number of objects in the exhibition, the objects were prioritized for treatment. Cased objects with completely broken but stable hinges were approved for exhibition without immediate repair. However, these objects were noted for future conservation treatment. It was felt that the cases with partly detached hinges were at greater risk for damage during the various stages of exhibition preparation, installation, and de-installation. Therefore, they received treatment priority.

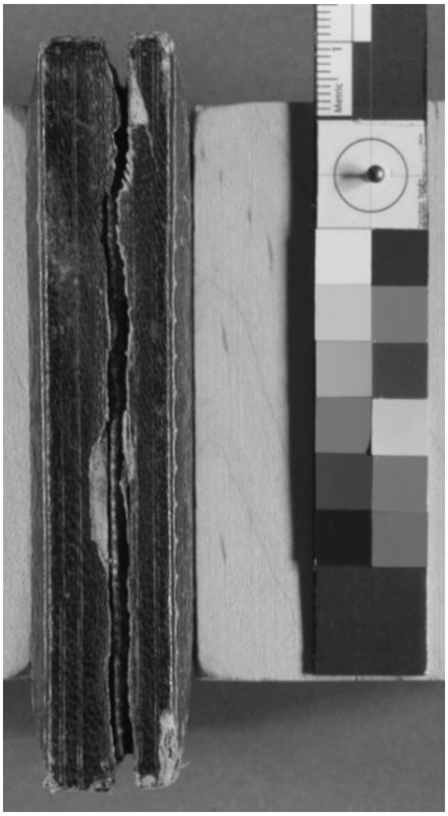

Fig. 3 Before treatment.

Approximately half of the treatments identified were completed within the three-month time span allotted for this work. Many objects with mild tearing or lifting of the leather covering or mild cracking in the thermoplastic case or frame were exhibited without receiving treatment. These objects' boxes were marked with special warnings calling for extreme care in handling during installation, and they were scheduled for treatment after the exhibition.

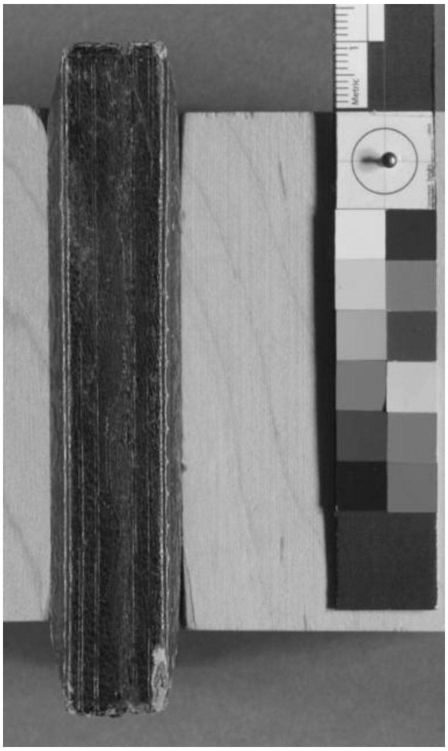

Fig. 4 After treatment.

Thermoplastic frames were cleaned with polyurethane cosmetic sponges, a soft brush, and an air bulb. The exteriors of cover glasses were cleaned with an air bulb and/or cotton swabs moistened with a 50:50 solution of ethanol and water. Pinch pads were cleaned with an air bulb and/or a kneaded eraser. Leather cases were consolidated and repaired using a polyvinyl acetate (PVA) adhesive, 2% methyl cellulose (MC), or 1:5 Lascaux 498 HV in ethanol. PVA was used for repairs in areas of the case that would likely not need to be reversed in the future. 2% MC or 1:5 Lascaux 498 HV in ethanol was used on areas that may need to be reversed in the future, for instance areas near hinges. Broken wooden cases were repaired with PVA.

Partially detached hinges were repaired with two different approaches. If the exterior hinge was completely broken and the interior hinge was partially broken, the leather was separated from the wooden case at the exterior, while the case was closed, using a 10A scalpel blade (HMD Healthcare (USA) Inc.). Then a medium-weight Japanese paper (RK 17) pre-coated with a 3:1 Lascaux 498 HV: 360 HV adhesive was cut to fit and placed beneath the lifted original leather hinge. Once in place, ethanol was brushed over the repair paper to re-activate the adhesive. The area was then burnished through an unspun polyester sheet to ensure good contact. The entire case was wrapped with an elastic bandage to apply gentle even pressure while the adhesive dried. In some instances, this method also attached the original leather hinge down onto the repair tissue. Where the original leather remained unattached to the repair tissue, 1:5 Lascaux 498 HV in ethanol was applied by brush to adhere the two layers together. The area was then burnished and wrapped to dry. Windsor & Newton™ watercolors were used to in-paint areas of exposed repair tissue.

Fig. 5 Separating original leather from wooden case.

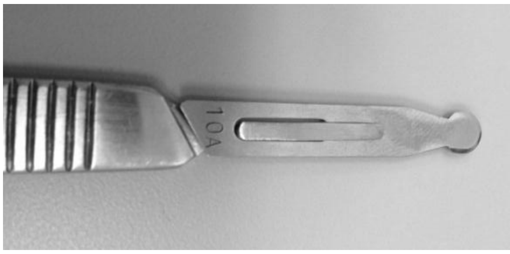

Fig. 6 10A scalpel blade.

If the interior hinge was completely broken and the exterior hinge was partially broken, the leather was first separated from the wooden case at the interior, while the case was open, using a 10A scalpel blade. A medium weight Japanese paper (RK 17), that was pre-toned with Liquitex® acrylic paint, was cut and placed into one side of the hinge between the leather and the wooden case. If necessary, a bone folder was used to score the tissue and introduce a crease in the correct location for proper opening. Then 1:5 Lascaux 498 HV in ethanol was applied with a brush. The case was closed and the exterior of the hinge was burnished through an unspun polyester sheet and wrapped with an elastic bandage. Once dry, the case was opened and the technique was repeated for the other side of the hinge.

Environmental Conditions

The environmental conditions for the exhibition cases were set at 70 degrees Fahrenheit +/- 5 degrees and 45% RH +/- 5%. The cases were sealed and had conditioned silica gel packets as well as PEM2® dataloggers located inside. Each case was illuminated using a fiber optic lighting system. Light levels were set between three to five footcandles for the duration of the four-month exhibition. The choice of this illumination level was based on the potential light sensitivity of the hand-coloring media, dyed leather, and velvet pinch pads.

Mount Design

Charles Bessant, a Washington D.C. based independent mount maker, was hired by the Library to assist with the mount design, mount making, and installation of the exhibition. Charles worked closely with representatives from CD, P&P, and IPO in order to design a mount that met the aesthetic and preservation requirements of each stakeholder. After an initial meeting with Dana Hemmenway, Alisha Chipman, Kaare Chaffee, Carol Johnson, Cheryl Regan, Chris O'Conner, and Debra Derbeck a prototype mount design was created.

Fig. 7 Charles Bessant, Debra Derbeck, and Dana Hemmenway discuss mount designs.

The final mount design consisted of a black 4-ply backing mat board with a polycarbonate (Lexan®) L-shaped lip attached at the bottom to support the weight of the object and two J-shaped polycarbonate tabs attached at the top to prevent forward tilting of the object. The polycarbonate pieces were adhered to the verso of the backing board with double-sided tape (3M® 415). Padding materials consisting of papers and boards of various thicknesses were adhered to the front of the mount, as needed, using double-sided tape in order to provide a level support for each object. For instance, if the pinch pad side of a case sat higher than the plate side then padding was placed under the pinch pad side so that it would rest evenly with the plate side. Once all of the individual mounts for a case were constructed, then padding materials were also adhered to the verso of each mount with double sided tape, as needed, in order to raise all of the objects up to the height of the tallest object in the case. This provided an overall leveling of all of the objects in the case to create a uniform visual presentation. All of the individual mounts were then attached using round Velcro coins to a large black mat board cut to the overall size of the display case. While all of the materials used for this exhibition were not tested with the Photographic Activity Test (PAT) at this time, similar materials have previously been tested by the LC Preservation Research & Testing Division (PRTD) and have passed the PAT.

Mount-making

Approximately seven days were spent prepping materials and constructing the mounts for each object. Three to six CD staff members worked on this phase of the project each day. All of the backing boards and polycarbonate pieces were prepared by Charlie Bessant and were pre-cut to standard sizes corresponding to the standard cased object sizes: quarter plate, half plate etc. Appropriately sized padding materials (papers and boards of various thicknesses) were also cut ahead of time. Mounts were constructed one object at a time and the cases were completed one at a time. Once finished, the case-sized overall mount (without objects attached) was sent to the IPO office where it was adhered to a thick Plexiglas backing using an acrylic film adhesive (FLEXmount®). The mount was then attached to the sealed and textile-covered wooden A-frame case structure using a cleat system. These A-frames were then placed into the display cases and installation of the objects began.

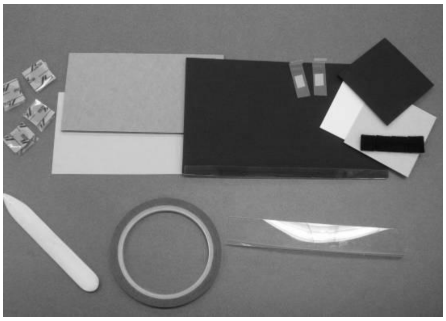

Fig. 8 All of the material used to make one of the mounts.

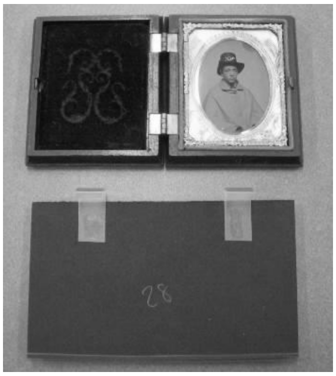

Fig. 9 An ambrotype and its mount.

Exhibition Installation

Five days were spent installing all 379 objects into their mounts in the exhibition space. Two to three CD staff members worked on this phase of the project each day. The exhibition was installed by focusing on one display case at a time. Prior to its placement in the case, each object's cover glass was cleaned using swabs moistened with a 50:50 ethanol and water mixture and/or a magnetic dusting fabric. The pinch pads were also cleaned, as needed, using kneaded erasers and soft brushes. Thermoplastic frames were cleaned, as needed, using polyurethane cosmetic sponges.

The final phase of installation was the lighting. A contracted lighting specialist installed fiber optic lights into each display case.

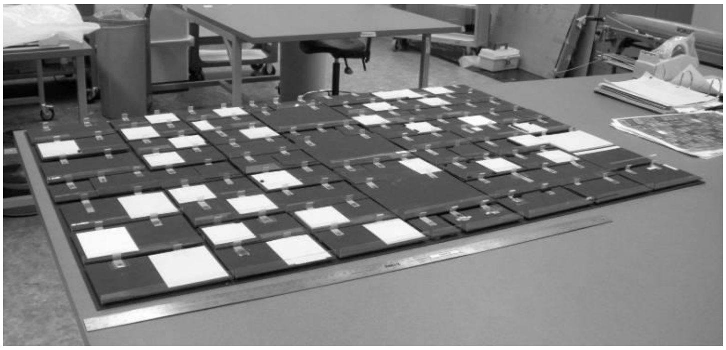

Fig. 10 Completed mounts for one exhibition case.

Fig. 11 A completed mount being installed.

Conclusions

In the end, the donor's vision was honored and the objects were safely displayed. The exhibition was well visited and widely appreciated by viewers. There was a beautiful and informative brochure that included information about the photographic processes and case design. An exhibition website was filled with similar information. A special treat for visitors to the exhibition were the interactive digital kiosks, which allowed visitors to see and zoom in on high resolutions images of each object in the exhibition. They could also leave comments of their choosing. The exhibition received a great deal of press. There were 200 million total media mentions including coverage on C-Span, BBC News, and NBC and in the Washington Post, The Boston Globe, and The Virginian Pilot among others. We were very proud of playing a part in making this exhibition a reality.

Fig. 12 Installing one of the objects in the display case.

Fig. 13 One of the completed exhibition cases.

Fig. 14. *The Last Full Measure*, Library of Congress, April 12, 2011 through August 13, 2011, Photo by Abby Brack.

Acknowledgments

We would like to thank the following LC employees for their hard work and collaboration on this project: Kaare Chaffee, Simonette della Torre, Debra Derbeck, Carol Johnson, Tambra Johnson, Lynn Kidder, Julie McInnis, Lisa Moberg, Chris O'Conner, Cheryl Regan, Andrew Robb, Jaime Roberts, Jamie Schmeits, and Tiffany Welch. Charles Bessant deserves our sincere gratitude for his expertise and assistance with the mount design. Alisha would also like to thank Bruno Pouliot, Lois Olcott Price, Barbara Lemmen, Jae Gutierrez, and Debra Hess-Norris of the Winterthur/University of Delaware Program in Art Conservation for their guidance and support during this project and her entire three years as a WUDPAC student. Alisha is indebted to all those that provided funding for her to travel to Wellington in order to present this project at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting: National Gallery of Art, Andrew W. Mellon Foundation, the Indigo Arts Alliance Mary Anne Burke Grant, and PMG.

Selected List of Supplies

Japanese papers RK 15 & RK 17 (Paper Nao Japanese Papers)
Korean paper (Fides International)
Lascaux 498 HV and Lascaux 360 HV (Lascaux Colours & Restauro)
Rhoplex™ AC-73 and Rhoplex™ AC-234 (The Dow Chemical Company)
10A surgical blade (HMD Healthcare (USA) Inc.)
FLEXmount® (FLEXcon)
Lexan® polycarbonate sheets (SABIC Innovative Plastics)

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Appendix: Treatment Form

Loan # 4814.______

Exhibition case #_____

Library of Congress
Conservation Division, Photograph Conservation
Examination & Treatment Report

In preparation for the April 2011 exhibition
The Last Full Measure: Civil War Photographs from the Liljenquist Family Collection

Master Control #: 2502
Division: Prints & Photographs
Collection: Liljenquist Family Collection
P&P Object #: AMB/TIN no.________

Examined by: Dana Hemmenway & Alisha Chipman
Curatorial Contact: Carol Johnson
Date:____________________________

Object Date: 1860s (Civil War 1861-65)
Photographer/Studio:______________________________
Subject/Description:______________________________
Distinguishing Marks:______________________________

Process: ☐ambrotype (glass support) ☐tintype (lacquered iron support) ☐hand-colored
Plate size: ☐whole ☐half ☐quarter ☐sixth ☐ninth ☐sixteenth ☐other___________
Housing: ☐leather case ☐paper case ☐thermoplastic case ☐thermoplastic frame ☐other___________
☐mat ☐preserver ☐cover glass
Case Hinge: ☐leather ☐textile ☐paper ☐other_________ ☐prior repair

Condition:

Silver Image Material
☐Loss ☐Corrosion ☐Other______________________________

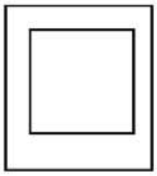
Collodion Binder
☐Loss ☐Flaking ☐Cracking ☐Abrasion ☐Surface Dirt
☐Accretions ☐☐Other______________________________

☐Glass Primary Support - Ambrotype
☐Loss ☐Fractured ☐Glass deterioration ☐Scratches ☐Surface Dirt
☐Other______________________________

☐Lacquered Iron Primary Support - Tintype
☐Loss ☐Corrosion ☐Abrasion ☐Flaking ☐Deformation
☐Surface Dirt ☐Other______________________________

☐Varnish Coating
☐Loss ☐Flaking ☐Yellowing ☐Other______________________________

Condition Diagram – Frame:
(see next page for case diagram)



Front

Back

Examination & Treatment Report_Civil War Photographs from the Liljenquist Family Collection

☐Cover Glass
☐Loss ☐Fractured ☐Glass deterioration ☐Scratches
☐Surface Dirt/Fingerprints ☐Other____________________

☐Mat
☐Corrosion ☐Abrasion ☐Deformation ☐Surface Dirt
☐Other____________________________________

☐Preserver
☐Corosion ☐Abrasion ☐Deformation ☐Surface Dirt
☐Other____________________________________

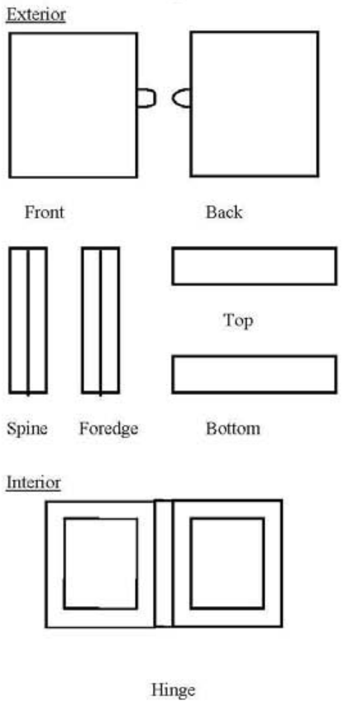
☐Pinch Pad
☐Loose ☐Fading ☐Surface Dirt ☐Other______________

☐Leather or Paper Case
☐Hinge detached ☐Exterior hinge partially broken
☐Interior hinge partially broken ☐Other________________

☐Thermoplastic Case or Frame
☐Loss ☐Cracking ☐Metal hinges damaged ☐Abrasion
☐Other____________________________________

☐Sealing Tape______
☐Type____________________
☐Loss ☐Surface Dirt ☐Other______________________
☐Package removed during examination

Condition Diagram – Case:



Treatment Goal: The purpose of this treatment is to stabilize the object for handling and exhibition.
Proposed Treatment: See associated 'Conservation Office Exhibits Data Form' for treatments proposed and approved at exhibition meetings.
Treatment Record:
Proposed: Completed:

☐ ☐Repair damaged leather hinge using
  ☐Japanese tissue coated with 3:1 Lascaux 498:360 & reactivated with ethanol
  ☐ 1:5 solutionof Lascaux 498:ethanol and toned Japanese tissue
☐ ☐Consolidate flaking areas of leather using☐ PVA☐1:5 Lascaux 498:ethanol☐ 2% MC
☐ ☐Secure loose pinch pad using☐ ....
☐ ☐Secure loose plate package using☐ ....
☐ ☐Stabilize cracking in thermoplastic frame/case using☐ ....
☐ ☐Clean exterior of cover glass using ☐ air bulb ☐50:50 solution of ethanol and deionized H_2O
☐ ☐Clean pinch pad using ☐kneaded eraser ☐vacuum with screen ☐ air ☐soft brush
☐ ☐Surface clean thermoplastic frame using☐ air ☐soft brush ☐Polyurethane cosmetic sponge
☐ ☐..

Date Treatment Completed:________________ **Conservator:**________________________

Reconstruction of European Daguerreotype and Ambrotype Cover Glasses

Jens Gold

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Abstract

Conservation work on daguerreotypes and ambrotypes is not new to most photograph conservators, and not for the conservation department at Preus Museum. The challenges of this work are well known in the field of photography conservation. The major difficulty for the conservator and the conservation interns during this project was the very high amount of extensively damaged, broken or complete missing cover glasses. The original cover glasses (or the existing fragments) of this time period were mostly decorated/reverse painted in the manner of *Hinterglasmalerei* (German term for glass hand-painted from behind) and *verré églomisé* (French term for reverse decorated, gilded, painted glass; coined in the 18th century). Occasionally, the cover glasses were also decorated with metallic gold lines. Restoring or reconstruction of such cover glasses in a high and satisfactory quality is, even with good skills and using helping tools like handmade masks, very time-consuming. This is maybe fine when dealing with one or two objects over a working year, but not with the amount of cover glasses as in this larger project. An extensive search, both in historic photo literature and contemporary conservation literature, did not lead to a description or a straight-forward method to make or reconstruct a European type cover glass for daguerreotype or ambrotype images. The consultation of conservator colleagues or articles from conservation literature/journals gave surprisingly little information. There was remarkably slight information on straight-forward reconstruction methods or paint application techniques! Because of this, the conservator of the Preus museum together with intern Tereza Cikrytová from the school of paper conservation at the University of Pardubice - Czech Republic, began searching for available procedures that could help to develop such a technique. Thus, the goal of our project was to develop a method for reconstruction European daguerreotype and ambrotype cover glasses, making them look very close to the original. Major objectives was also to find a method that would be safe for the original photographic material, not too time consuming to use, useable for conservators in all types of institutions or in private practice, relatively easy to handle and economic in terms of time and financial resources.

Background

In 2010-11 Norwegian museum and archival institutions launched the project “fotografiets barneår”, which means “the childhood of photography”. This project aims to register, document and conserve the parts of national photographic heritage produced in the first ten to twenty years of photography. In connection with this, many different photographic works came to the conservation department in Preus Museum, and among them were many European daguerreotypes and ambrotypes with damaged or missing cover glasses.
The project “fotografiets barneår” additionally intends to document daguerreotypes and ambrotypes, not only nationally, but also internationally together with other nations in the Daguerreobase project (initiated by the conservation department of *Nederlands Fotomuseum*), organized for Norway by the National Library of Norway in Oslo.

Fig. 1. *Brud fra Lærdal i Sogn* by Marcus Selmer, Bergen – Norway, 1855

The Norwegian photographic heritage on daguerreotypes and ambrotypes consists of about 700 objects. Because of the international trade connections and the fact that Norway has always been a sea nation, all kinds of daguerreotype mounting/housing designs are possible to find. However, the major part of the Norwegian daguerreotypes and ambrotypes are housed in European daguerreotype/ambrotype frames (see figure 1).

Typical damages observed on Norwegian daguerreotypes and ambrotypes

The most common damages observed on the daguerreotypes and ambrotypes, coming to the conservation department at Preus Museum are no different to what exists in many other collections:

- Broken seal of the daguerreotype/ambrotype package
- Damage and dirt caused by insects and dust
- Loose plates in the package
- Scratches on the plates and cover glasses
- Broken cover glasses (fig. 2 & 3)
- Glass corrosion in different stages

Figs. 2 and 3. Objects with broken cover glasses.

- Glass corrosion products on image surfaces
- Delamination of varnishes on the cover glass and ambrotype background
- Corrosion and delamination of image materials, in different stages
- Missing cover glass (fig. 4 & 5)
- Missing housing parts
- Complete absence of housing


Figs. 4 and 5. Objects missing cover glasses.

Methods to Make Replacements of 19th Century European Daguerreotype and Ambrotype Cover Glasses

Historic Literature and Previous Research

As mentioned, historic literature and periodicals on production of daguerreotypes and ambrotypes gave no or very little helpful information on the making and reconstruction of 19th century European cover glasses paint-decorated from behind (Hinterglasmalerei). Major focus in the early photographic literature was almost exclusively on the photographic processes. Exceptions were advertisements concerning design of housings or only very short notes in the photo literature of that time-period (Coucher & Le Gray 1851, Eder & Kuchinka1927, Bland & Long 1856, Humphrey 1853-54).

When studying articles from conservation literature/journals little information on reconstruction or paint application techniques were found, apart from a few recent articles and publications:

- Susie Clark: Conservation of wet collodion positives, *Studies in Conservation,* 1998, page 231–241
- Hanako Murata: Investigation of Historical and Modern Conservation Daguerreotype Housings, ARP 2003
- Lene Grinde: Conservation of Stereo Daguerreotypes, ARP 2005
- Caroline Barcella: The Conservation Project of the Manila Daguerreotypes, ARP 2009.

These publications gave essential information concerning analysis and information regarding historic pigments and binders used on housings, and also on contemporary conservation materials (pigments, binders, glass), photographic activity tests on materials used at the time-period and also on modern alternatives, deterioration issues about historic housing materials and their contemporary alternatives. Especially helpful was three publications of research projects at the Mellon Advanced Residency Program in Photograph Conservation (ARP): The work of, respectively, Murata (2003), Grinde (2005) and Barcella (2009). They not only describe many of the used materials in the 19th Century period using analyses like FTIR, but they also describe contemporary alternatives putting several of these materials through the Photographic Activity Test (PAT). This gave us a great tool and starting point for what kind of materials we should go for in a reconstruction project of daguerreotype cover glasses.

Typical Materials Used to Make 19th Century Cover Glasses

The Glass

From the beginning of the 19th century, with the availability of cheap soda production and improvements in the glass production technology, glass became a cheap mass product. Typical for the period was to produce flat glass sheets with the “cylinder technique”. A bottle-like cylinder was blown of a glassmaker, the top end button of this bottle was removed and the cylinder was opened (cut) on one side. During a heating process, the cylinder was opened up and flattened on a surface to become a glass sheet (Corning Museum of Glass / Cylinder of Window Glass http://www.youtube.com/watch?v=hx2JO1QcZjY). This was the common type of glass used for windows, frame making and for daguerreotype and ambrotype cover glasses. Practically all flat glass for these purposes was made of the soda lime glass type. Depending on variations in the production (impurities and contents of the raw material) the glass color could vary from almost colorless to shades of light green, green yellow or blue green (easily to observe from the edge of the glass sheet). The thickness of the used glass sheet could vary from about 2 – 4 mm depending on the format of the daguerreotype or ambrotype, or due to unknown reasons. Though glass was an industrial product, still a great deal of handwork was involved (Koesling 1997, The New Encyclopedia Britannica 1974). That might be the reason why these glass sheets often hold imperfections such as a little wavy uneven surface character, tiny encapsulated air bubbles or solid small particles.

19th Century Binders, Pigments and Other Materials Used on Reverse Painted Cover Glasses

Laboratory analyses (Clark 1998, Grinde 2005, Barcella 2009) indicate that a wide range of pigments and binder substances have been used to paint-decorate daguerreotype and ambrotype cover glasses. Almost everything available in the period, which proved to work for painting on glass, was used. Little workshops and manufactures produced series of handmade housing systems for photographic studios (Clark, verbal information, 2012). Thus, there is no surprise to find many variations in design, materials and techniques. Some typical binders at the time-period would be Shellac, Dammar, Sandarac, Bitumen, Asphalt, Canada balsam, Casein glue, Oil of turpentine and Linseed oil. Common pigments were for example Carbon black, Lamp black, Bone black, red iron oxide pigment, chalk or plaster and many more. The golden lines were decorated with the help of brass powder (Clark 1998, Grinde 2005) or by the use of metallic gold (Barcella 2009). Recipes for these paints can be found in the historic literature or in Grindes work as mentioned earlier.

Contemporary Materials for Making 19th Century-Style Cover Glasses

On an early stage in this project, we decided to use materials for the cover glass replicas that would fulfill following requirements:

- harmless to photographic materials
- resemble 19th century look “perfectly”
- varnishes should adhere very good to glass also over time (if possible, they should not be sensitive to moisture)

- varnishes should not interact with other paints neither during application nor in a long term perspective

It is likely that most 19th century binder materials would not have passed a PAT. From a wide variety of possible binders, a few that had the necessary properties and that had passed PAT earlier, were chosen (Grinde 2005). The only exception was Shellac, which does not pass PAT, but proved to have very good performance in the paint application process of thin lines. However, when using shellac it was isolated behind layers of B-72 binder after applying the last paint layer.

Practical Tests and Evaluation of Materials Used in the Project

Binders in the Test Series

To begin with, several binders like Shellac, Dammar, Bitumen, Canada balsam, Paraloid B-72 (acrylic resin), Plextol D 498 (acrylic resin in aqueous emulsion), Lascaux (acrylic paint in aqueous emulsion with different pigments) were tried and examined. It turned out that most suitable, in terms of adhesion to glass and ability to blend with different pigments, was Paraloid B-72, Lascaux acrylic paint in aqueous emulsion and shellac. Plextol D 498 worked well as a binder but built many small air bubbles during mixing with pigment and application.

Pigments in the Test Series

From a wide variety of pigments used in the 19th century, a few were picked out - the ones that, together with a suitable binder, closely resembled the quality of the colors seen on 19th century cover glasses. In addition, modern pigment resources were included in the search for suitable reconstruction materials. The table below shows pigments that, together with binders like shellac, acrylic binder in aqueous solution or B-72 acrylic binder in Toluene, proved to have suitable properties.

Pigments Used		
Black	***Gold***	***Other***
Bone black (Kremer 47100) Ivory black (Kremer 12000) Spinel black (Kremer 47400)	Mica pigments / Pearl Luster / pearlescent pigments in different shades of gold Kremer Pigments 50000 – 50990 and Deffner &Johann, Germany Best. Nr. 1785900 Metallic gold powder / Altgold / Malergold (Deffner & Johann, Germany, Best. Nr. 3256000)	Different pigments in acrylic aqueous emulsion of *Lascaux Artists' Acrylic Colors* Art. Nr. 3920: oxide black, ultramarine deep blue, titanium white, cobalt blue, emerald green, carmine red, permanent yellow medium, yellow ochre, English red

To find a good combination of binders, pigments and practical combinations of these, several tests were made. To recreate the gold lines, Mica based pigments or metallic gold powders were mixed with different binders. The same were done with pigments of carbon black, ivory black and spinel black to resemble the deep black background for the gold lines. The mixtures were applied to small glass sheets to examine their properties, - visually, application-wise (different brushes, masking tapes and other tools), and their ability for adhesion (Fig. 6). In addition, mixtures of Lascaux paint (see table above; acrylic resin in aqueous emulsion with different pigments) was applied to glass sheets for testing of the same properties. After selecting the pigment / binder combinations (see table above), the next step was to find a good combination between the materials used for the gold lines and the background color. This was done by cross-testing on sheets of glass (Fig. 7) checking the interaction of the different varnishes concerning eventual properties regarding dissolving or softening of the previous applied layer of varnish. Here it became obvious which combination was good and which were not recommendable. The test showed that the safest combination is a water-soluble acrylic binder like Plextol D 498 (Kremer 76000) or Lascaux Artists' acrylic colors with a solvent- based binder like Paraloid B-72 or shellac. However, combinations of shellac-based varnishes with Paraloid B-72 in Toluene works in many circumstances well since Paraloid B-72 is not so easy to dissolve once it has hardened/dried.

Fig. 6. Gold pigment tests.

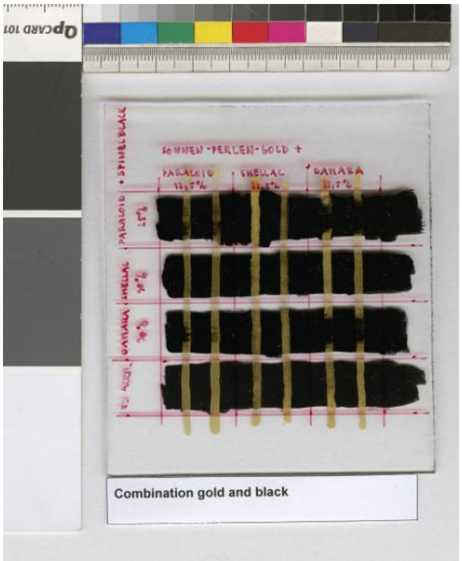


Fig. 7. Gold and black cross-testing.

The set of binders, which behaved satisfying in several combinations with each other, in the test are:

- **Gold lines:** Paraloid B-72 (25 % solution in Toluene), Dammar (30 % solution in Toluene), Shellac (30 % solution in Ethanol)
- **Black background:** Paraloid B-72 (25 % solution in Toluene), Dammar (30 % solution in Toluene), Shellac (30 % solution in Ethanol)
- **Various colored background:** Lascaux Artists' acrylic colors Art. Nr. 3920 / acrylic paint mixture in aqueous emulsion

For the final work the combination Paraloid B72 with Shellac or Lascaux Artists' acrylic colors Art. Nr. 3920 was preferred.

Glass Alternatives for a Cover Glass Replica

Two different glass types are most suitable for producing cover glass replicas today. Both are available as common float glass or in the old-fashioned cylinder-made version.

The modern soda lime glass, sold as window or frame-maker glass, is the contemporary version of the old traditional soda lime glass. It is available in a wide variety of thicknesses and optical properties. This type of glass is unfortunately hard to find in a neutral color as is the case also with the 19th century soda lime glass, but it exists from almost neutral color to shades of light green, green yellow or blue green. The neutral type may be very hard to find. Soda lime glass is, under good environmental conditions, a moderately stable material. However, this type of glass usually develops glass corrosion over time. The glass is easy to work with and very cheap.

A more modern glass type, also used in this project, is the borosilicate float glass. There is no difference in surface characteristics between modern soda lime glass and borosilicate glass since both types are produced in both of the mentioned shapes. However, compared to soda lime glass, this glass contains, besides a higher content of silica, also boron oxide and phosphor oxide and other special ingredients. This composition makes borosilicate glass a chemically and physically very stable material compared to traditional soda lime glass. Borosilicate glass is more resistant to mechanical damages (like scratching), heat and temperature changes (little expansion coefficient) and a great variety of chemicals, high humidity and other environmental factors (Koesling 1997, Murata 2003). Since borosilicate glass is somewhat resistant to scratching, it is a little bit harder to cut. Today it is available in a great variety of thicknesses and to an affordable price (http://www.schott.com/architecture/english/products/index.html). Other significant advantages are the color of the glass, it's almost exclusively neutral. The mechanical stability prevents it to a degree from damages. However, the major advantage is the chemical stability: borosilicate glass is not prone to glass corrosion.

Glass alternatives		
Glass type	**Advantages**	**Disadvantages**
Antique window glass (soda-lime glass)	authentic look (?) easy to cut inexpensive	prone to glass corrosion breaks easier than modern glass often hard to find the right type/look hard to find neutral colored
Modern window glass (soda-lime float glass) 2 mm frame maker glass	easy to cut and work with inexpensive easy to get	suffers glass corrosion breaks easier than borosilicate often no neutral color (green/blue tint)
Borosilicate glass (float glass) Schott Borofloat 2 or 2.75 mm (+/- 0.2 mm)	no optical difference to traditional float glass neutral color extreme high resistance to corrosion good resistance against mechanical damage	often special order harder to cut

Yet another option would of course be the use of antique glass. But since this is not only hard to find, but also breaks much easier than modern glass, it is obvious that there are not many good reasons to use this glass type today.

Cleaning the Glass

After cutting, the glass sheets are abraded with a type 300 sanding paper to remove sharp edges. After that, the glass sheets are washed under running water to remove all particles from the sanding in order to prevent scratches. Now the glass is ready for thorough cleaning of the surface to remove all residue of oily or fatty substances and products of glass corrosion.

There are many types and ways of cleaning glass surfaces. The table in the text shows some of the common ones in the 19^{th} century. They are still quite effective and many are still in use. For our purpose we chose the method with rottenstone. It is a cheap and effective method that have been in use also for cleaning glass sheets used to make wet collodion negatives and positives, and also to polish daguerreotype plates.

For this method the glass sheet is placed on a suitable support (for example some clean smooth cotton fabric, foam sheet etc.). Very fine rottenstone powder is then, with some water and ethanol, applied to the glass surface. With a moist cotton or microfiber tissue and moderate pressure, the rottenstone is then applied, using a circular agitation pattern, to the glass surface. This process should go on for several minutes to make sure that all possible dirt and glass corrosion products are removed from the surface. After cleaning both sides, the glass sheet is washed under running water. To make sure that all oily substances are gone, and to speed up the drying process, the glass sheet is washed again with a 50 % ethanol/water solution. The final drying is done by using a clean cotton tissue.

Glass Cleaning Methods	
Polishing / cleaning substance	**Type of cleaning**
Jeweler's rouge / red rouge [Iron(III) oxide] (Kleffel 1863, Eder 1927)	Mechanical
Optician's rouge / ceria (Kleffel 1863, Eder 1927, Clark 2012) [Cerium(IV) oxide]	Mechanical
Pumice, Tripoli, rottenstone, limestone, (Robert & Sobieszek 1854, Kleffel 1863, Eder 1927, Osterman 2000) [Mineral: mix of silica & calcium carbonate]	Mechanical
Acid cleaning (Kleffel 1863, Eder 1927), [Nitric acid]	Chemical *Very aggressive, not recommended*

The Reconstruction of the 19th Century Cover Glass Design

Examinations of various cover glasses show that there are variations in paint applications even with similar designs. Brush strokes and the possible use of some kind of mask can be observed or assumed (Fig. 8 & 9) (Grinde 2005). As already mentioned, the literature reveals little about paint application methods. Because of that, a few methods have been tested like free hand painting (known from glass ware and porcelain painting), paint decorating with the help of handmade masks and paint application with the help of computer-generated machine-cut masking film.

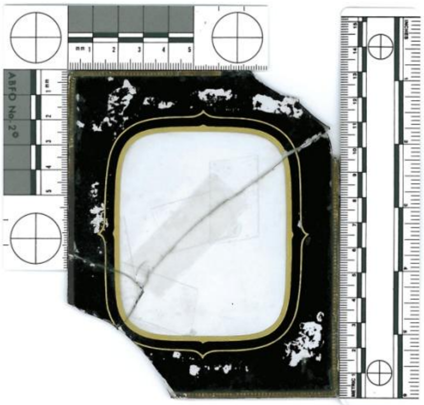


Fig. 8. Overall photograph of a 19th century cover glass

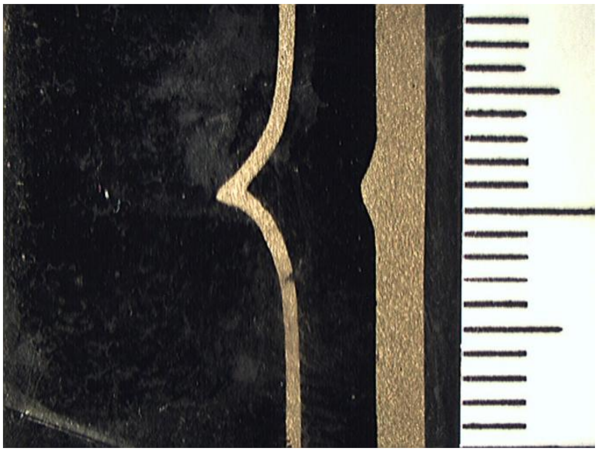


Fig. 9. Detail indicating the possible use of a mask to aid in design application.

Free Hand Painting

Painting the decoration by hand without masking help has been tested and was a successful way to apply paint in terms of the quality of the work (Fig. 10). The method is very time-consuming and it demands very good skill to do this in a reasonable time. Porcelain painters who have developed routine and skill over many years might be able to do paint decorations like this on a daguerreotype cover glass in a few minutes. A conservator, which paints maybe one or two decorations a year, will probably have difficulties to do the same thing in such a short amount of time. The test proved noticeably that there ought to be a more efficient way of doing this.

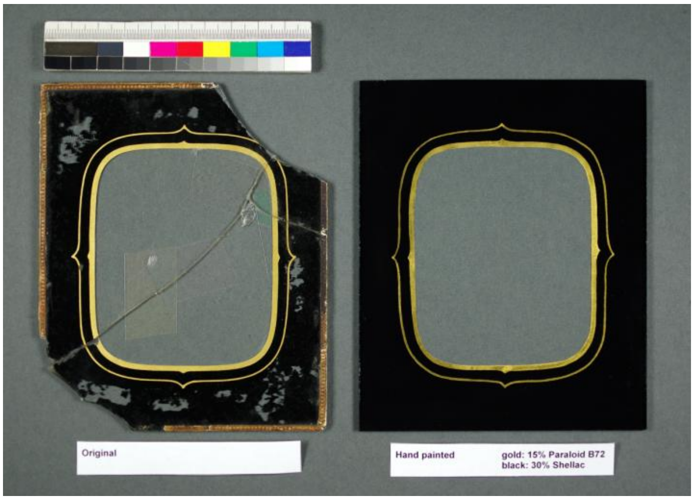


Fig. 10. Hand-applied decoration.

Decorating with the Help of Handmade Masks

Another method tested, is paint decoration with the help of handmade masks or masking film cutouts. For this method, self-adhesive masking film is attached to the glass sheet to be decorated. The desired design is drawn on with a pen and then cut out with a sharp cutter or scalpel. Afterwards, the masking film areas for the first paint layer are removed. The now open glass surface is carefully cleaned from tape residue before the desired paint is applied. This method works well although the cutting of the masking film is very time-consuming and not always flawless. A small mistake and the whole cutting-out process needs to be repeated. Another difficulty is the (usually) very thin lines in the decorations. The use of this method does not provide the typical look of the original fragments. No surprise really, since smooth, even brush marks on many of the originals indicate that masks like these probably were not used. This test also indicated that there ought to be a more efficient and practical way of doing this work.

Decorating with the Help of Plotter Generated Self-Adhesive Masks

By studying modern technologies for the application of complicated graphic designs on all kinds of surfaces, one technology seemed quite suitable for the work that needed to be done in our project. Computer/plotter generated self-adhesive masking film is a universal tool for many applications in advertisement, motorsports tuning, wide-ranging paint decoration and many other applications. A great variety of decoration and masking films for all kinds of purposes are available. The author came across this technology some years ago when visiting a graphic art studio that created advertisement materials for all kinds of purposes and costumers. While working on this project it became apparent that this product, as it is quite wide spread, easy, cheap and available almost over the whole world, would be good also to recommend also to other colleagues.

A short description of how this tool was used in the daguerreotype/ambrotype cover glass project may help to illustrate the working principle.

Step 1: Fragments of a broken cover glass or a handmade sketch are scanned together with a centimeter scale (see fig.9). Original fragments or a handmade sketch are used to keep a human touch in the final product. The image is then transformed to a graphic image to make the mask. Missing parts of the fragments image are replaced. The image of the final décor is placed in the right proportion with the help of graphic software (fig. 11). Important proportions are the general size of the original but also the thickness of the lines and "brushstrokes". Asymmetric properties of the original and original dimensions are copied as far as possible 1:1 in the final plotter image. The final image is copied several times to make several masks in one step on one foil sheet.

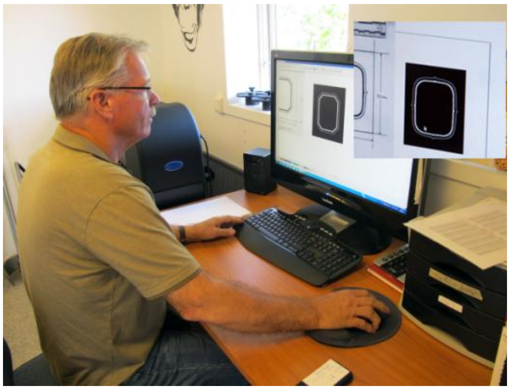


Fig. 11. Digitally recreating missing components of the original cover glass.

Step 2: The décor image is conversed to a special plotter/cutter, which is cutting the final image in the masking film with the help of very small cutter blades (fig. 12). After that, the masking film is arranged on a working table where particular parts of the cutout are removed (fig. 13) after which the masking film is covered with transfer film. The removal of cut-out areas can also be done later if desired.

Fig. 12. The plotter/cutter.

Step 3: After cutting the masking film pieces to the cover glass sizes, the material is ready for use. The previously cleaned cover glass sheet should be placed on a smooth and flat surface, maybe fixed with a little piece of double-sided tape. It is practical to have a dark background since this makes it easier to see dust and air bubbles on the glass sheet or the film. When transferring the film to the glass surface, first detach about $^{1}/_{10}$ of the thick waxy mask carrier paper so that only one narrow side of the tacky masking film gets in touch with the glass, making it easier to position the mask fittingly edge to edge on the glass sheet. After setting the masking film correctly, the rest of the carrier paper is removed carefully and the film is pushed down with the help of a wide spatula from one end of the glass sheet to the other (fig. 14). It is critical to do this in an even and smooth way to avoid big air bubbles between film and glass surface. However, should it happen that some bigger air bubbles appear it is possible to remove them by sticking a sharp needle in the foil/bubble.

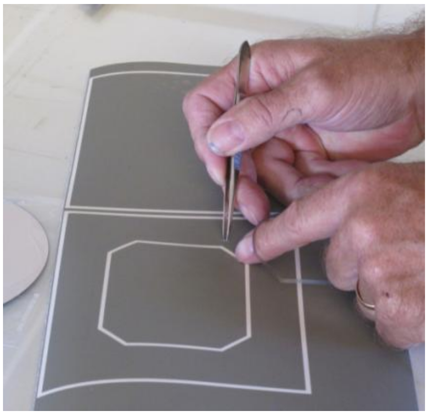


Fig. 13. Removing parts of the cut-out mask by hand.

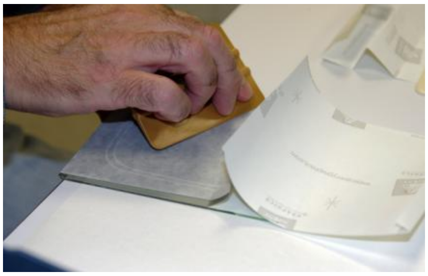


Fig. 14. The mask is placed onto the glass sheet.

Step 4: After the film is fixed to the glass, the transfer paper can be removed (fig. 15). This is done by carefully lifting one edge of it and slowly removing it from edge to edge.

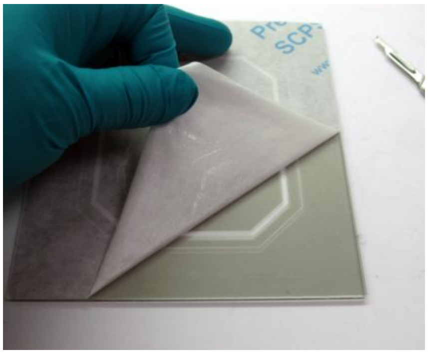


Fig. 15. The transfer paper is removed from the glass.

Step 5: If not done right, after the printing/plotting, the desired area of the masking film can be removed also now (fig. 16). Some masking films leave a little bit of adhesive residue on the glass surface. This should be cleaned off, since it may disturb the paint application. Often a cotton swab moistened slightly with distilled water is enough for this job. In addition, it is sometimes advisable to use gentle pressure to push the edges of the cutouts in the masking film down to the glass surface. A very good tool for that is a little Teflon spatula (fig. 17).

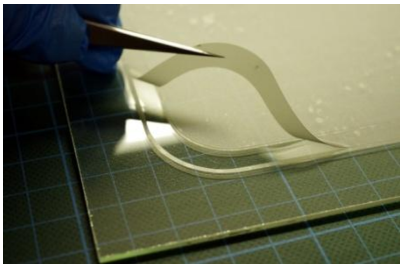


Fig. 16. Removing the desired area of the masking film.

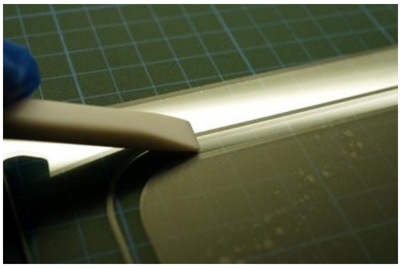


Fig. 17. Applying gentle pressure with a Teflon spatula.

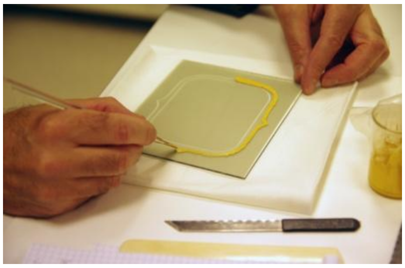


Fig. 18. Applying the initial varnish – the gold lines.

Step 6. The prepared varnish for the first step, the gold lines, can now be applied to the open glass surface (fig. 18).

Step 7. After a short drying time, the masking film that covers the background area is removed carefully from edge to edge (fig. 19). It is important not to wait too long with this step since otherwise parts of the just applied décor may also be removed and thereby destroyed. Sometimes a little cut in the paint edge can be helpful to start the removal of the masking film.

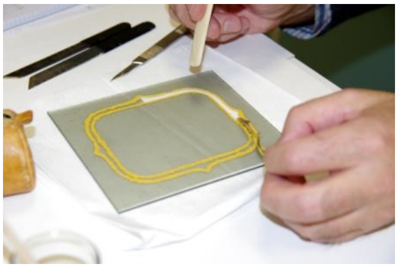


Fig. 19. The masking film is removed from the background.

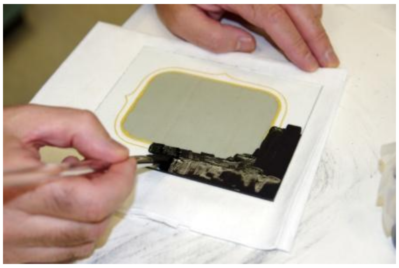


Fig. 20. The background color is evenly applied.

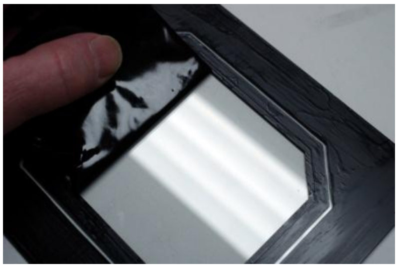


Fig. 21. The central part of the mask is removed.

Step 8. The now open glass area is checked and may be cleaned of any adhesive residues.

Step 9. The background color is evenly applied to the glass surface (fig. 20).

Step 10. The last part of the masking film, left in the center area for the opening in the cover glass, is removed carefully (fig. 21). Also here it is important not to wait too long after the paint application. Otherwise problems of paint coming off where it should not, may occur.

Step 11. After the paint has dried, the opening of the cover glass can be cleaned. The cover glass is now ready for use in the rehousing of a daguerreotype or ambrotype (fig. 22).

Fig. 22. A new cover glass used in the rehousing of a daguerreotype.

A Technique for Gilding Mirror-Like Metallic Gold Lines

Some daguerreotype or ambrotype cover glasses have decorative mirror-like metallic gold lines (figs. 23 & 24). These lines are in their look often similar to metallic gold lines known from china or glassware. There are several ways, also known in the 19th century, of applying such lines. The table below shows three of them. The one method, which works well and can be done easily in small conservation studios, is the application of gold leaf. For this method, 1 g gelatin is dissolved in 125 cm³ distilled water of 60 °C (Rottländer 2000, Schönburg, 2001). (In the project photo gelatin type Restoration 1, Nr. 40321 from GMW-Gabi Kleindorfer in Germany, was used and performed very well.) The solution should be very clean and possibly filtered before use. To create the thin metallic lines with the masking film system, it is wise to start with the background paint application. Then remove the masking film pieces for the lines and apply the gold leaf in the open areas overlapping to the already applied background paint.

Figs. 23 & 24. A mirror-like gilded surface in different lighting conditions.

Fresh gelatin solution is brushed on the glass area which is supposed to be gilded (fig. 25). The small gold leaf pieces are then applied to this surface with a gilders brush (fig. 26)'. (The gold leaf used in the project was Dukaten-Doppel-Poliergold 23 $^{1}/_{2}$ kt from Arkivprodukter AS - Norway and Orange-Doppelgold 22 kt from Deffner & Johann - Germany). Some instructions recommend pressing the gold leaf down after application by the use of soft leather or paper. For the use of making small gold lines, this step has not proven to be very practical because some gold tend to stick to the leather. When the water has evaporated, the gold adheres very well to the glass surface (fig. 27). Some gilding instructions recommend also gilding twice to fill in imperfections like small areas without gold.

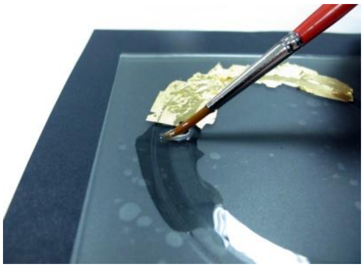


Fig. 25. Gelatin is brush-applied to the area to be gilded.

Fig. 26. Small pieces of gold leaf are applied with a gilder's brush.

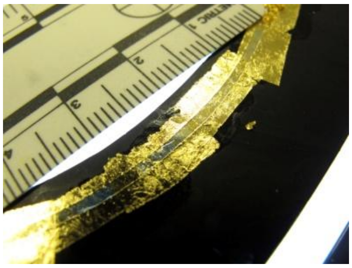


Fig 27. The gold is well adhered to the glass surface.

Finally, to protect the very thin gold layer and also to correct possible imperfections in the gold (little holes) it is possible to cover the dried gold layer with a layer of yellow varnish. In this project, water based acrylic paint, shellac based paint or B-72 based paint was used for this purpose (fig.28).

Fig. 28. The gilding is covered with a layer of yellow varnish.

Recommended literature about gilding:

- *Practical Gilding,* Peter MacTaggart and Ann MacTaggart, 2007.
- *Historische Beschichtungstechniken*, Kurt Schönburg, 2011.
- *Historische Techniken des Malers*, Hans Rottländer, 2000.
- *Vergolden / Das Arbeiten mit Blattgold*, Hans Keller, 1992/2009.

Gilding Technique	
Technique	**Application Method**
Industrial metal preparations on ceramics and glass (Heraeus: http://www.heraeus-ceramiccolours.com)	Brush or spraying, setting by heat (glaze-firing), by about 750 or 850-1250 °C (difficult, expensive)
Classic gold- and silver leaf application behind glass (Hinterglasvergoldung) behind the glass gilding	Adhesion with a gelatin solution (safe, easy, inexpensive)
Chemical application of gold (Liebig 1856)	Chemical reduction of gold onto glass surface (poor adhesion, difficult)

Evaluation of the Technique

Glass Types

Two types of glass have been used in the project. Both of them worked well for the glass decoration job. However, in the long run the Borosilicate glass will probably be the better choice, mainly because of its high permanence and resistance to glass corrosion and its neutral color. The price should be no issue anymore since prices have fallen significantly in the resent years and glass sheets for daguerreotypes and ambrotypes are mostly very small in size.

Gold Leaf: Types and Application Techniques

The use of gold leaf may not be the ultimate way to produce metallic gold lines. Never the less it is almost ideal since it is relatively easy to do after some training, very permanent and inexpensive. The author also found that with some improvement, the quality of the lines became so good that they almost are comparable to industrial applications, which use high amounts of heat and expensive equipment. However, some observations made during this project indicate that several techniques have been in use originally to make mirror-like metallic gold lines and

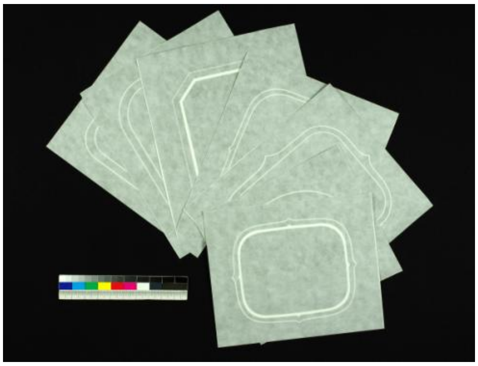


Fig. 29. Multiple variations of decorative cover glasses are permitted by the masking technique.

that the use of gold leaf seems to be one of them. On some original cover-glasses the reflection of light in gold lines are not always perfect but looks very much like gold applied with the leaf gold technique (fig. 23 & 24). As this technique was well known at the time-period this would not be surprising.

Plotter Generated Masks

The self-adhesive masking film (fig. 29) allows for many variations of décor and direction possibilities. It seems that only the imagination of the user is the limitation. Different types of self-adhesive foil are interesting to investigate. Properties like thickness, adhesion power or resistance to a range of solvents are most interesting for the conservator.

Binder / Pigment Combinations

There are surely many binder/pigment variations that might work for this kind of glass decoration. The chosen combination, described in this article seemed easy to handle also in terms of reproduction in several cover glass productions. However, the experiences made during this project proved that there certainly are lots of room for improvement and new variations. Especially the use of contemporary materials gave the impression of improvement in terms of: greater permanence, easier handling and the paradox of a closer look to materials from the 19th century.

For example, in the search for the right black pigment, the use of Spinel black gave the closest look to the black on the original 19th century cover glass fragments. Spinel black belongs to the copper-manganese-iron-system of spinel minerals. This pigment is characterized by a deep black appearance. While other pigments remit at least some part of the light spectrum and appear more or less colored, spinel black remits no more than 1.5% of incoming light at any point of the spectrum. No other pigment achieves this kind of optical blackness. Its good hiding power also gives this pigment a high yield (information from Kremer data sheet: 47400, www.kremer-pigmente.com).

Strategize

No system is flawless. It is a good idea to plot/print more masks (for example three) for one type of design. In addition, it is smart to cut and clean several glass sheets in advance. These materials are cheap and, in case of a little mistake, for example during paint application or mask removal, easy to replace. It can also be a good strategy to make two cover glasses in the same time and then use the best one in the end.

Pigment/Binder Combinations		
Gold lines	**Black background or lines**	**Other colors**
Pigments: Mica pigments /pearlescent pigments *(Kremer Pigments 50000 – 50990 Pearl Luster or similar from Deffner & Johann - D&J, Germany)*	**Pigments:** Spinel Black *(Kremer 47400)* Bone black *(Kremer 47100)*	**Acrylic paints**: Lascaux Studio or Golden Acrylics
Binders: B-72 Mixture 15% B-72 in 1:1 toluene/ethanol *(Paraloid B-72 D&J 2522000)* Shellac Mixture 30% shellac in ethanol *(Kremer 60450)*	**Binders:** B-72 Mixture 15% B-72 in 1:1 toluene/ethanol Shellac Mixture 30% shellac in ethanol	**Binders:** Lascaux Studio original *(D&J no:1929)* B-72 Mixture 15% B-72 in 1:1 toluene/ethanol Shellac Mixture 30% shellac in ethanol
! The amount of pigment used in a binder ranged from 5 – 20 %, depending on the specific use. Make a small test on a glass support before the final application, to ensure adhesion.		

Improvements in the Technique

A little workshop, organized in the Preus Museum after this project in 2012, showed clearly that there still is great room for several ways to go in terms of binder, pigments, leaf gold application, or methods of paint application. The author of this paper is therefore grateful for any kind of helpful suggestions to improve the work with the reconstruction of daguerreotype or ambrotype cover glasses.

Overall Evaluation: Materials			
Binders	**Pigments**	**Glass**	**Application**
Historic Binders	**Historic Pigments**	**Antique Glass**	**Hand Application**
(shellac, dammar, rabbit glue, gelatin, bitumen, Canada balsam) • good to use with proven recipes • most historic materials do not pass the PAT • tendency to exfoliation • only shellac and gelatin were used in the final projects	*(ivory black, bone black, carbon black, zinc white, etc.)* • difficult to find the black pigment/pigment tone which is comparable to the black on the historic fragments • mostly unproblematic to use also with the contemporary binders	• good appearance • can be hard to find • breaks easy • often suffers from glass corrosion	• time-consuming • difficult for some application steps • hard to reproduce • good training is required
Modern Binders	**Modern Pigments**	**Modern Soda Lime Glass**	**Handmade Mask**
• good to use after testing *Plextol D498* • builds in air bubbles when mixed with pigments *Paraloid B72* • works very well but solvents can harm the masking tape • passed the PAT *Lascaux acrylic paints* • adheres well and is easy to use All modern binder systems had little tendency to delaminate.	*(spinel black)* • spinel-black best resembled the historic black on the original cover glass fragments *(mica pearlescent pigments)* • for the gold lines • worked well and easy to use with different binders	• easy to find in many thicknesses • cheap • easy to work with • glass corrosion can be an issue	• inexpensive • difficult for some application steps • time-consuming • hard to reproduce • can be difficult to make • works well with different solvents (test first)
		Borosilicate Glass	**Plotter Generated Mask**
		• available in many types (also as float glass, cylinder glass / antique look) • can be harder to cut • very resistant to glass corrosion • good resistance to mechanical damage	• easy to produce and reproduce • very cheap • time saving • available almost everywhere • works with different solvents (test first)

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Images

Figures 1-5 & 8-29 Jens Gold
Figures 6 & 7 Tereza Cikrytová

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Conservation of an Oversized Photographic Collage: First Phase

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Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

ABSTRACT

In January 2012, students in the Post-Graduate Course in Conservation of Photographs at the National School for Conservation in Mexico City, in collaboration with the *Museo Nacional de Historia, Castillo de Chapultepec (National Museum of History)*, started the first phase of a large project: drafting the conservation treatment proposal and exhibition guidelines for an oversized photographic collage measuring 2.5m x 3m (8.2ft x 9.8ft). From ca. 1910–1912, the photographic collage consists of 769 photographs mounted on a secondary paper support lined overall to a cotton fabric and mounted on a wooden stretcher. Due to its complexity the photographic collage is of great technical interest to conservators. It is also of important historical significance for Mexico due to the inclusion of photographic portraits of the most relevant Mexican politicians since the Declaration of Independence in 1810, through 1910.

The first phase of the project focused on the historical and technical aspects of this invaluable piece, including preliminary scientific analysis to help confirm identification of the photographic processes.

1. INTRODUCTION

During the first decade of the Twentieth Century, the editor and draftsman Vicente Rivera Melo (1870–1940) created a photographic collage measuring 2.5 m (8.2ft.) high and 3 m (9.8ft.) wide (figure 1). Today this photographic collage is part of the collection of the National Museum of History in Mexico City.

The collage's title is as large as the historical events honored: *Cuadro Geográfico Histórico Cronológico Conmemorativo del Centenario de la Proclamación de la Independencia de los Estados Unidos Mexicanos* (*Geographical, Historical, Chronological and Commemorative Composition for the Centennial Anniversary of the Mexican United States' Proclamation of Independence*). It includes 769 photographic portraits mounted on a paper support and decorated with political iconography of the period.

As the name suggests, this collage encompasses different narratives (historical, political and chronological) established with the distribution and organization of portraits of independence heroes and related key actors involved in the development and growth of the Mexican nation from 1810 until 1910. Its aesthetic characteristics are more elaborate and decorative than similar photographic collages made in Mexico during the same period.

3m (9.8ft.)

2.5m (8.2ft.)

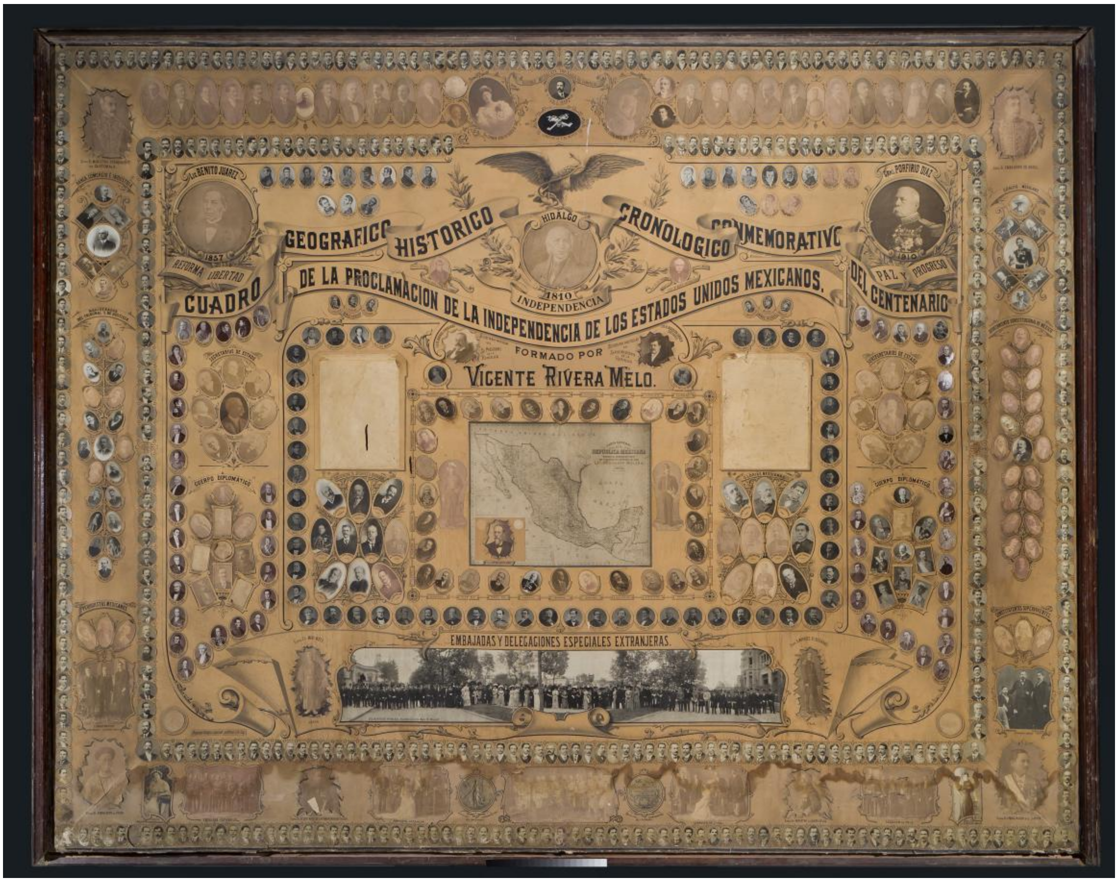

Fig. 1. Overall view of the photographic collage. Photograph courtesy of ENCRyM, ECRF 2011–2012. Reproduction authorized by INAH–CONACULTA–MEX.

In January 2012, students of the Post-Graduate Course in Conservation of Photographs (ECRF) at the National School for Conservation (ENCRyM) in Mexico City, started the conservation project for this remarkable piece. The project focused not only on the conservation treatment of the object but was also used as part of the students' learning process, as you can see in the flowchart below (figure 2). The project was structured in three phases:

- First phase: material identification, scientific analysis, and research on the history of the object as methodological and theoretical approaches.

- Second phase: elaboration of a treatment proposal, based on the analyses and information previously compiled.

- Third phase: conservation treatment and drafting of exhibition guidelines.

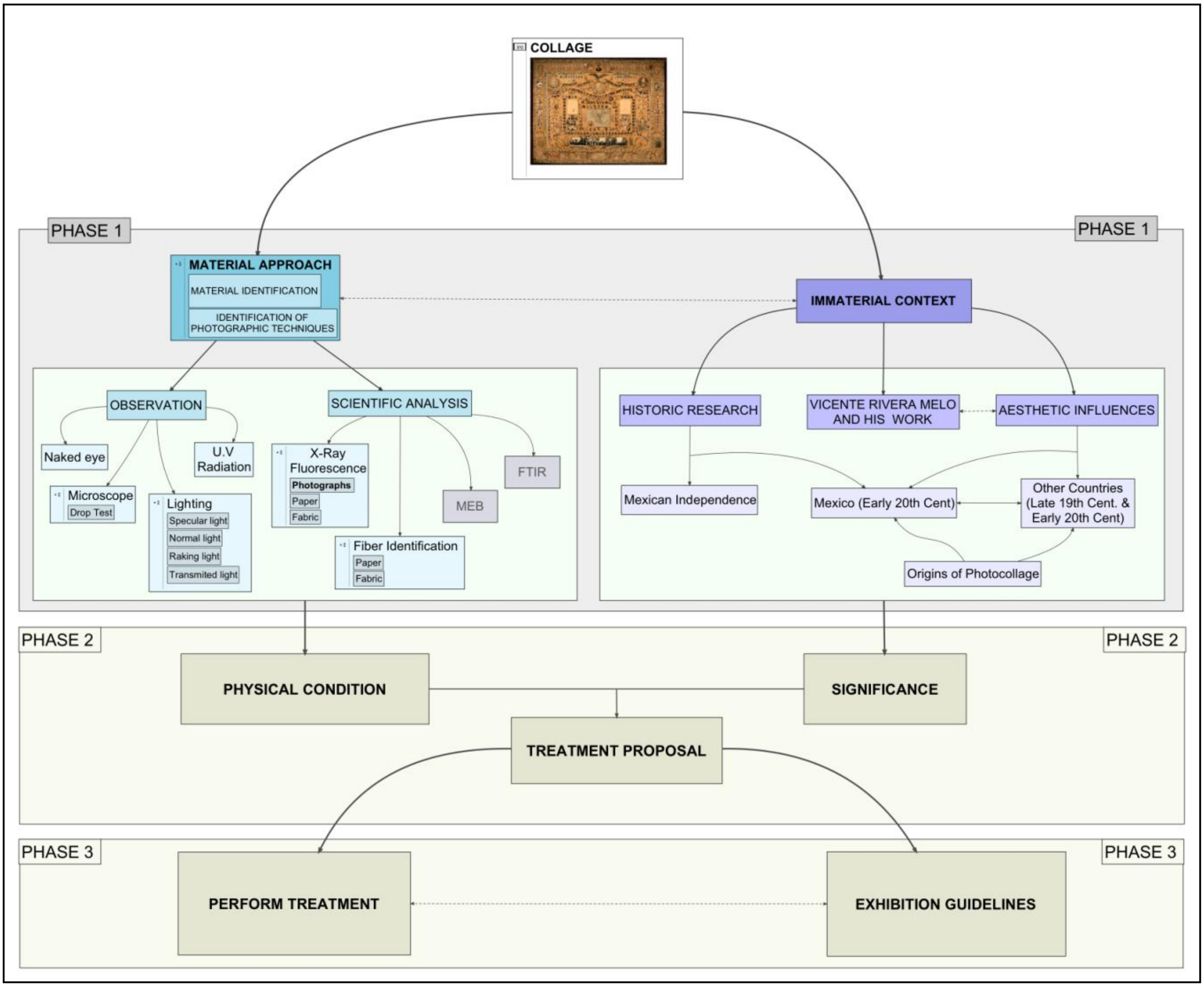

Fig. 2. Flowchart showing the three phases of the project.

Thereby, the results obtained during the first phase of this project will be presented here: the identification of materials and photographic techniques together with the historic research and contextualization of this collage.

2. DESCRIPTION

This oversized photo collage was conceived and made by the editor and artist Vicente Rivera Melo, in collaboration with draftsman Espinosa.

A political map of Mexico surrounded by the governors of each state in 1910 sits in the center of the composition (figures 3*a* and 3*b*).

Figs. 3*a*, and 3*b*. Political map of Mexico in the center of the composition, surrounded by the governors of each state in 1910. Courtesy of ENCRyM, ECRF 2011–2012.
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Portraits of the most relevant characters involved in the development of Mexico as a nation since the Declaration of Independence in 1810, until the Independence's centennial in 1910 are also included.

Vicente Rivera Melo used 769 portraits and organized them in groups, surrounding the map. The most important elements of the composition are:

- The long title in capital letters presented on two flowing ribbons.
- A heavily retouched photograph of the keys to the city of Mexico City.
- The drawing of an eagle with a snake in its beak, which represents the establishment of Mexico City.
- The circular portraits of Benito Juarez, Miguel Hidalgo, and Porfirio Díaz, surrounded by their political achievements (Reformation and Liberty for Juarez, Independence for Hidalgo, and Peace and Progress for Díaz), and smaller portraits of 24 independence heroes.
- The portraits of Leona Vicario and Josefa Ortiz de Dominguez, two women who participated in the independence.
- The Minister of Guatemala and the Ambassadors of Brazil, China and Japan, which emphasize the international relations held by Mexico and therefore its political strength in 1910.
- Figures of the Mexican banking, commerce, and industry.

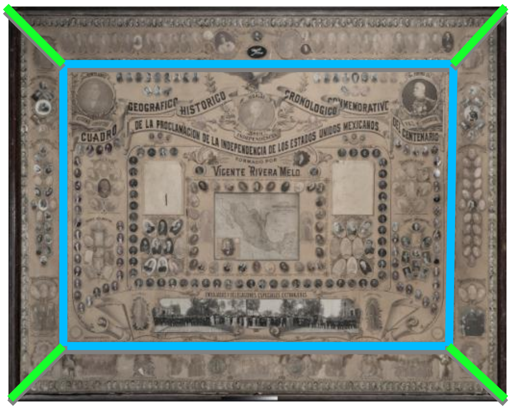
- Prominent Mexican journalists.
- A panorama showing the members of the foreign embassies and special branches.
- The representatives of the National Commission for the Independence Centennial.
- Two large empty spaces in the upper left and right sides, which were identified during the project.

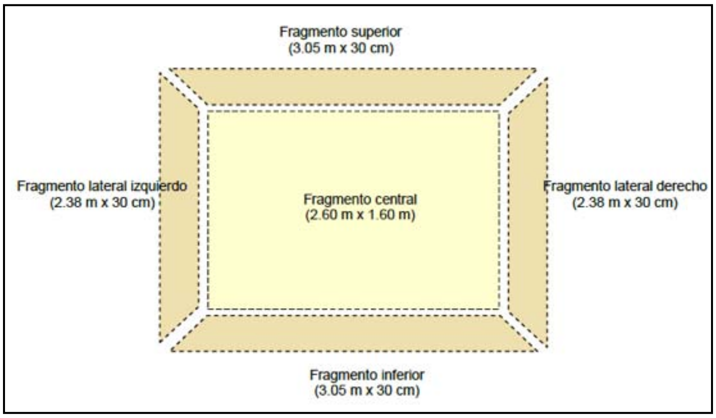
3. TECHNIQUE

The construction of this collage started with a plain cotton fabric which supports all the elements and is mounted on a pinewood stretcher using cloves along the edges (figure 4).

Fig. 4. Verso of photographic collage, showing cotton fabric and pinewood stretcher. Courtesy of ENCRyM, ECRF 2011–2012. Reproduction authorized by INAH–CONACULTA–MEX.

The paper support, manufactured by the paper company Schleicher & Schüll, was adhered to the fabric with starch paste and is comprised of five pieces: the largest in the center and four wide strips along the edges. The pieces of paper were probably adhered to the fabric starting from the center, followed by the surrounding papers, with edges aligned and abutted, not overlapping (Figures 5*a* and 5*b*).

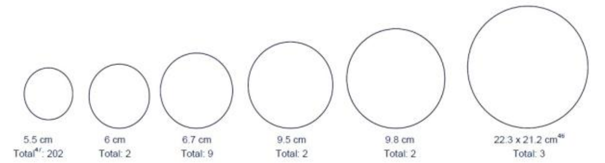




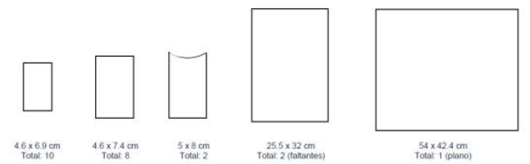
Figs. 5*a* and 5*b*. Diagrams showing the distribution of the five pieces of paper support. Courtesy of ENCRyM, ECRF 2011–2012. Reproduction authorized by INAH–CONACULTA–MEX.

Afterwards, a layout drawing was made using graphite in order to distribute the different elements of the collage, including the flowing ribbons with the title, the eagle, the map, and the groups of portraits with their names. The final drawing was done in black ink over the graphite.

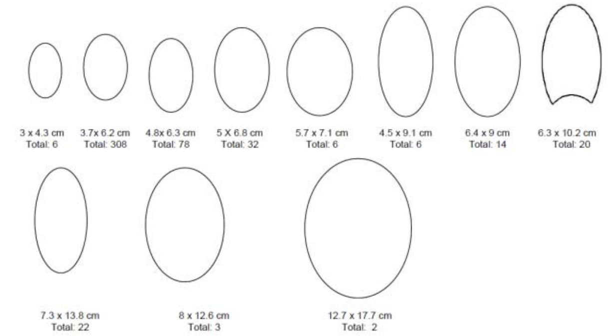
The photographs were then pasted on the paper, following a symmetrical distribution according to the vertical axis that divides the composition in two. This setting also influenced the five shapes that can be found in the photographs, which were identified as: circular, oval, rectangular, mixtilinear and irregular (table 1).



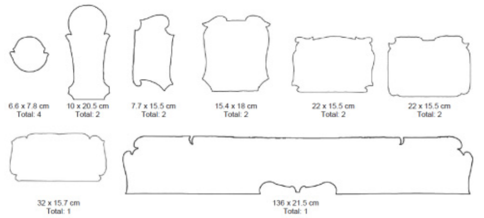
Circular



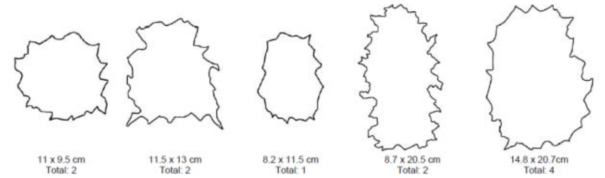
Rectangular



Oval



Mixtilinear



Irregular

Table 1. Groups of shapes found in the photographic collage.

The photographs were adhered to the paper support using starch paste. The surrounding areas of some photographs were decorated, using templates or a pair of compasses for the circular shapes.

3.1. Identification Of Photographic Processes

After understanding the general construction of the collage, the next step was the identification of the photographic processes. Starting with observation under ultraviolet radiation, it was possible to see differences between the fluorescense of gelatin binders (bluish fluorescence), and collodion binders (white–grayish), as seen in figure 6. Very careful and meticulous spot tests and examination under microscope were performed all over the collage in order to identify binders, the presence or absence of baryta, and other technical aspects such as retouching. Out of the 769 photographs, 606 are silver gelatin prints, 158 are semi-gloss collodion prints, 2 are platinum prints, and 3 are halftone photomechanical prints.

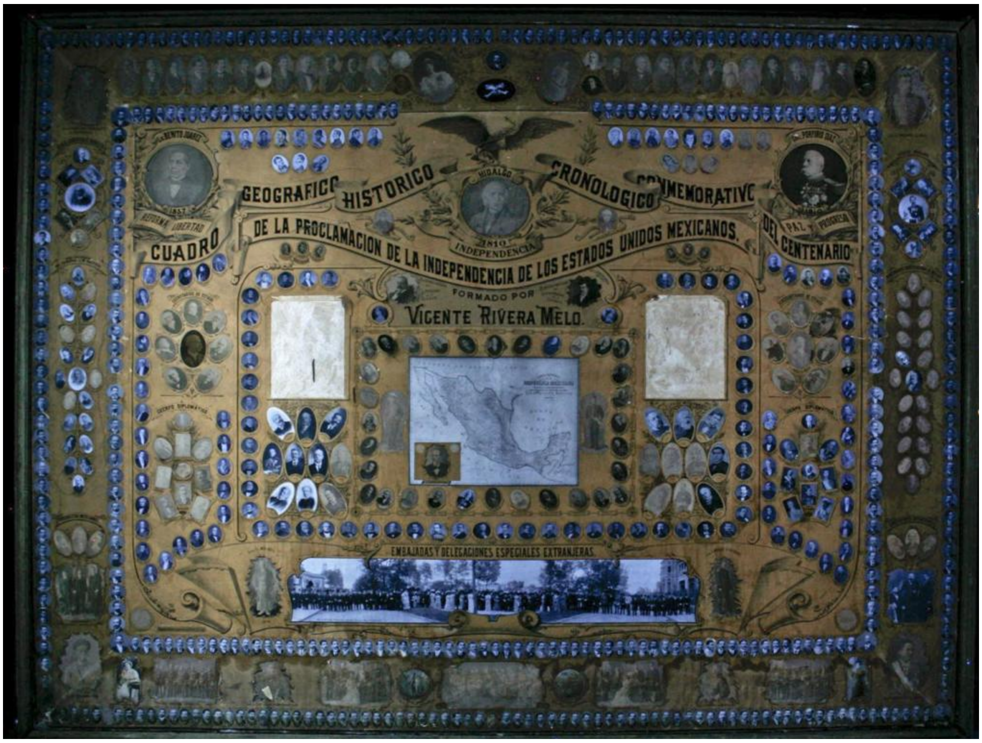


Fig. 6. Overall view of the photographic collage under ultraviolet radiation. Photograph courtesy of ENCRyM, ECRF 2011–2012. Reproduction authorized by INAH–CONACULTA–MEX.

Under the naked eye are evident different tonalities in the photographs, after identifying the different photographic techniques it was clear that the variations in the tonalities are due to different steps during processing, especially the use of toners. XRF analysis was used to confirm the image forming material.

The photographs' texture is determined by the thickness of the baryta and the binder. As expected, platinum prints have a matte surface due to the absence of baryta and binder, collodion prints and some silver gelatin prints have semi-gloss surfaces, in most of the cases the gelatin prints are more glossy than the collodion ones. It was noticed that the collodion prints have an uncommon faded appereance.

3.2. Analysis With X-Ray Fluorescence (XRF)

The XRF analysis confirmed the absence of baryta and the presence of platinum as well as some mercury in the platinotypes. The presence of baryta in the collodion prints was also confirmed, even when it was so thin that it was barely visible under the microscope.

In the silver gelatin photographs, the presence of gold, sulphur, and platinum was detected as toning elements. The collodion prints also showed gold and platinum as part of the image layer, which was unexpected due to the strong fading of the images.

So the question arises: why are the collodion prints showing such a strong fading compared with the silver gelatin prints?

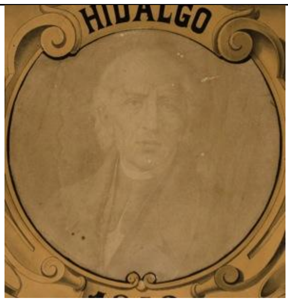
The first possible explanation would be poor processing, as well as the thinness of the collodion.

In order to better understand this deterioration, further examination was carried out in three steps:

1. Collodion prints were groups by tonalities (see table 2):

   a. Warm: images show a good condition with details in the highlights and good contrast.
   b. Warm faded: highlights, contrast, and image density are strongly faded.
   c. Pink: photographs display a slight fading, and details in highlights are mostly lost.
   d. Pink faded: highlights are faded.
   e. Sepia faded: in general these images have different levels of strong fading; in some photographs the image is almost completely lost.

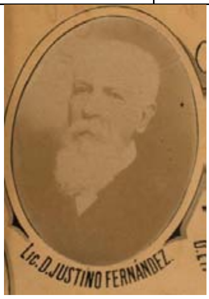
a. Warm.



b. Warm faded.

c. Pink.

d. Pink faded.



Sepia faded.

Table 2. Examples of tonalities and fading levels established for collodion prints in the photo-collage. Courtesy of ENCRyM, ECRF 2011–2012. Reproduction authorized by INAH.

2. On each group, a series of XRF analysis were performed in order to identify the image forming material. The equipment used was a Bruker Tracer III-V Handheld XRF with a Rhodium tube target and aperture of 1cm, Aluminum/Titanium filter, air atmosphere, tube voltage of 40KV, tube current: 1.10 mA, and livetime between 180 and 300 seconds. Once the elements present in the image layer were identified, the ARTAX software was used to generate a semi quantitative approach to said elements.

3. Interpretation of results and relate this information with the condition of the collodion prints.

The comparison of the XRF analysis made on each group allowed us to obtain the following results: silver, gold and platinum were found in groups *a*, *b*, *c*, and *d*, while only silver and gold were found in group *e*.

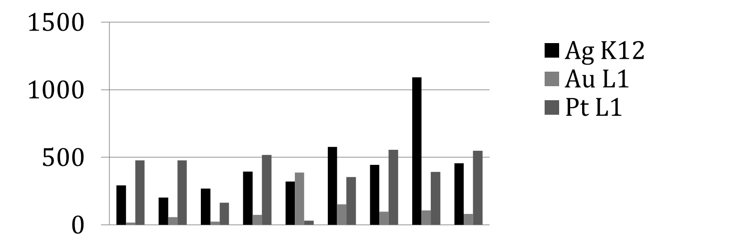


Fig. 7. A comparison of the amounts of silver, gold, and platinim found in the areas of high image density within sample group *a* using quanititative XRF. (x-axis, samples; y-axis, counts)

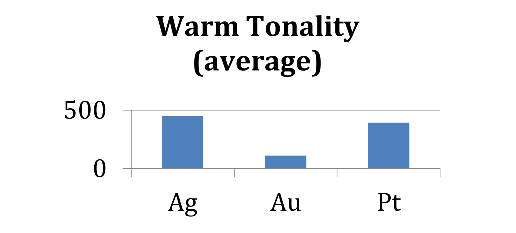


Fig. 8. Average quantities (counts) of silver, gold, and platinum detected in all of the photographs within sample group *a*. Photographs in sample group *a* contain a significantly more platinum than gold.

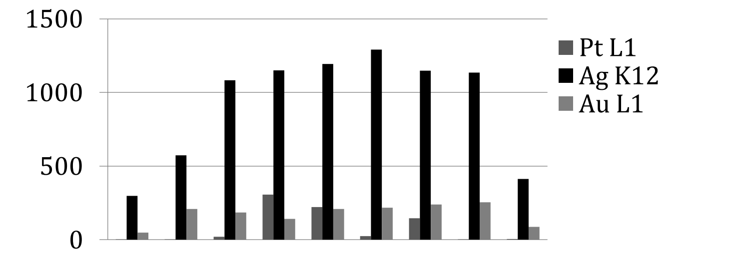


Fig. 9. A comparison of the amounts of silver, gold, and platinim found in the areas of high image density within sample group *C* using quanititative XRF. (x-axis, samples; y-axis, counts)

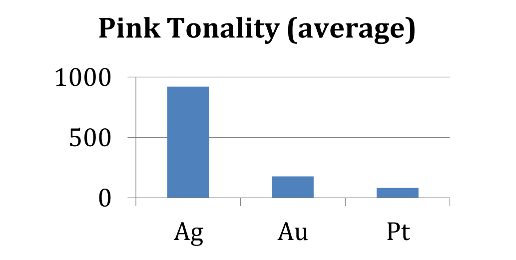


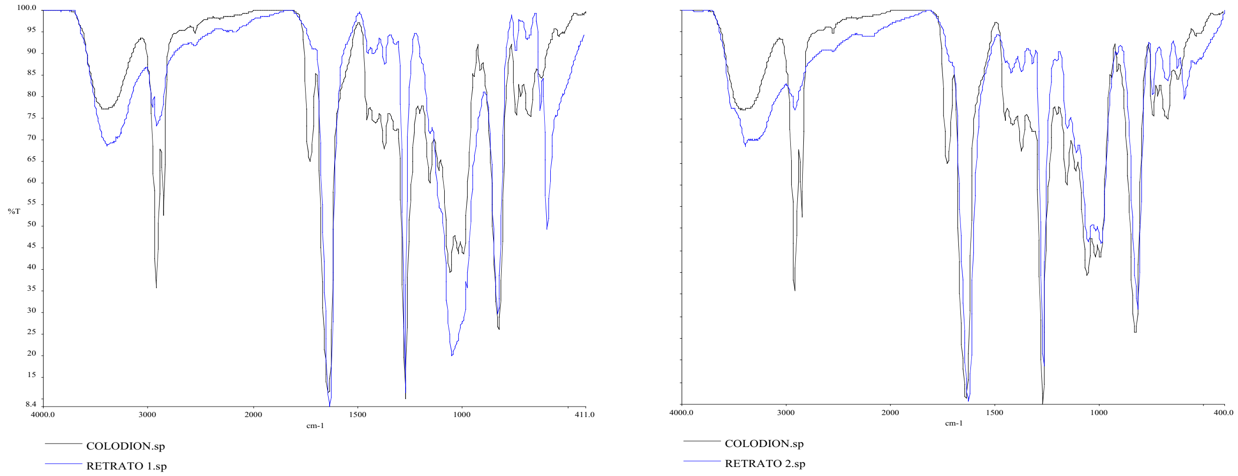
Fig. 10. Average quantities (counts) of silver, gold, and platinum detected in all of the photographs within sample group *c*. Photographs in sample goup *c* contain a greater amount of silver and less gold and platinum than those in sample group *a*.

So even when there is gold and platinum in most of the images, reddish and yellowish tonalities could have resulted from poor processing during toning, or if the temperature, the purity and/or concentration of toners was not the appropriate.

Further analysis will be performed as an attempt to quantify more accurately the quantity of silver, gold, and platinum in each group. For this, more XRF measurements will be done with a different protocol in order to establish statistical data and using a logarithmic scale to get accurate quantitative information.

If possible, other analyses will be used to try to identify traces of pollutants, which could be related with fading, but also affect the stability of the prints and possibly of the other photographic processes present in the collage.

FTIR was used to analyze the collodion binder, in order to confirm its nature. With the help of chemist Marisela Gutiérrez, from the *National University of Mexico* (UNAM), it was possible to confirm the basic structure of cellulose nitrate by comparing the spectrums obtained from photographs in the collage with some reference samples of nitrate cellulose from the UNAM database and from the Infrared and Raman Users Group (IRUG) (figures 11*a* and 11*b*).



Figs. 11*a*, and 11*b*. In blue, two FTIR spectrums of collodion prints from the photo–collage. In black, FTIR spectrum of a sample of collodion (cellulose nitrate) from UMAN reference database. The peaks coincide around 1650, 1280, 1000 and 845, confirming the basic structure of cellulose nitrate.

4. HISTORIC RESEARCH

The history of the collage can also gave us some clues about its condition. As mentioned earlier, the creator of the collage, Vicente Rivera Melo was an editor and draftsman, not a photographer. So he obtained the photographs from different sources:

1. He invited legislators to have their pictures taken in a photographic studio in Mexico City. Or, as in the case of the panorama, a photographer and its company were hired to produce the image.

2. He had access to famous portraits taken years before by different photographic studios, such as the images produced by the studio *Cruces y Campa* in 1874, used to commemorate the heroes of Mexican Independence from 1810 through 1874. According

to the author Olivier Debroise (1994), the production of these portraits was well received and quickly became popular, so the initiative was followed by other studios established in the city that started selling images of renowned people of the time including deputies, senators, writers, and so on.

According to author De los Reyes (2002), the tradition of commemorative photographic portraits in Mexico can be traced to 1864, when photographic portraits of the Emperor of Mexico Maximilian 1st and his wife Empress Carlota, were sent and sold in Mexico as a way to introduce the new Emperors to the people. Also, the *carte de visite* and family albums were a common practice among wealthy families. So it is possible that, in a way, some of the Victorian tradition of photo–collages had come to Mexico through the Emperors, especially through Empress Carlota who was also cousin of Queen Victoria of the United Kingdom.

According to Elizabeth Siegel in her book *Playing with Pictures*, in the Victorian photographic collages there was an intention of showing an aesthetic taste but also a way to consolidate relationships and networking, but also to show their recognition and position in society (Siegel 2009), which is very similar to some characteristics of this collage: the author was trying to emphasize the figure of president Porfirio Diaz by equating him with the most important figures in Mexican history such as Benito Juarez, who defeated the *French Intervention* in Mexico, and Miguel Hidalgo, one of the main leaders of Mexican independence. In fact Diaz is the only character that appears several times in this photographic collage.

Making photographic collages was also a common practice among many photographic studios. The oldest Mexican collage we have found so far dated 1879; although earlier collages were usually governmental projects assigned directly to the photographic studios where lithographic prints were used as background and usually combined with photographs in a single collage. The Mexican patriotic symbols are recurrent in these collages, including the eagle holding a ribbon in its grips and/or a snake in the beak, military symbols, flags, vine and olive branches, among others. Rivera Melo used all theses elements, but he arranged them in a more elaborate composition articulated with a political and historic intention.

The historic research was carried out in different photographic archives, libraries, and electronic media, and lead to the discovery of other versions and early photographic documentation of this photo–collage. Perhaps the most important find is the glass plate negative found in the *National Photographic Archive–INAH* in the city of Pachuca, belonging to the Casasola collection. The plate shows an approximate condition of the images in the photo–collage years ago, as well as the missing elements in the blank areas next to the map: two photographs, the one at the left shows Francisco Gonzalez Bocanegra, the writer of the National Anthem lyrics; and at the right is Jaime Nunó, the melody composer.

Finally, it was possible to contact and interview one of Mr Rivera Melo's grandson, Doctor Vicente Rivera Melo Vázquez, who remembers seeing this collage at his grandfather's house. Dr. Rivera Melo Vázquez also provided information about his grandfather's artistic training and background as lawyer.

According to the acquisition records of the National Museum of History (MNH), reveal that after Mr. Rivera Melo death, his son Joaquín Rivera Melo tried to sell this photo-collage to the Museum, for the amount of one thousand pesos of the time, but the transaction wasn't possible and Mr. Joaquín decided to donate the photo–collage to the Museum on November 23, 1942 (Archivo MNH, 1942), and since 1944 the collage is part of the collections of the National Museum of History.

5. CONCLUSIONS

The celebrations for the Centennial were intended to be the most important political and social events in 1910. This Commemorative Photographic Collage shows a synthesis of those intentions by organizing and distributing portraits of the most influential Mexican politicians together with diplomats and ambassadors of different countries, bankers, and journalists, and placing them next to historical figures that contributed to the building of the Mexican nation a hundred years before, and those who continued such efforts until 1910, right before the Mexican Revolution.

The historic approach to this oeuvre allowed us to discover more photographic collages from the same author, as well as discover the images that once filled the empty spaces in the center of the collage. Further research could increase the knowledge about the techniques used by Rivera Melo.

Thanks to the generous help of Vicente Rivera Melo's grandson, Dr. Vicente Rivera Melo Vázquez, it was possible to find the institutions where his work still remains, and better understand Rivera Melo's work.

Close examination and elemental analysis allowed us to identify and locate the different photographic processes present in the photo–collage. The XRF analysis and related software, allowed us to make a semi–quantitative approach to the elements present in the photographs. In this case we could say that having a small quantity of gold and platinum means more faded images, while larger quantities of toning materials mean more image stability. However, it doesn't explain why the collodion prints show such strong fading. Further analysis should be done to better understand this behavior.Some analyses that has been considered are:

- SEM: to explore the physical characteristics of the collodion binder such as the thickness, together with the analysis of the image materials.

- More XRF readings in order to get a statistical approach, as an attempt to better quantify the elements present on each group of photographs and co-relate this information with other analytical techniques.

Finally, we should mention that the second phase has already started and important treatment challenges are approaching.

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Abstract: Re-visiting Strip Lining of Large Format Photographs

Pip Morrison and Sarah Brown

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

The National Gallery of Victoria has been using variations on strip lining methods for the hinging and mounting of photographs for the last ten years or so. In the last year, a number of photographs mounted using these methods have had to be re-tensioned and rehoused. While removing many works from their frames, it was decided to use this as an opportunity to assess the methods and issues with the hinging system that have been arising. Some photographs have responded well to re-tensioning of the hinges, while others have needed a lot of time, handling, and ultimately, re-mounting to restore their appearance. This has led to assessments of the success and reversibility of systems, and whether reversibility outweighs potential damage due to continued handling of large pieces of sensitive photographic papers. This paper outlines the various issues, and discusses the ethics versus the practicalities of caring for these vulnerable collection items.

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

A Cost Effective Method for Removing Dry Mount Tissue from Photographic Prints

Cheryl Jackson

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

ABSTRACT

Photographic prints have commonly been adhered to their supports with dry mount tissue. Early tissues used a shellac based adhesive that was superseded in the 1970's by synthetic adhesives. The formulation of these synthetics was a closely guarded commercial secret.

Removing photographic prints from acidic mount boards when they have been mounted with dry mount tissue can be extremely time consuming, which means it is also an expensive process.

Vapor chambers and immersion baths have been used in the past with success, but here, a passive, cost effective system for removing dry mount tissue has been developed. Synthetic tissues have been analyzed using FTIR and solvents found for them using the Teas Chart. This system could also work for whole pages from self-adhesive albums.

A mounted print is placed in a simple zip-lock bag with a barrier layer and a piece of thick blotter soaked in solvent. The system is sealed and left alone for several hours. At the end of this time, the dry mount tissue can simply be peeled away from the print leaving the back of the print undamaged, clean and flat. This system literally reduces the time spent on this procedure from hours to minutes, with the added bonus that other work can take place while the system is working without intervention.

The system takes almost no time to set up or monitor, uses far less solvent than a chamber or bath, and the materials used in the system are inexpensive and readily available. The materials are also completely reusable, saving on consumables.

INTRODUCTION

Photographs mounted with dry mounting tissues can be extremely difficult and time consuming to remove from their backboards. A faster, more efficient method is required. Vapor chambers and immersion baths have been used in the past with success, but a system that uses less solvent would benefit the environment and the budget. A low cost, low impact system has been developed here.

SET UP

Five samples of dry mount tissue were sourced. Four historic tissues were purchased from EBay: an early Kodak Dry Mounting Tissue, a somewhat later Kodak Dry Mounting Tissue Type 1, Kodak Dry Mounting Tissue Type 2, and Seal MT5 Permanent Dry Mounting Tissue. A contemporary product, Bienfang Colormount Permanent Dry Mounting Tissue, was also purchased as it was felt that it would be unlikely for modern photographic prints to be mounted with historic shellac-based tissues (see figures 1-5).

Fig.1 An early Kodak Dry Mounting Tissue.

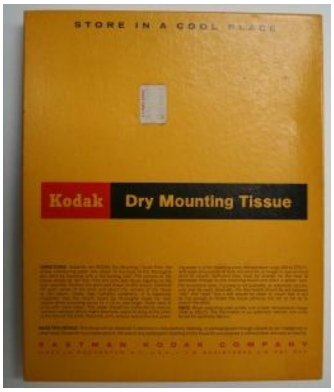


Fig. 2 A somewhat later Kodak Dry Mounting Tissue.

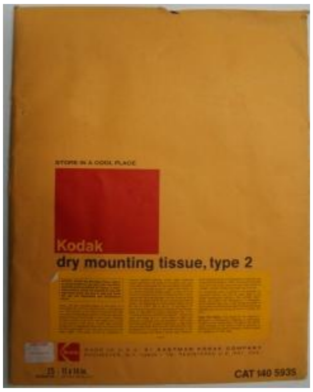


Fig. 3 Kodak Dry Mounting Tissue Type 2.

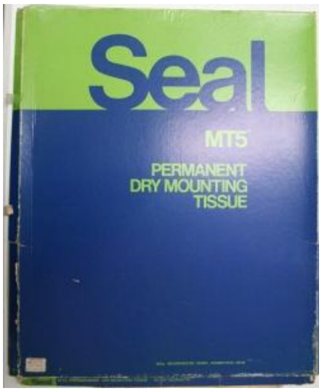


Fig. 4 Seal MT5 Permanent Dry Mounting Tissue.

Fig. 5 Bienfang Colormount Permanent Dry Mounting Tissue.

Two more self-adhesive products were found in our paper store and added to the sample set (see figures 6 and 7):

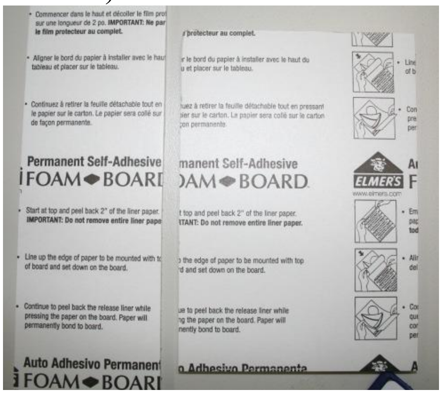


Fig. 6 Elmers Self-Adhesive Foam Board.

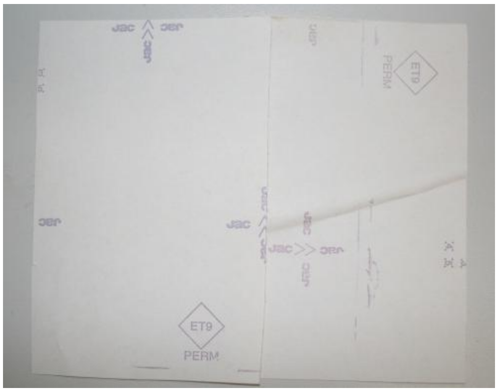


Fig. 7 JAC Double Sided Self Adhesive Paper.

These tissues were used to mount a variety of photographic prints to 2-ply conservation-quality mount board secondary supports. The photographic processes selected for testing were as follows:

- Silver gelatin fiber based prints, c 1950
- Silver gelatin resin coated prints, c 1990
- Epson Ultrachrome black and white print on Epson photographic paper, c 2006
- Epson Ultrachrome black and white print on Epson photographic paper, 2012
- Fuji Pictrograph black and white print on Pictrograph paper, c 2006
- Chromogenic color prints on Kodak resin coated paper (square format), c 1980
- Chromogenic color prints on Kodak resin coated paper (4 x 6” format), c 1985
- Chromogenic color prints on Fujicolor resin coated paper, c 1985
- Chromogenic color prints on Sakuracolor resin coated paper, c 1985
- Chromogenic color prints on Fuji digital exposure, resin coated paper, 2012
- Epson Ultrachrome color print on Epson photographic paper, 2012
- Dye based inkjet print on generic photo paper, 2012

This ensured that the prepared samples include various historic prints mounted with historic tissues, historic prints mounted with modern tissues, and modern prints mounted with modern tissues.

These known samples were then supplemented by a selection of historic, mounted photographs.

Sample 1 Sample 2 Sample 3 Sample 4

Fig. 8 Mounted Silver Gelatin and Chromogenic Prints

PROCEDURE

All of the dry mount tissue samples were analyzed using Fourier transform infrared (FTIR) spectroscopy in order identify the main component(s) present within the adhesive layers. The results indicated that the adhesives were based on one of the three following materials: shellac, polymethyl methacrylate, or an ethylene vinyl acetate copolymer.

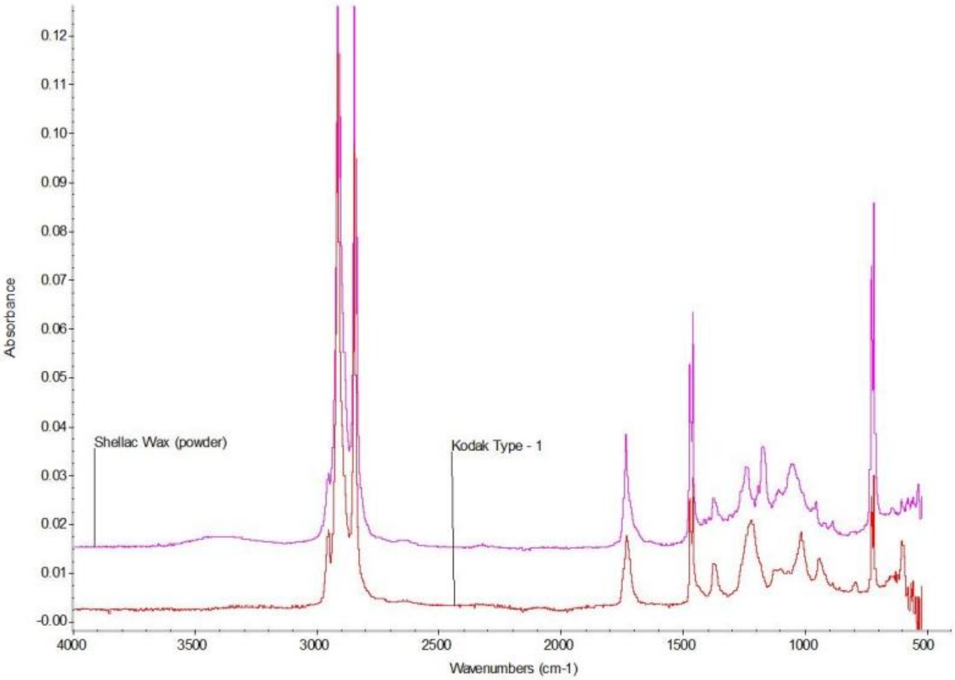


Fig. 9 FTIR spectra of Kodak Dry Mounting Tissue overlaid with a reference library spectra of shellac.

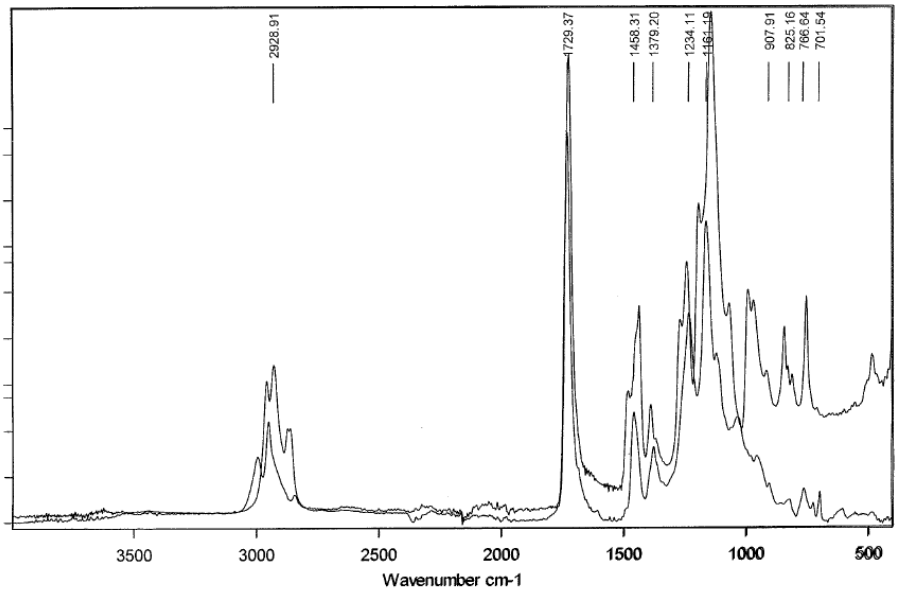


Fig. 10 FTIR spectra of Elmers Self-Adhesive Foam Board overlaid with a reference library spectra of polymethyl methacrylate.

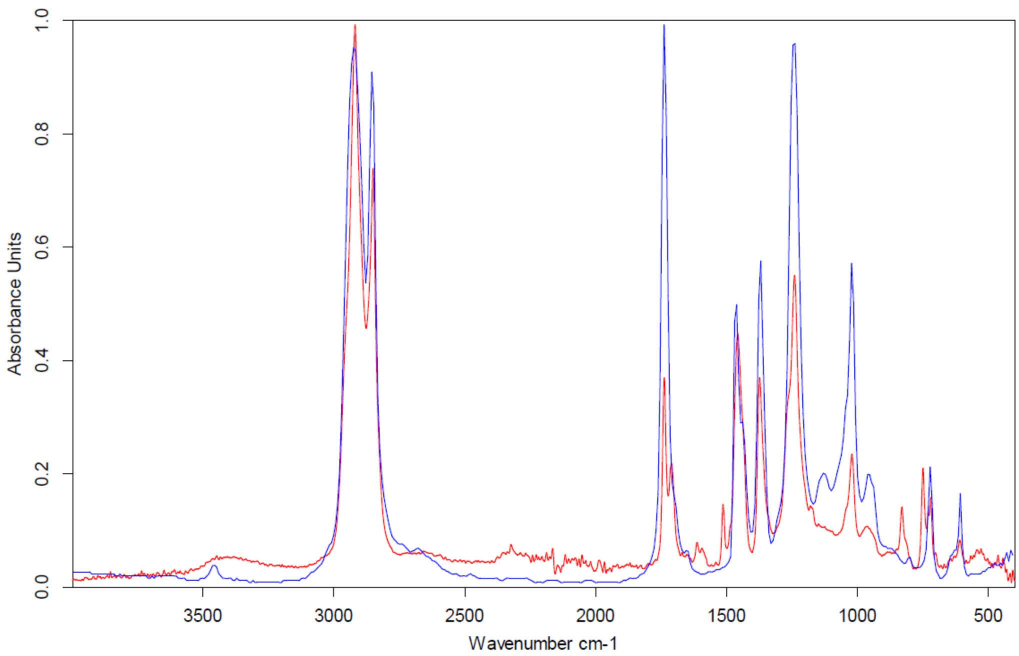


Fig. 11 FTIR spectra of Bienfang Colormount Permanent Dry Mounting Tissue overlaid with a reference library spectra of ethyl vinyl acetate.

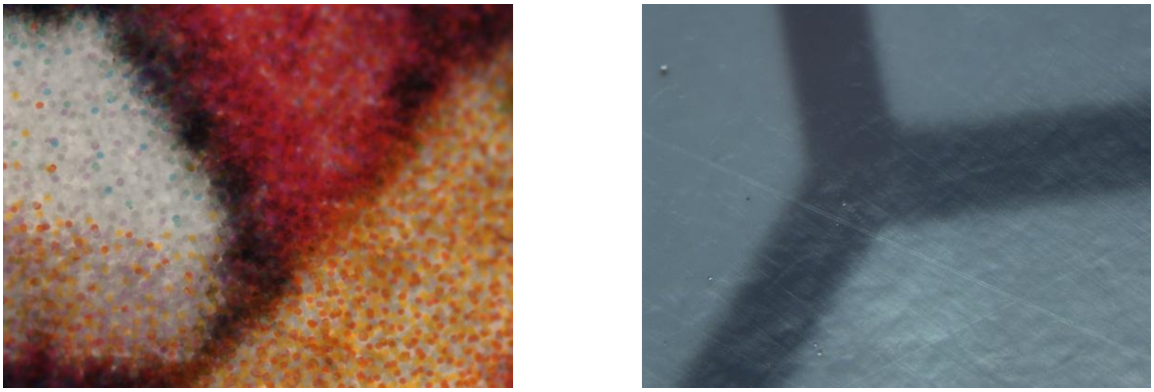
All of the prints that required mounting were joined to their backboards and tissues using a domestic iron on “Synthetic” setting with no steam. This procedure was used as it was specifically described on the tissue packs if a professional mounting press was not available. After heating, the prints were immediately placed under a weight to allow them to cool flat. This was especially necessary for the Kodak Type 2 tissue as it was very slippery and soft while hot, and would release around the edges of the print if not cooled under pressure (Wilhelm 1993)

The earliest Kodak product proved very difficult to work with. The tissue sheets had adhered to each other while in the package, but would not longer adhere to the prints or the mounting boards when heated (Wilhelm 1993). Repeated attempts with different temperature and different heating appliances could not achieve a bond. This tissue was then excluded from the rest of the project.

After setting up the samples, there were 12 print types on 6 tissue types.

Fig. 12 Mounted black-and-white and color sample prints.

Each type of photographic print included in the sample set was photographed under 30x stereo magnification to set a base line for the condition of the material before it was exposed to long hours in a solvent vapor chamber.



Detail: pigment inkjet print Detail: silver gelatin fiber based paper

Fig. 13 Examples of the baseline 30x magnification pre-treatment photodocumentation.

Each sample print was placed individually into a vapor chamber made using two zip-lock polyethylene bags, as seen in figure 14.

Two layers of thick blotter were inserted into zip-lock bag and, for a 4x6” print, approximately 20 ml of solvent was pipetted onto the blotter. The mounted print was placed on three layers of Reemay and inserted into the first bag along with the solvent soaked blotter. All the air was squeezed out of the bag, and the bag was sealed. This sealed bag was then placed into a larger zip-lock bag. Again, the air squeezed out and the bag sealed. The function of the second bag was to limit any accidental solvent vapor in the event of leakage of the first bag.

Gore-Tex was used instead of Reemay during initial testing, but it quickly became apparent that a solvent with a low surface tension, like ethanol, could move through the Gore-Tex and come into contact with the print. The use of Gore-Tex was therefore discontinued.

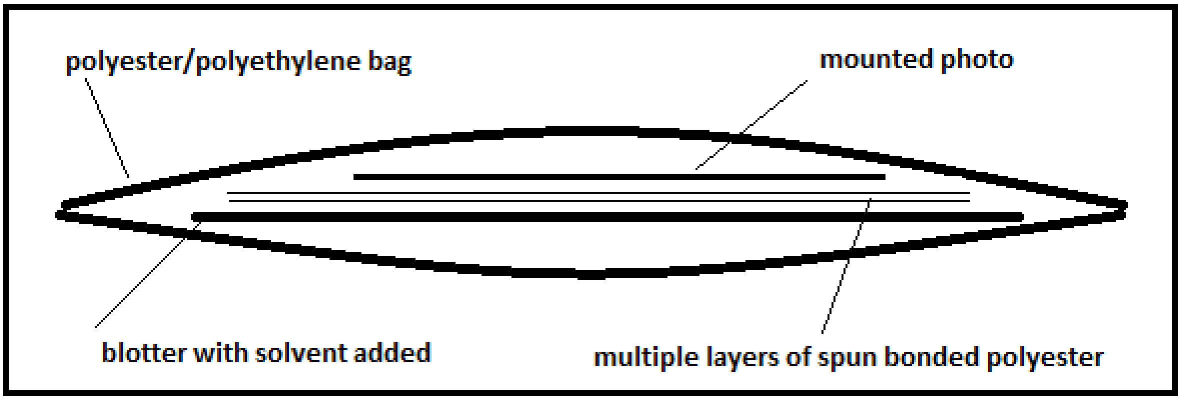


Fig. 14 Cross section diagram of the bag set up.

The polyethylene bags worked well for ethanol, but the plastic was softened and wrinkled by toluene, and the solvent could be smelled outside the enclosure.

Fig. 15 A toluene-softened polyethylene bag.

To overcome this issue a polyester bag was made using 4 mil Mylar, double folding the sides and securing them with double sided tape. The opening was then double folded and secured with a Velcro self adhesive hook and loop fastener.

The polyester bags were also tested using the thick solvent-soaked blotter and three layers of Reemay (which kept the photographs out of contact with the liquid solvent). This polyester-bag system worked well, with no softening/wrinkling of the bag, and no apparent solvent odor.

Fig. 16 The resealable polyester bag.

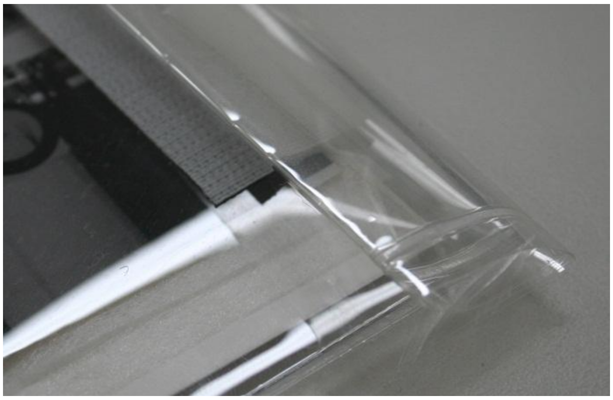


Fig. 17 Detail of the double fold-over and Velcro closure.

RESULTS

This solvent chamber technique was successful in separating most of the mounted samples. It was found that the synthetic adhesive based tissues released more readily than the shellac adhesive based tissues.

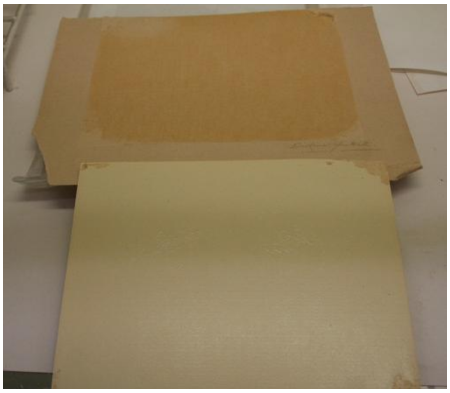
Tissue	Ethanol		Toluene	
	After 2 Hours	After 6 Hours	After 2 Hours	After 4 Hours
Kodak Type 1	Board released	Tissue did not release	---------------------	----------------------
Kodak Type 2	Board released	Tissue released	---------------------	----------------------
Seal MT5 Tissue	----------------------	----------------------	Board released	Tissue released
Bienfang Colormount	----------------------	----------------------	Board released	Tissue released
Elmers Foam Board	----------------------	-----------------------	Board released	Tissue released
JAC Self Adhesive Paper	----------------------	-----------------------	Board released	Tissue released

For example after two hours in the toluene vapor chamber, the test sample had released from the backboard. The tissue was still adhered to the print, so the object was returned to the bag. An additional 10 mL of toluene was added to the solvent soaked blotter in order to compensate for any solvent vapors lost while opening the chamber. After two more hours in the solvent chamber, the tissue could be removed from the back of the print and any residual adhesive swabbed off.

The historic sample prints were tested using the same polyester bags. The three black-and-white prints were put into ethanol vapor chambers and the three chromogenic prints into toluene vapor chambers.

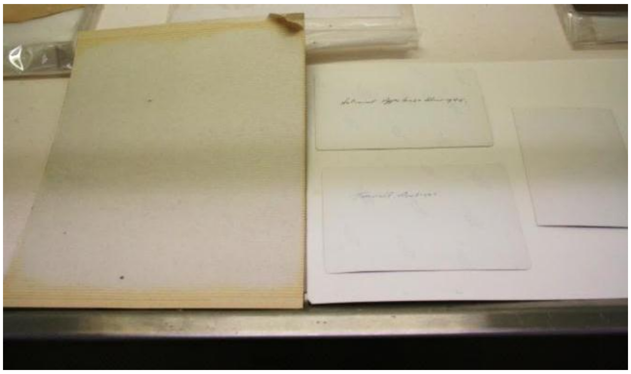
The silver gelatin print on a single, porous board and the chromogenic prints on the self-adhesive album page released very quickly, taking only thirty-five minutes to separate.

Historic silver gelatin print before treatment.



After thirty-five minutes in an ethanol vapor chamber.

A magnetic album page and chromogenic before treatment.

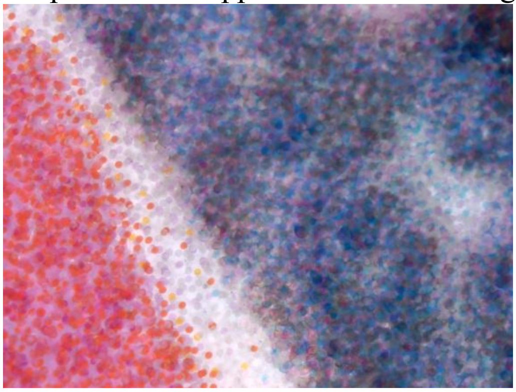


After thirty-five minutes in chamber a toluene vapor chamber.

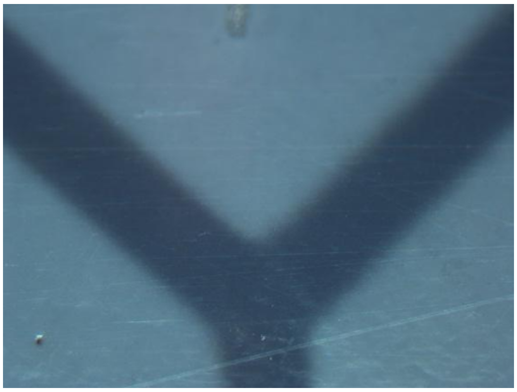
Fig. 18 Before treatment and after 35 minutes in a chamber of the appropriate solvent vapors.

Despite the success of these initial tests, the question arises as to what effect such prolonged exposure to solvent vapors may have on the image forming materials.

After treatment all of the samples were re-photographed under 30x stereo magnification. Most of the samples did not appear to have been negatively affected.



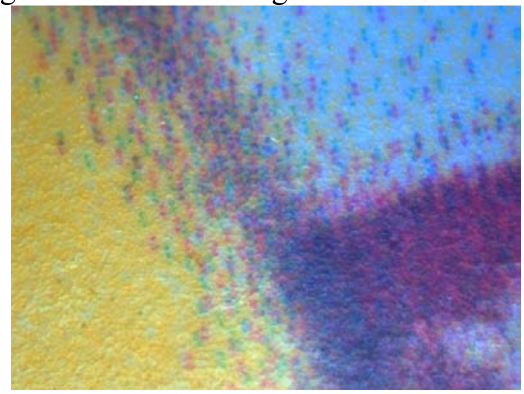
Detail: pigment inkjet print after 4 hours in a toluene vapor chamber.



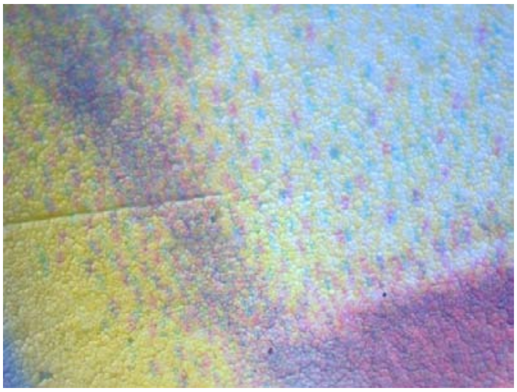
Detail: silver gelatin fiber based paper after 4 hours in a toluene vapor chamber.

Fig. 19 After treatment photo-documentation, photographed at 30x magnification.

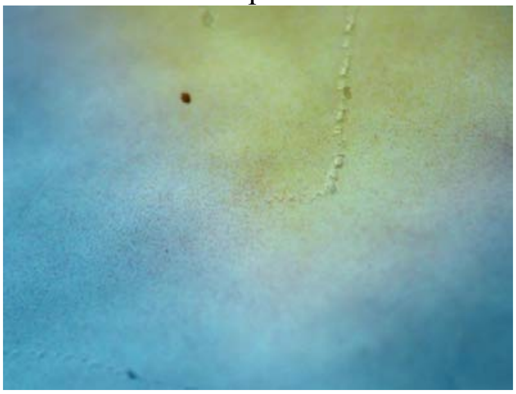
There were two exceptions: the dye-based inkjet prints (2012) and the Sakuracolor resin coated paper (1980s) were softened in appearance after four hours in a toluene vapor chamber. The dye drops appeared as though they had bled sideways, and the grain of the Sakuracolor print could no longer be seen under magnification.



Detail: dye based inkjet print before 4 hours in a toluene vapor chamber.



Detail: dye based inkjet print after 4 hours in a toluene vapor chamber.



Detail: Sakuracolor before 4 hours in a toluene vapor chamber.

Detail: Sakuracolor after 4 hours in a toluene vapor chamber.

Fig. 20 After treatment photodocumentation, photographed at 30x magnification.

CONCLUSIONS

The goal of this project was to develop a vapor chamber technique to release photographs from dry mount tissue mounting systems using less of simple, inexpensive materials. The system designed as part of this preliminary testing does appear to have potential. For objects where immersion within a bath of organic solvent is problematic, a vapor chamber may be a more appropriate treatment option, and in these days of economic hardship, a compact and portable chamber using a minimal amount of solvent (40 mL) may be advantageous.

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Investigation of Fusion 4000 as an Alternative to Lascaux for Hinging Inkjet Prints

Alice Cannon

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Abstract

Lascaux 360HV and 498HV are commonly used adhesives in photographic conservation. Both adhesives, either singly or in mixtures, have been used successfully for hinging and repairing a variety of photographic formats. The solvent and heat-activation properties of Lascaux adhesives are attractive, particularly for mounting oversized and contemporary photographic works.

However, recent tests at the Canadian Conservation Institute (CCI) found that both Lascaux adhesives failed the Photographic Activity Test (PAT). The PAT has been used as a standard in the conservation field for establishing what materials can be safely used in conjunction with traditional photographic formats.

Though a recent study by the Image Permanence Institute suggests the PAT cannot be used to accurately predict the effects of materials on inkjet photographic images, it seems wise to investigate alternatives to Lascaux. To this end, Fusion 4000 dry mounting adhesive was investigated for the purpose of mounting a large contemporary work by photographer John Gollings.

Fusion 4000 is an ethylene vinyl acetate (EVA) film used for face mounting photographs. It passed the PAT in CCI's testing and is activated by temperatures of 77-82^{o}C. Using the clip peel test method, it was determined that Fusion 4000 is weaker than Lascaux 498HV in peel strength, though in shear mode both adhesives are very strong. Peel test results for Fusion 4000 were similar for both Japanese paper and Hollytex™ hinges. Designed to be used in a heated press, the success of the adhesive bond depended greatly on consistent application of heat and pressure, much more so than Lascaux. However, Fusion 4000 appears strong enough to be used in many instances, particularly as many hinging methods utilise shear forces. The clip peel test, used primarily by textiles conservators to date, proved to be a useful aid to decision-making.

Introduction

This paper outlines research and testing performed prior to mounting a large format inkjet photograph. It had been planned to carry out a standard strip-lining technique, as described by Morrison (2007). However, recent research by the Canadian Conservation Institute (CCI) found that the adhesive of choice — Lascaux 498HV — was unsuitable for use with photographic works, as it had failed the Photographic Activity Test (Down et al 2011). Therefore, testing was carried out to identify another adhesive that could be used in a similar manner to Lascaux. This involved identifying an alternative adhesive, based on CCI's adhesive testing program, constructing mock-ups of the hinging method, and conducting peel strength tests to objectively judge the strength of the replacement adhesive when compared to Lascaux 498HV.

The Work

The work to be mounted and framed was an untitled photograph by Melbourne architectural photographer John Gollings. Gollings is known for his technique of photographing at night, using partial artificial light over an extended exposure time. The photograph shows the State Library of Victoria and was scheduled to be included in an exhibition called *The Enchanted Dome*. This exhibition opened in late 2012, as part of the State Library's celebratory programs for the 100th year of the library's domed reading room.

The photograph measured approximately 1120 x 1840 mm. It was printed on 300 gsm Epson Traditional Photo Paper (known in the US as Exhibition Fibre Paper — see Wilhelm 2010), using pigment Ultrachrome inks. Gollings' studio uses an Epson Stylus Pro 11880 printer to print his works in-house, and the work was printed on this machine in February 2012.

The Problem

Mounting large contemporary photographs is not a routine task at the State Library of Victoria, though more and more such works are being added to the collection. In the past we have used mounting techniques developed by other organisations, such as the National Gallery of Victoria. These generally have involved attaching hinges along all edges of the verso of the photograph and stretching them taut around a rigid support. This allows the photograph to be displayed in a box frame, without a window mount. A variety of hinging materials and adhesives has been used.

We were keen to do something similar for the Gollings photograph and looked at using the strip lining technique method described by Morrison (2007). Morrison's technique utilises hinges of about 20cm in width, which are applied to the entire perimeter of the reverse of a photograph. The hinges are generally made from Hollytex and are secured with a one-centimetre wide strip of Lascaux adhesive, heat-set. Once applied, the hinges are then wrapped around a rigid support like Dibond (an aluminium and polyethylene laminate) and secured with Velcro. This method allows the photograph to be retensioned if necessary. This method has been used extensively and successfully for several years.[1]

Our general approach was therefore clear. However, in 2011 a study (Down et al) by the Canadian Conservation Institute (CCI) found that both commonly used varieties of Lascaux failed the Photographic Activity Test (PAT). This begged the question — should we still use Lascaux? If not, what alternative could we use? Tests on sample pieces of the Epson photographic paper showed that starch paste could not be used for hinging — though it adhered well, it altered the surface of the front of the work, causing distortion and a change in gloss. We wondered what other adhesives might be suitable for this purpose.

Lascaux

Lascaux 360 HV and 498 HV, manufactured by Lascaux Restauro, are water-soluble acrylic dispersions. The acrylic polymer is made from methyl methacrylate (MMA) and n-butyl acrylate (BA), thickened by acrylic butylester. They are manufactured to have a pH of 8-9 and are "biocide stabilised". The manufacturer's safety data sheet (MSDS) for each product notes that they contain 1-5% ammonia solution (Lascaux 2004 a & b). The 1999 product information sheet notes that the base dispersions are also available as Plextol D-360 and D-498, without a thickening agent (Lascaux 1999).

Dried films of both adhesives can be activated by solvents or heat. The 360 HV requires a minimum sealing temperature of about 50°C; the 498 HV requires about 68-76°C.
Lascaux 360 dries to a very elastic, permanently tacky film. Lascaux 498 HV dries to a stronger film.

The 2011 CCI Photograph Activity Test (PAT) found that both types of Lascaux failed the part of the PAT that tests for oxidation and reduction of the colloidal silver. There are three components to the PAT; Lascaux failed the oxidation and reduction test but passed the mottling and staining measurements (Down 2012).

We sent samples of our own Lascaux to the National Archives of Australia (NAA), who are an accredited testing facility. We sent samples from two different batches of each adhesive — one dating from 2005/2006 and the other dating from 2012 (this being the date we received the adhesives, not necessarily the year in which they were manufactured). The NAA found that the older samples passed the PAT but the newer samples failed, again failing the image test for oxidation and reduction. They concluded that either something had off-gassed from the older samples or that there had been a formulation change. They recommended that each new batch of Lascaux be tested (Rai 2012).

The Photographic Activity Test

The Photographic Activity Test (PAT) was developed by the Image Permanence Institute to evaluate materials used for the storage and display of traditional photographic materials. The PAT incubates a sandwich consisting of two types of detectors and the material to be tested (e.g. an adhesive) in order to predict the long-term interactions between the test material and photographs. It can be used to predict the long-term effects on inkjet, electrophotography and dye sublimation prints, as well as traditional silver-based photographic processes. The PAT cannot be used to assess the effects on some other color processes, like diazo prints.

A paper published recently by staff at the Image Permanence Institute (Gordeladze et al 2011) did find that the PAT results for adhesives were not always valid for digitally printed materials, but this was because adhesives reacted with digital materials in ways that the PAT is not designed to detect — for example, bleeding of inkjet colors due to water-based adhesives, physical distortion of the support, or staining not detected by the gelatin stain portion of the PAT. They concluded that the PAT does not accurately predict all interactions between adhesives and digital prints and that there is need for further investigation of the long-term effects of adhesives on inkjet materials.

However, seeing as the Gollings photo was an inkjet print and thus the results of the PAT are thought to be applicable, we thought it prudent to investigate alternatives to Lascaux.

Fusion 4000

The 2011 CCI study included hinges made using Fusion 4000, an ethylene vinyl acetate (EVA) film used to face-mount contemporary photographs onto rigid supports. It is applied using a heat press, which heats the adhesive to about 80^{o}C and then allows it to cool while remaining under pressure. This latter step is an important part of achieving a good bond (D&K Group 2005). Fusion 4000 passed the PAT in the CCI study (Down et al 2011).

We conducted experiments to determine if Fusion 4000 would work using the hinge method described by Morrison (2007). We prepared the hinges in a similar manner, using strips of Fusion 4000 film cut one centimetre thick ironed onto Hollytex hinges. The tacking iron was set at 85^{o}C. The resulting hinges were not satisfactory and could be peeled away from the photographic paper test pieces very easily.

However, we also set up a mock hinge, attaching a hinge to a sample piece of Dibond and hanging a small weight from the hinge by using a bulldog clip and cotton tape. After several days the hinge was still solid.

These subjective judgments didn't feel like a good way to make decisions. Fortunately, Karsten (2005, 2011) developed a method of using clip peel tests to make more objective assessments of the strength of adhesive bonds. This method has been used primarily by textiles conservators, to assess the strength of adhesive bonds for lining fragile textiles. Karsten found that by making a series of weights and attaching them to samples of bonded materials, a lab method could be used that closely fitted the results obtained from more scientific equipment.

Strength Testing - Method

Karsten's method relies on the use of six different weights, made using fabric or Tyvek and metal shot. The six weights are 10 g, 25 g, 50 g, 75 g, 100 g and 150 g. These weights correspond to bond strengths ranging from very weak to very strong, when measured with an analytical machine such as an Instron Universal Testing Instrument. Test hinge samples (comprised of the substrate, adhesive and hinge material) are cut to 25 mm widths. (This also allows adhesives across various studies to be compared more easily). The sample strips are attached to a retort stand using a bulldog clip, and the "peel" of the test materials is started by hand. Then a test weight is attached to the bottom of the hinge, again using a bulldog clip (included in the overall weight measurement), starting with the smallest (10 g). The weight at which the bond fails is recorded. Karsten recommends testing the bond at multiple points, as the peel strength of a bond can vary from point to point; we tested each sample at three points within the bonded area.

Failure of a 25 mm-wide specimen to hold a 10 g weight indicates a very weak bond. The ability to hold a 150 g weight indicates a very strong bond — and, in Karsten's work, a bond too strong for most textiles conservation purposes. In photographic conservation we have not made any such formal or quantitative decisions regarding adhesive strength, beyond a certain degree of practical working knowledge — i.e. an adhesive that is too weak will not remain stuck; an adhesive that is too strong may cause curvature, distortion or make adjacent areas more susceptible to failure or tearing.

Samples were prepared using Lascaux 498, as per Morrison's method (undiluted film painted onto silicon release, dried and cut into one cm and two cm strips, applied with a tacking iron), and with Fusion 4000 (one cm and two cm strips, applied with a tacking iron and later with a lining iron). I also tested the Fusion 4000 with both Hollytex 3257 and kozo paper hinges. All hinges were applied to offcuts of the Epson paper used to print the photograph; these offcuts were supplied by Gollings' studio.

Strength Testing - Results

The Lascaux hinges passed all the clip peel tests (see Table 1). According to Karsten, Lascaux used in this manner (undiluted) would classify as a very strong adhesive.

In comparison, the Fusion 4000 hinges we made using the tacking iron sometimes failed even the 10 g test, making them very weak. The results were not consistent, however, suggesting that the quality of the bond was very variable. We decided this was due to inconsistencies and inadequacies in our production method — mainly, that not enough heat was applied for long enough. In fact, the two cm thick hinges performed worse than the one cm strips, probably because overall less time and heat was spent per unit area of adhesive in their manufacture.

So we rethought our manufacturing method. Fusion 4000 is usually used in a heat press, with even and prolonged heat exposure and pressure. A cool-down period is also advised. Using a tacking iron inevitably results in inconsistent temperature and pressure application. Instead we tried a heavy lining iron made for paintings conservation, thereby providing the necessary pressure. We set it to 85^{o}C, though it was more often at about 90^{o}C. After a heating period of 30 seconds we allowed the hinge to cool down under a glass weight, again for at least 30 seconds.

The Fusion hinges made using this second method passed all tests up to the 100 g weight, failing the 150 g test. This makes it a moderately strong adhesive. The samples made using two cm strips of Fusion 4000 passed the 150 g test as well. This demonstrated very effectively that the hinges we made in this way were much more consistent in quality than those we made using the tacking iron. It was probably also faster, and easier on our hands. So, the clip peel tests also assisted us to develop a better, more reliable way of making the hinges, one that more closely resembled the way Fusion 4000 is used in a heat press.

Fusion 4000 was tested with hinges made from Hollytex and a kozo Japanese paper, mostly just to see if there was a difference in bond strength; both hinge materials returned the same results. The paper hinges were nicer to work with, as it was easier to handle and the Hollytex had a tendency to wrinkle under the heat. But the paper hinges weren't as robust or abrasion-resistant when it came to retensioning the hinges with Velcro, over the relatively sharp edge of a piece of Dibond.

Table 1: Results of peel tests, where P = pass and F = fail

Adhesive	Hinge	Application method	Temp. (°C)	Length of heat application (seconds)	10g	25g	50g	75g	100g	150g
Lascaux, 1cm	Hollytex	Tacking iron	80	10	P	P	P	P	P	P
Lascaux, 2cm	Hollytex	Tacking iron	80	10	P	P	P	P	P	P
Fusion 4000, 1cm	Hollytex	Tacking iron	90	10	P	P	F	P	F	F
Fusion 4000, 2cm	Hollytex	Tacking iron	90	10	F	F	F	F	F	F
Fusion 4000, 1cm	Kozo	Tacking iron	90	10	P	P	F	P	F	F
Fusion 4000, 2cm	Hollytex	Lining iron	85-90	30 (+ cool down)	P	P	P	P	P	P
Fusion 4000, 2cm	Kozo	Lining iron	85-90	30 (+ cool down)	P	P	P	P	P	P
Fusion 4000, 1cm	Hollytex	Lining iron	85-90	30 (+ cool down)	P	P	P	P	P	F
Fusion 4000 , 1cm	Kozo	Lining iron	85-90	30 (+ cool down)	P	P	P	P	P	F

Mounting the Photograph

Though Lascaux was undeniably stronger than the Fusion 4000 and less susceptible to variations in application, we decided to try the Fusion 4000, as the test results suggested it was strong enough. We made the hinges according to the method described previously (using the lining iron) and applied them to the reverse of the photograph using the same application and cooling methods. (Testing had been conducted to make sure the photographic paper wouldn't be affected by the heat and weight of the lining iron). I decided not to use the two cm wide Fusion strips as I thought perhaps I could see a little distortion of the paper on a larger mock-up, around the adhered section, when compared to the one cm strip. Once the hinges were applied, a piece of Dibond was laid over the verso of the photograph and the hinges stretched around and attached to the Dibond using low-profile Velcro. The photograph was then placed into a box frame for display.

Conclusions

At the time of writing this paper, the photograph has been on display for about ten months. The hinges appear sound and there is no evidence of slippage or failure. This single case study isn't conclusive evidence that Fusion 4000 is acceptable to use in this manner for long periods, of course, but it shows strong promise as a mounting adhesive. The clip peel test method developed by Karsten was very useful in helping us to make a decision about what mounting adhesive to use, and could prove very useful to photographic conservators in general — especially as it doesn't require any expensive analytical equipment. It is likely that photograph conservators could benefit from examining the work done by textiles conservators in this area more closely. Karsten and her colleagues (2005, 2011) have examined many factors influencing bond strength — adhesive concentration, activation method (heat or solvent), the type of substrate and so on — and this may help photographic conservators to formulate more appropriate mounting and lining methods. It may also be beneficial for us to consider what the ideal strength of an adhesive for various purposes actually is and to consider how we can better make use of the differences between shear and peel modes. There is certainly much more research that can be done.

Endnotes

1. It should be noted that Morrison reviewed and reassessed this method at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand. Mounted photographs were often not flat enough for the artist's liking and required laborious retensioning. The National Gallery of Victoria is leaning more and more towards fully mounting photographs to their supports, rather than using a strip lining technique.

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Sources of materials

- *Dibond*: White/Metallic sheet 2500 x 1000 x 2 mm, cut to size and supplied by Alucobond Architectural (alucobond.com.au).
- *Fusion 4000 Dry Mounting Adhesive*: manufactured by Expression Framing Products, a division of D & K Group, Inc. (dkgroup.com, forframersonly.com), supplied by Talas (talasonline.com) via Archival Survival (archivalsurvival.com.au).
- *Hollytex*: #3257 (thickness 0.00029”), manufactured by Ahlstrom Filtration LLC®, supplied by Talas (talasonline.com) via Archival Survival (archivalsurvival.com.au).
- *Japanese paper*: Yachio, thick, No. 1266 (kozo, machine-made) from Masumi Corporation (masumi-j.com/english/profile.html, info@masumi-j.com)
- *Lascaux 498HV*: manufactured by Alois K. Diethelm AG, Lascaux Farbenfabrik (lascaux.ch), supplied by Talas (talasonline.com) via Archival Survival (archivalsurvival.com.au).
- *Lining iron*: Model C”01 RH Conservation Engineering (http://www.rhconservationeng.com)
- *Velcro*: 3M Dual Lock Low Profile (SJ4570), supplied by Adept Industrial Solutions (adept-industrial.com.au).

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Same Albums, Different Treatment Approaches: The Conservation of Two Photographic Albums from the First Modern Olympic Games in Athens, 1896

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Presented as a poster at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

The conservation treatment of photographic albums dating to the nineteenth century has been examined in the past in various workshops, publications and conservation articles. The focus of this paper is two unique photographic albums with rare pictures from the first modern Olympic Games in Athens in 1896, compiled by the photographer Ioannis Lampakis. Lampakis is now recognized for his pioneering depiction of movement and action, despite the technical limitations of his era, and these two albums are acknowledged for their aesthetic and stylistic value. This paper provides a useful case study, which will discuss the rationale for two different treatment approaches to two almost identical photographic albums, made at the same time, in the same way, with the same pictures, kept in the same place, and experiencing a similar flood history. Prior to treatment, the following significant factors are considered: the value, rarity, quality and condition of the albums and prints, the owner's will, and the expected future use. Two different conservation strategies were devised for these albums, which ensured improved preservation and access for both.

Introduction and Evaluation of the Albums

The professional photographer Ioannis Lampakis (1848–1916) was born in Athens and documented in his pictures significant events in Greece during the later nineteenth century (Xanthakis 2006). Among these works were memorable photos from the first modern Olympiad in 1896, which was a successful revival of the ancient Olympic Games. Lampakis' themes included the sports, the ceremonies and the side social events during the games. What differentiates him from his contemporaries is that his pictures are not posed but are taken while the athletes are in motion. His images were taken from the viewer's position in the stadium, establishing an unorthodox perspective, which typically comprised three aspects in his frames: 'athlete–sport–viewer' (Delatolas 2006). It is generally accepted that his work signals the birth of photo reportage in Greece (see Figure 1).

Fig. 1. The final of the 100 metres race, where the American athlete Tom Burke came first. © Lampakis Family Archive

In 2010, the photographer's grandson and solitary inheritor of the Lampakis family archives entrusted for conservation a green cloth-bound album with thirty-five pictures taken during the

Olympic Games of 1896. In 2011, the family entrusted a second album similar to the first but bound in a red cloth cover. It contained the same pictures, plus an additional photograph of the first marathon winner, Spyridon Louis. It was proposed to display a selection of the images in a photographic exhibition at the summer Olympic Games in 2012 in London. This paper intends to discuss the individual aspects of two entirely different conservation treatments undertaken on these two similar artifacts.

The albums contain images taken exclusively by Ioannis Lampakis on the occasion of the first International Olympic Games of the Modern Era. During his photographic career, Lampakis collaborated with his two brothers – Georgios, a distinguished archaeologist who was a dedicated photographer that documented Byzantine monuments throughout Greece, and Emmanouil, an accomplished painter – both of whom probably helped him with the production of the albums.[1] On the front page was placed an index with the prints' titles and informative details, indicating that individual photographs were available for sale at book and stationery stores in Athens. Inside the albums there was also kept a series of unbound, low-quality pages with extra copies of some photographs that probably remained unsold. Unfortunately, these Olympic images don't appear to have been a commercial success at the time, possibly due to their unconventional perspective. However, today they are highly regarded for their innovative depictions of athletes in motion.

Description and Condition of the Albums

Prior to describing the albums, it must be mentioned that in 1984 they suffered water damage in a small flood. A plumbing problem in the storehouse where the photographic collection was held in boxes on the floor resulted in water to a depth of 10 cm. Mould growth was reduced by air drying the photographic material, and controlling the environment with the use of thymol crystals and ventilators.[2]

The Lampakis albums have the characteristics of a scrapbook, featuring acidic pages and extravagantly decorated covers (Horton 2000). They have case bindings whereby the covers were made separately and then bound to the textblock by adhesion of the endpapers, although the spine of the cover was not adhered to the textblock (Primanis 2000). The albums were covered with green and red book cloth respectively, and decorated with gold embossed designs and a piece of printed leather on the front cover. All covers are worn from frequent use and are bowed and warped due to absorption of water, possibly during the flood. A higher degree of water damage is evident on the red album whose book cloth is severely stained, mould affected, discolored and delaminated (see Figure 2).

Fig. 2. Exterior views of the albums before conservation treatment. © Adia Adamopoulou

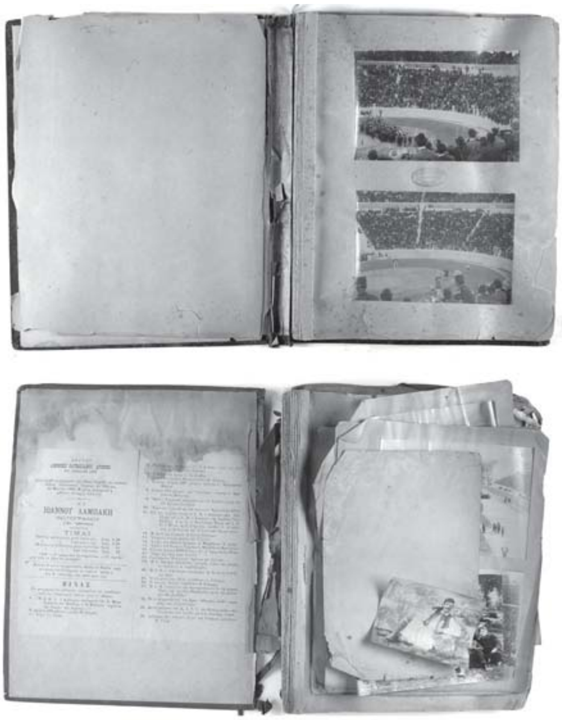

Fig. 3. Interior view of the green album (above) in comparison to the red album (below), where the unbound pages were kept. © Adia Adamopoulou

The spine of the cover has a relief paper lining that has detached from both albums; in the red album, it is almost destroyed. This failure is due to the poor quality of the materials used for the construction of the binding, such as the glue and the paper lining. Moisture has caused expansion and damage throughout the spine of the textblock.

The machine-made endpapers are discolored and adhered overall to the covers. The title page is glued onto the front pastedown.

Despite the impressive exterior of these commercial albums, the interiors were constructed of average quality materials, as was common (Lavedrine 2007). The pages of the albums were initially flexible and were utilized to form the stub structure. As the paper has aged, it has become brittle and weak, developing many tears. Typical cockling and undulation were present on each page, caused by the adhesive as it dried unrestrained under each photograph. There was foxing on many of the album pages, in some cases very severe (see Figure 3).

The structure of these albums consists of paper stubs created by folding the album pages at the gutter edge. Each of the stubs is interlocking, as shown in Figure 4. The purpose of each stub is to create an allowance within the book structure to accommodate the photographic images. In the centre of the spine, between the ninth and tenth pages, there is an auxiliary stub, which is folded three times. The structure of the red album was weak but intact, whereas the structure of the green album had been compromised and was broken into four sections.

The prints are mounted two to a page, only on the recto side; one single image is mounted on the verso. All are albumen prints in landscape format

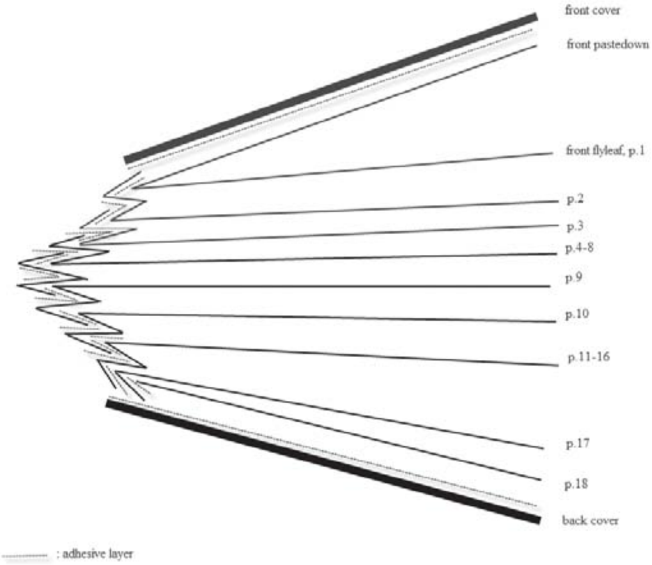

Fig. 4. The page construction and connection.
© Adia Adamopoulou

(13 x 18 cm). The main degradation problem of the prints was fading and yellowing, accelerated by the high lignin content of the album pages and the acidic nature of the adhesive used for mounting. Undulation of the pages has trapped dust particles and increased oxidation of the external borders of the prints (Ploye 2001). Adhesive degradation has created tension across the surface of the prints and increased emulsion cracking, minor tears and delamination.

The extent of mould varies between the two albums, with the green album being the least affected. Examination under visible light indicated microorganisms to a limited extent on some photographs, and ultraviolet (UV) illumination clearly shows areas of bright blue-white fluorescence. A survey of images within the album shows minor damage in the form of image loss, planar distortion, mirroring and insect deposits. Photographs have been affected by foxing to a lesser extent than the album pages.

After surveying the contents of both albums, it was possible to compare the quality of each set of images. It was concluded that the overall contrast in the prints of the green album was superior, with almost 30% of images tinted pink with aniline dye. This was a common procedure in albumen printing, commercialized after 1863, and consisted of adding aniline or other organic dyes into the emulsion layer. The color pink was chosen to counterbalance the yellowing of these prints. However, aniline dye is lightfast, so the pink-tinted albumen prints tend to discolor and become buff toned with age (Cartier-Bresson 2008).

Treatment Considerations

The impetus for conservation treatment of the albums was a display in London to coincide with the 2012 Summer Olympiad. The albums are unique tokens of Lampakis' work, who states in his index page: 'This is the only complete and probably successful collection of photographs from the International Games of 1896'. The owner had also asked to improve access to his collection.

In practice, it was not feasible to restore both albums to their original status. In order to make an accurate assessment of the full extent of the damage, to differentiate between the two albums and to consider treatment options, a damage scale comparison was prepared (Figure 5). It can be seen that the green album had covers in better condition but a detached textblock while the red album had badly worn covers with the textblock intact. The red album had sustained greater saturation in the flood as the pages were extremely cockled and would require intensive treatment to become functional again. Viewing of the images in both albums was impeded due to binding damage.

In many instances, the best conservation plan is to organize good storage conditions to minimize physical stress to the objects during handling, and to produce digital copies.

Rationale for Treatment of the Green Album

The green album is frequently consulted and had already been duplicated for the 2004 Olympic Games in Athens, but the resolution was poor by today's standards.[3] Therefore, an important factor in the preservation of this album was the achievement of high-quality images, which would increase the versatility and access to reproductions while reducing the necessity to handle the original material. With moderate use expected in the future, the conservation treatment was aimed at preventing further deterioration by reinforcing those areas of weakness within the binding structure. The flexing of the pages during turning caused tears, which needed to be strengthened and protected from further deterioration.

In examining the treatment options and after some unsuccessful trials to flatten in situ those album pages that were still intact, it was decided that the most satisfactory solution was to deconstruct the album's binding structure. Pages were detached from the binding, enabling each image to be scanned separately without any strain on the spine, and then strengthened before reassembly. This ensured a good-quality digital copy and eliminated any distortion caused by the album's restricted opening angle.

Damage Type	Degree of Damage to the Green Album	Degree of Damage to the Red Album
1. Cover mechanical stability	2	4
2. Cover chemical deterioration	4	**5**
3. Delaminating cover	4	**5**
4. Boards detached	3	4
5. Spine damage	4	**5**
6. Endpaper stability	1	1
7. Album page connection stability	3	1
8. Adhesive failure	2	2
9. Album page brittleness	4	4
10. Page creases	2	1
11. Page cockling	4	2
12. Losses of paper	3	3
13. Tears	3	4
14. Surface dirt	3	3
15. Foxing	3	3
16. Page discoloration	4	4
17. Microorganisms / mould growth	3	4
18. Insect deposits	2	1
19. Cracked emulsion on photographs	2	2
20. Mirroring	2	2
21. Fingerprints on photographs	1	1
22. Emulsion losses	2	3
23. Image discoloration	3	4
24. Image yellowing	3	3
25. Chemical residues	2	2

Fig. 5. Damage scale comparison between the two albums. © Adia Adamopoulou
(1: no damage, 2: little damage, 3: fair damage, 4: very damaged, 5: severe damage)

Rationale for Treatment of the Red Album

The rationale for treating the red album was influenced by a number of factors. The overall condition of this album was significantly degraded due to its extensive water damage (see Figure 6). Although the images in the red album do not display the same degree of contrast observed in those from the green album, it was considered necessary to salvage them from their detrimental environment within the album where the chemical state of the photographs was at risk. Since the binding structure for both albums was identical and a record of the overall layout would be retained by the green album, the priority was to prevent further damage to these images. To this end all thirty-six photographs were removed, cleaned and stored in an isolated environment.

Fig. 6. The damaged textblock of the red album.
© Adia Adamopoulou

Treatment of the Green Album

A number of tests were undertaken. A spot test on the stability of the stamp ink revealed that it was partially soluble in water but stable in ethanol. A phloroglucinol test of the album pages indicated high lignin content. Tests on the binding adhesive indicated it was protein based.[4] And as suspected, the pH of the pages in both albums before conservation treatment was acidic with a reading of pH 6. This reading meant there were implications in terms of managing exposure to light while on display and ensuring stable environmental conditions for future storage.

Conservation treatment of the green album began with dry cleaning of the album pages and the photographs. A Mars Plastic Staedtler eraser was used for the album pages and the inks were avoided on the front pastedown. A Pentel eraser pen (using ZER 2 refills) was used on the photographic prints, avoiding the cracked edges. Controlled suction from a mini vacuum cleaner was used to collect both eraser debris and mould spores. The fungi-affected areas appeared to have inactive mould but, as a precautionary measure, a denaturing solution of 70% ethyl alcohol was used on the affected areas (Florian 2002).

The approach adopted for disbinding the textblock was to mechanically remove the adhesive as attempts to swell the adhesive with humidity had resulted in preferential softening of the paper ahead of the adhesive. Once the stubs were cleaned of adhesive residue they were reinforced with Japanese tissue, Tengujo (weight 9 gsm), and a 1:1 mixture of corn-starch adhesive and methylcellulose.

The numerous tears were repaired with Japanese tissue, Tengujo (weight 9 gsm), and a 1:1 mixture of corn-starch paste and methylcellulose. All the losses were repaired with paper fill from an archival paper, Heritage Woodfree (weight 160 gsm). These paper fills were given a sizing layer of 8% Klucel-G and toned with gouache colors using an airbrush. Humidification was undertaken on both sides using Capillary Matting® and Gore- Tex® for ninety minutes, and then flattening was undertaken in the press between wool felts and dry blotters, which were changed regularly until dry.

Fig. 7. The rebinding of the green album. © Adia Adamopoulou

Reassembly of the repaired pages replicated the original structure, using a combination of wheat-starch paste and methylcellulose in a ratio of 2:1. A Japanese tissue, Kozo (weight 17 gsm) was used to attach the textblock to the endleaves, and the body of the album to the flyleaves.

Rebinding of the album covers to the textblock was undertaken by Ms Frosso Ganniaris, a bookbinding specialist in Greece. The spine of the textblock was reinforced with mull, heavyweight paper and headbands, and then the spine was joined to the two covers. Losses along the edges of the covers were filled with a matching textile (see Figure 7).

During treatment it was possible to resolve the location of a loose second page of the index by examining the edge of the index page, which revealed that it matched the front endpaper. This page had been previously placed within the album alongside the last endpaper, and had been replicated in this location for the
2004 surrogate edition.

Treatment of the Red Album

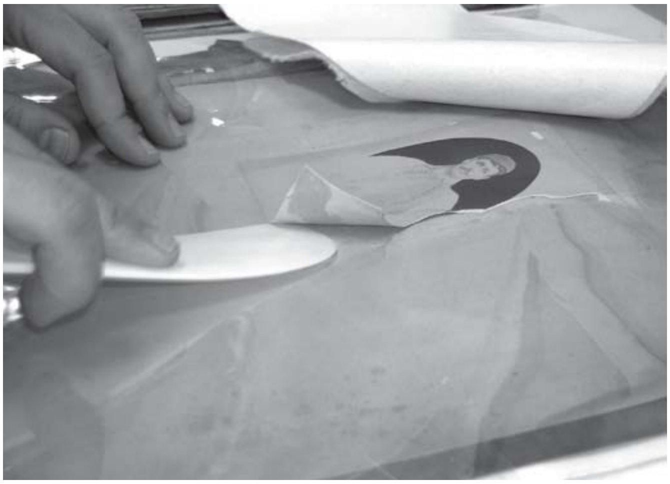

Fig. 8. Delaminating the photograph of the marathon winner, Spyridon Louis, from the red album. © Adia Adamopoulou

The photographs were dry cleaned using the same method as described for the green album. Considerable research was undertaken to determine an appropriate method to detach the photographs. The immersion option was excluded in order to avoid the formation of cracks in the emulsion layer (Messier 1991). Various humidifying materials were tested in order to find a controlled procedure, and humidification was achieved using a damp pack of Capillary Matting and Gore-Tex. The verso of each album page was isolated overall from the rest of the album with a sheet of polyester and on the recto the borders of the album page were isolated with strips of polyester sheet. Each page was sandwiched between two sheets of Hollytex®, two sheets of Gore-Tex and two pieces of wetted Capillary Matting were placed over the photograph. A piece of glass was placed on top. The length of humidification varied from one and a half to three hours, dependent upon the individual photograph. The photographs were then delaminated from their support with a Teflon spatula (see Figure 8). The ease of removal was dependent upon the application of adhesive and how easily the album paper separated, but a thin layer of paper was left on the verso of each image. This remaining paper layer was removed using a methylcellulose poultice with a solution of 1:1 ethanol:distilled water. This resulted in minor cockling but after a gentle humidification using a Gore-Tex membrane the photograph was relaxed. Each photograph was dried in a press for a week, sandwiched between blotters and wool felts, with silicone paper on the emulsion side to preserve the glossy finish. Blotters were changed regularly.

The humidification of the album pages increased their flexibility marginally. Due to time constraints it was not possible to provide a lining of Japanese tissue for each of the photographs; instead they were placed in polyester sleeves with an interleaving photosafe paper.

Digital Scanning

Images on the flattened pages were digitally scanned using a resolution of 300dpi and the digital images were enhanced by a chromolithographer, which, although using a restricted color palette, has the advantage of accurately calibrating colors for reproduction.[5] A new edition from the 2011 digitization project is expected shortly.

Recommended Conditions and Handling

It is recommended that photographic albums be stored at 30–40% RH (+/-5%) and a maximum temperature of 18ºC (+/-1ºC) (Lavedrine 2000). Conditions above 70% RH pose the risk of biological contamination, and a dry atmosphere may lead to loss of flexibility and delamination between the paper support and the image layer. For display, to minimize photochemical degradation of albumen prints, daylight and fluorescent illumination should be avoided; the preferred illumination level is 50 lux and prints should be illuminated with tungsten lamps (Reilly, Severson and McCabe 1982).

The green album is stored horizontally to reduce any strain on the binding. Renaissance Tissue (45gsm) is placed between the pages to protect the photographs; the exterior cover is protected with a wrapping of soft Tyvek (39g/m^2) and placed into an archival clam-shell box fabricated from photosafe materials. Both the archival wrapping and box serve to create a microenvironment, minimizing the effects of humidity, and excluding dust.

The detached photographs from the red album have been retained in A4 polyester pockets, which fit into a ring-binder box. This ensures the images are stable, protected and readily accessible for consultation.

To ensure the long-term preservation of the green album it is necessary to minimize handling. The viewing of the album will be specifically for research purposes. Handling should be careful and a book support has been constructed out of archival corrugated board to reduce the strain on the binding and limit the opening angle to 90 degrees (see Figure 9).

The red album will be retained for future study as an example of a commercial binding style.

Fig. 9. The green album after conservation treatment onto the custom made book support. ©Adia Adamopoulou

Conclusions

Reconciling both the physical nature and the long-term preservation of photographic albums is often difficult. Using technology offers a way to provide access and thereby reduce the demand on the fragile original material.

In this case study the conservation treatment of the green album has retained the integrity of the original format for display, while the digitization of each photograph has provided wider access. The conservation treatment of the photographs in the red album has prevented further deterioration of these individual images.

In the 1984 water incident, the immediate response of the archive-keeper saved the albums from complete damage, and the recovery by a conservator proved to be an effective method. Primarily dehumidification and good air circulation halted the mould growth, probably assisted by the antimicrobial properties of the thymol, although it is no longer recommended for use with photographic materials.[6]

The intention of this paper was to provide the rationale that guided the treatment approach to each album. This conservation project has enabled both an accurate digital record of a historically significant suite of photographs and preserved the original material for display and long-term storage.

Notes

1. All three Lampakis brothers were distinguished personalities of nineteenth century Athenian society: Georgios, an archaeologist and also a dedicated photographer that documented Byzantine monuments throughout Greece, contributed greatly in the foundation of the Christian and Byzantine Museum of Athens and became its first director; Emmanouil, an accomplished painter who studied at the Munich Academy of Fine Art, and finally Ioannis, the photographer, who collaborated with famous Greek photographic firms of the time and in his late years became a priest.

2. Mould can grow within 48 hours in 60% relative humidity and 21°C and can cause permanent staining on photographs; therefore, it is crucial to dry out the material immediately. Air movement prevents the retention of high moisture content, which favors mould growth (Olcott Price 1994).

   Consultation with the paper conservator who dealt with the flood damaged material in 1984 advised that the photographic material was found lying on the floor in boxes, partially submerged in the water and emitting a strong odor. Action was taken a few hours after the incident with water being pumped out the same day. Ventilation was used and thymol crystals were used the following day as was common practice at this time.

3. In the following resource access is offered to the digital surrogate: http://www.aol.org.gr/sylloges/fotografiko-arxeio/ olympiakoi-agwnes/leukwma-olympiakwn-agwnwn.pdf

4. Two tests were conducted. Firstly the Iodine Potassium Iodide test showed no color formation, so starch was excluded. Secondly, the Biuret Test resulted positive for protein. (Mayer 1990 pp. 26, 31)

5. A chromolithographer uses the CMYK (cyan, magenta, yellow, black) color palette and possesses fewer hues than a photographer who works with RGB (red, green, blue) colors.

6. Thymol doesn't meet the criteria of effectiveness and residual protection of photographs; it may also leave undesirable effects on the artifacts. The Centre de Reserche sur la Conservation des Collections (CRCC) in France proposes the use of oxyfume 2002 (10% ethylene oxide, 27% chlorodifluoromethane - HCFC-22, 63% chlorotetrafluoroethane- HCFC-1 24). Ethylene oxide is safe for photographic material, but it must be used by specialized personnel in an appropriate facility. (Lavedrine 2007, Olcott Price 1994)

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Saving Film History through Photography

Claudia Sofía Arévalo Gallardo

Presented as a poster at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

ABSTRACT

In Mexico, the preservation of the ephemeral paper materials related to motion picture film productions (posters, stills, etc) is not considered to be as important as the preservation and conservation of the actual films, even within institutions devoted to the preservation of Mexican cinema. Specialists in the history of film also give greater significance to films themselves, relying on them as the sole primary sources, despite the fact that other closely related ephemeral materials can provide equally important information. On many occasions, such information cannot be found elsewhere. The intent in conserving such materials and making them available to the public is to change the way scholars view these ephemeral objects.

Two unique lobby cards of the 1917 film *En defensa propia* (*In Self Defense*) were found in the collection of the Cineteca Nacional de México (National Film Archives of Mexico). *En defensa propia* was made by Azteca Film, the first Mexican film production company: there are currently no extant copies. As these lobby cards are the only known records of this film, they are of great importance to the cinematic history of Mexico. These materials also demonstrate the relationship between still photography and motion pictures. In this case, the still photographs are a key element to better understanding the motion picture film. Preserving such paper-based objects not only increase knowledge of the history of Mexican motion picture films, but also of the history of motion picture advertizing in Mexico.

The conservation treatment of these lobby cards is intended to ensure their preservation for future generations and to inform scholars and the public of their value as documentary objects of film history.

1. INTRODUCTION

Popular live entertainment in Mexico at the end of the 19th century was mainly theatrical or musical performances. However, new technologies were often adapted for entertainment purposes, especially for the amusement of the citizens of Mexico City.

Audiences were used to the familiar forms of entertainment, which was highly dependent on the interaction between the actor and the live audience. As motion pictures were a new and unfamiliar entertainment form, film producers needed to catch the attention of a potential audience. New methods of advertising were developed, one of which led to the lobby card.

LOBBY CARDS

Lobby cards were graphic advertisements designed and sent to cinemas by film studio publicity departments. They were intended for display in the lobbies of theaters, on easels or tacked to the lobby walls, to entice the movie-going public. They were done in sets of eight to twenty, with design elements and text that reflected the content of the newly released movie. They are printed images (often photographic) mounted onto an 11 x 14" paperboard secondary support.

The design would be one larger attached 11 x 14" image or a smaller 8 x 10" photograph, which allows the inclusion of the film's logo, credits, and/or additional artwork. One film may have both 11 x 14" and 8 x 10" lobby card sets: the photographs on the different-sized sets may have identical or entirely different images.

THE HISTORY OF LOBBY CARDS

The earliest known lobby cards date to 1908 and were part of the advertising material provided by the early film companies to theatre owners: widespread use of lobby cards began in the 1910s. These cards, with sepia or duo-tinted 8x10" images, were placed onto easels beside the box office window or inside the theater lobby. Brown and white rotogravure reproductions of stills, the images displayed were selected to give a sense of the movie's story line and to supply the credits. Prior to 1916, the images displayed on lobby cards were frequently taken directly from the motion picture film and enlarged. Alternatively, dedicated photographer may have been hired specifically to produce still shots for advertising purposes.

The style and format of lobby cards is relatively consistent over time. There appears to have been a notable shift in style to a more high-contrast image in 1919, however so few lobby cards exist that it is extremely difficult to study any stylistic changes. As the use of lobby cards declined, they were collected by only a handful of film enthusiasts. Now these ephemeral items, whose initial value had been less than the cost of printing, have reached exorbitant prices at auction. In addition to titles, directors, and notable talents, any printed text would caption an image or made appeals to a potential audience based on plot, tone, or visual artistry. As filmmaking and advertising became more sophisticated, so did the content presented by lobby cards.

A BRIEF HISTORY OF MEXICAN CINEMA

The early and rapid popularity of cinema in Mexico is reflected by the printed culture of the time, with advertisements placed in newspapers, flyers, posters, and gazettes: by 1906 there were 19 movie salons in Mexico City. Not every movie theater advertised in the same way: some relied on flyers and programs, while others displayed large posters on street corners. In Mexico City, the relatively small lobby cards displayed at theater entrances evolved into such a quantity of large-scale posters and other advertisements that in 1913 new regulations appeared which limited film advertisements to authorized locations only.

In 1916, the Mexican Revolution and accompanying bouts of censorship led to the decreased production of motion pictures. The ongoing political instability was more favorable to imported full-length features: by 1917 the majority of motion pictures were imported into Mexico. These European films, especially *films d'art* from France and Italy, would as the artistic point of reference for the eventual rebirth of the Mexican film industry, which began in 1917 with the end of the Mexican Revolution.

The first broadly acknowledged full-length Mexican film is *La luz, tríptico de la vida moderna* (1917). An earlier full-length film *1810* or *¡Los libertadores de México!* (1916) by the Yucatecans Carlos Martínez de Arredondo and Manuel Cirerol Sansores is know. However, as it was filmed in the move provincial Yucatán, it has been overshadowed by *La luz, tríptico de la vida moderna*, which was made in Mexico City. Other notable films of this first golden age of film are *En defensa propia* (1917), *La tigresa* (1917) and *La soñadora* (1917). These films were all produced by Compañía Azteca Films, a firm founded by Enrique Rosas and actress Mimí Derba. A number of these films are no longer extant, and collections contain little to no materials related to them.

LOBBY CARDS AT THE CINETECA NACIONAL

The archive at Cineteca Nacional holds more than 365,000 items related to the history of Mexican cinema, dating from early 20th century to the present day. These materials include color and black-and-white photographs, photographic albums, transparencies, costumes, projectors, cameras, magic lanterns, drawings, awards, documents, posters, and lobby cards. Despite these extensive holdings, there are few objects in the collection from the golden age of silent Mexican film: some reproductions of newspaper articles and a few lobby cards, four of which are pictured below (Figs 1-4).

Figs. 1, 2. Lobby cards for *Alma de sacrificio,* 1917, directed by Joaquín Coss and Enrique Rosas. Cineteca Nacional México©.

Figs. 3, 4. Lobby cards for *La soñadora*, 1917, directed by Eduardo Arozamena and Enrique Rosas. Cineteca Nacional México©.

Looking at figures 1-4, the typical style of a lobby card can be easily determined. This uniform method of presentation is perhaps due to the specific design request of the film production company. In 1919 there is a notable change in the style of lobby cards: the photographs used increase in contrast, likely to better catch the eye of the movie-going public. However, as there are so few extant lobby cards, it is difficult to accurately determine any stylistic changes over time.

After the 2012 publication of the ten most wanted lost films by the film library at the Universidad Nacional Autónoma de México (UNAM), staff at the Cineteca Nacional began to search the archive holdings for materials related to the titles specified. In that way, two rare lobby cards of the film *En defensa propia* were rediscovered in the archives. Since their existence was previously unknown, the objects were slated for display in the opening exhibition of the new film museum at the Cineteca Nacional.

THE IMPORTANCE OF THESE LOBBY CARDS

At the middle of the last century global perceptions of cinema changed from viewing motion pictures as a form of popular entertainment to considering them as being worthy of preservation. In Mexico there are two major institutions dedicated to the preservation of the country's cinematic history: the Cineteca Nacional and the Filmoteca UNAM. These preservation and conservation endeavors focus heavily on the actual films themselves.

Over the last few decades there has been a gradual shift in the way that scholars and collecting institutions of all types have approached archival objects. The artifactual value of such pieces is now considered to be of equal importance to their informational value. Despite this, paper-based ephemera related to cinematography (such as posters, photographic stills, etc.) are not given the same importance as the motion picture films themselves. Scholars also place great value on the films themselves, using them as important study sources, but ignoring the ephemeral materials that may provide equally important information, some of which may not be found elsewhere.

For instance, the two lobby cards of *En defensa propia* are objects of high historical importance to the history of Mexican cinema because they are the only existing visual record of the film. As such, they are a direct source of information. The images themselves provide information in regards to topics such as wardrobes, sets, and locations and the information on the lobby cards' secondary supports supplies the production company, scriptwriter, and director. By preserving these objects not only is awareness and knowledge of *En defensa propia* increased, but also that of silent film advertising methods in Mexico.

2. CONSERVATION

Though all of the rediscovered lobby cards were originally desired for an exhibition at the Cineteca Nacional, only one lobby card was ultimately selected. *En defensa propia* (*In Self Defense*) was directed in 1917 by Joaquín Coss. The film was produced by Enrique Rosas and Mimí Derba, of Azteca Films / Rosas-Derba y Cia. Derba also wrote the script.

Fig. 5. Recto, before treatment. Fig. 6. Verso, before treatment.
Cineteca Nacional México©.

The lobby card is a silver gelatin developed-out photograph (fiber based paper) adhered overall for a secondary support of light green cardboard. There are also several areas of historic retouching that no longer matches the photograph.

Fig.7. Details, historic retouching.

CONDITION

The lobby card exhibits deterioration of both the photograph and the cardboard secondary support.

The secondary support was soiled overall, and had yellow/brown tidelines related to past water exposure. There was significant edge wear, loss, and delamination at the corners and outer edge of the paperboard, as well as a number of thumbtack punctures in the corners where the lobby cards were displayed within a movie theater (Fig. 8). There were also a number of accretions scattered across the recto and verso of the secondary support. Paper adhesive tape was also found on the verso of the object.

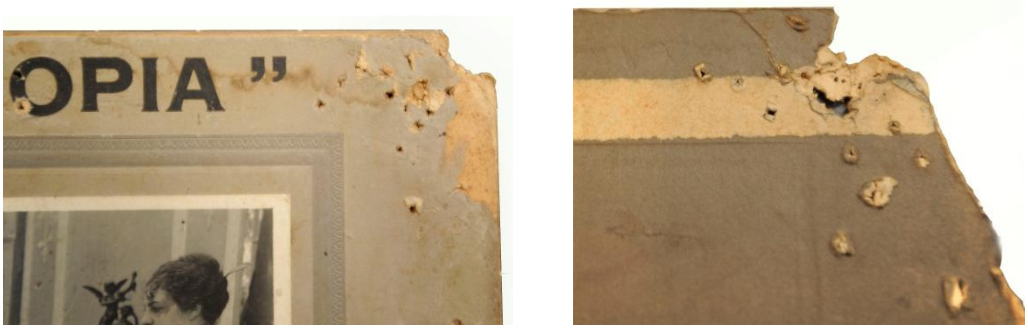

Fig. 8. Detail images of damages at the corners of the secondary support, recto *(left)* and verso *(right)*.

The photograph has a number of scratches on the recto, some of which extent through the emulsion/baryta and into the paper primary support, and several small losses. There are also a number of minor accretions and small dark water stains (Fig. 9).

Fig. 9. Detail images: scratches *(left)*, minor stains *(center)*, and small losses to the surface of the photograph *(right)*.

JUSTIFICATION FOR TREATMENT

With ephemeral objects such as lobby cards, it is important to consider their dual nature as both documentary objects and as an art objects. It is tempting to give priority to either the informational or artifactual value of such objects: however, they should be treated as a whole unit with a complex function and history.

As stated by Brandi (1988) in his theory of conservation, this "must address to the recovery of the potential unit of the work of art, provided that this is possible without committing a historical art forgery, and without erasing any traces of the passing of the work of art through time," [compiler's note: translated from Spanish by the author].

It is important to understand the aging processes of the components of a work of art in order to identify the natural transformations that materials undergo. This is why it is fundamental to understand the "characteristics of the work in order to achieve a full projection of it in the future, apart from the implicit deduction of how it must be conserved and of the transmission of the conservation process as a historic testimony" (Brandi 1988) [compiler's note: translated from Spanish by the author].

When considering the condition of the lobby card, noting moderate deterioration, it was possible to conclude that the state of conservation of the lobby cards was good. The primary issues were aesthetic, as the scratches, accretions, and loss to the image layer prevent a viewer from focusing on the content. However, as an ephemeral object with a dual nature (information/aesthetic), it was decided that addressing the aesthetic issues was not the most important aspect of the proposed conservation intervention. As mentioned above, this lobby card is one of only two extant original objects from the film *En Defensa Propia* and as such, the documentary value exceeds the aesthetic value.

Accumulated surface dirt and grime on the photograph caused it to appear in much worse condition than it actually was, making reduction of the surface dirt a major goal of the conservation treatment. The areas of image loss within the photograph were actually quite small, almost imperceptible, but addressing them in the treatment would also help to reintegrate the aesthetic qualities of the image.

With the secondary support, instability related to damages at the corners of the support represented the biggest risk to the integrity of the object. The tidelines were also distracting to a viewer, and were reduced. The reduction of the tidelines could be considered an aesthetic decision, but their reduction also helped to eliminate acidic degradation products from within the secondary support. Punctures caused by tacks in the corners of the support remained untouched as they are evidence of the use of the object. The only punctures that were treated were those that contributed to the instability of the secondary support.

3. TREATMENT

DRY SURFACE CLEANING

Eraser crumbs were used to clean the surface of the secondary support. The eraser crumbs were manipulated on the surface of the photograph in circular motions, with a cotton ball. Soiled crumbs were removed from the surface with a soft brush. This process was repeated on the verso of the secondary support. A microspatula was used reduce accretions.

Fig. 10. Accretion reduction.

AQUEOUS SURFACE CLEANING

A methylcellulose poultice was used to reduce the appearance of the tidelines on the secondary support (Fig 11). After three to five minutes, depending on the intensity of the tideline, the poultice was removed. Methyl cellulose residue was reduced with a cotton swab and distilled water. The area was dried using a tacking iron and a dry blotter (Fig. 12). The paper tape on the verso of the secondary support was removed in the same way (Fig. 13). This process was done only on the secondary support, and not on the photograph itself.

Fig. 11. Methyl cellulose poultice applied to the secondary support. Detail of recto *(left)* and on verso *(right)*.

Fig. 12. Drying the support with blotter and a tacking iron.

Fig. 13. Removing the paper tape from the verso with the poultice.

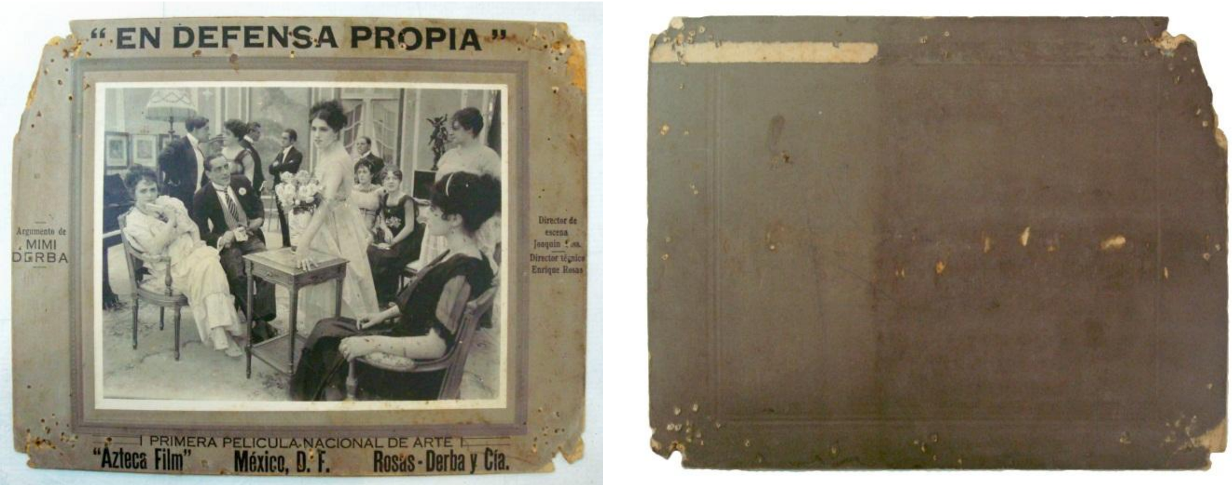

Fig. 14. During surface cleaning: recto *(left)* and verso *(right)*.

STABILIZING THE CORNERS OF THE SECONDARY SUPPORT

The delaminating corners of the secondary support were first stabilized by applying methyl cellulose between the delaminating layers. Methyl cellulose was also used to reinforce any small tears surrounding the tack holes.

It was decided that the secondary support would be further stabilized by filling the losses at the corners. To do this, the outlines of the losses were first traced onto an acid-free, 100% cotton ragboard, which was then cut into the proper shape (Fig. 15).

Fig. 15. A ragboard insert is cut to size.

As the secondary support was a thick paperboard, these ragboard inserts served to bulk up the reconstructed corner to the appropriate thickness. The thickness of the inserts was approximately half that of the original secondary support. Two inserts were cut for each loss. They were secured in place with small bamboo struts that were inserted between the delaminating layers of the original paperboard secondary support (Fig. 16). For further details on this technique, see figures 18-20.

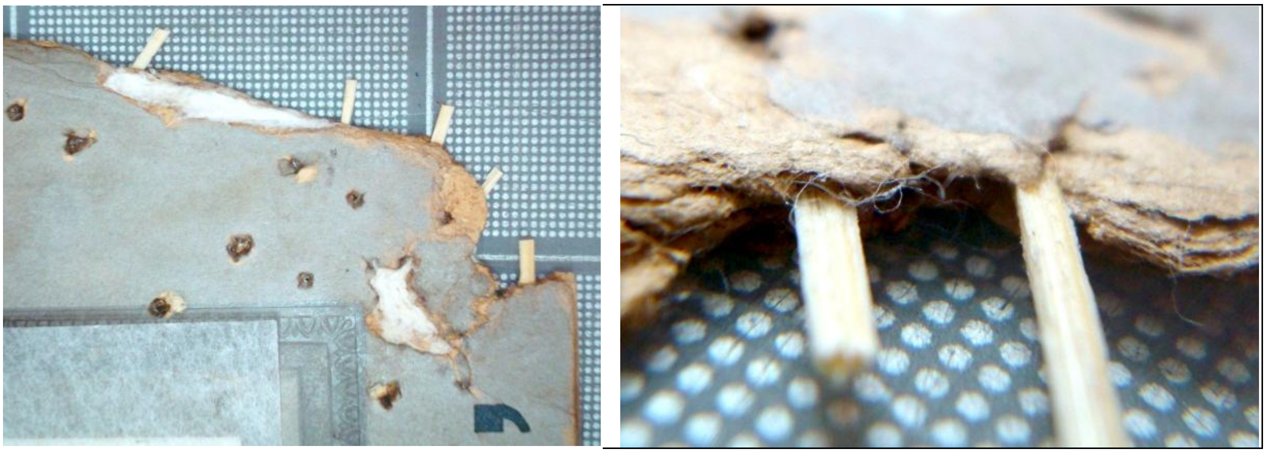

Fig. 16 Bamboo struts in place *(left)*; detail, the struts inserted within the delaminating layers *(right)*.

Gaps between the ragboard insert and the original mount were filled with a paste of Japanese paper and methyl cellulose (Fig 17).

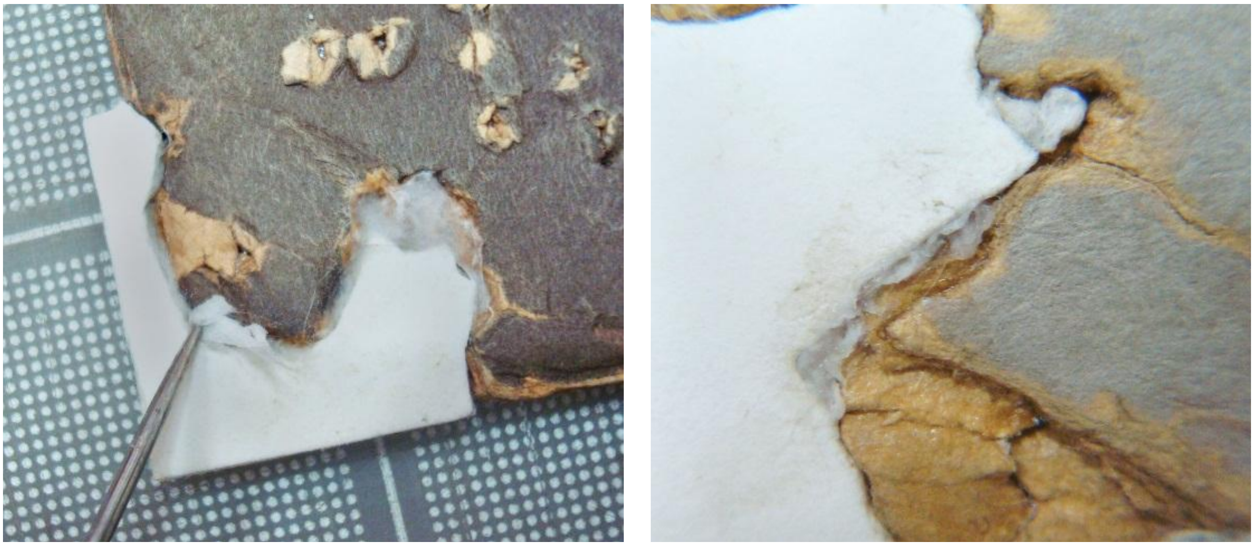

Fig. 17. A Japanese paper/methyl cellulose mixture is inserted into the gaps between the original secondary support and the ragboard insert *(left)*; a detail of a gap with the filler in place *(right)*.

Fig. 18. Two ragboard inserts are cut for each loss. The thickness of each insert is approximately half that of the original secondary support. One of the inserts has been secured to the original paperboard with the bamboo struts inserted within the delaminating layers of the board. The insert is placed *behind* the struts. The adhesive used is methyl cellulose.

Fig. 19. The second tailored insert is secured to the object, also with a methyl cellulose adhesive. This insert is placed *over top* of the bamboo struts, sandwiching them between the two ragboard inserts. These two inserts together make a fill of the appropriate thickness, held in place with the bamboo struts.

Fig. 20. Gaps between the insert and the original support are filled with a mixture of Japanese paper and methyl cellulose.

AESTHETIC REINTIGRATION

Losses within the photographic image were inpainted with watercolors, over a thin isolating layer of methyl cellulose.

Inpainting was done within the secondary support only in areas of new material. In order to reintegrate smoothly within the object, these areas were toned to match the exposed core of the paperboard and not the grey facing paper.

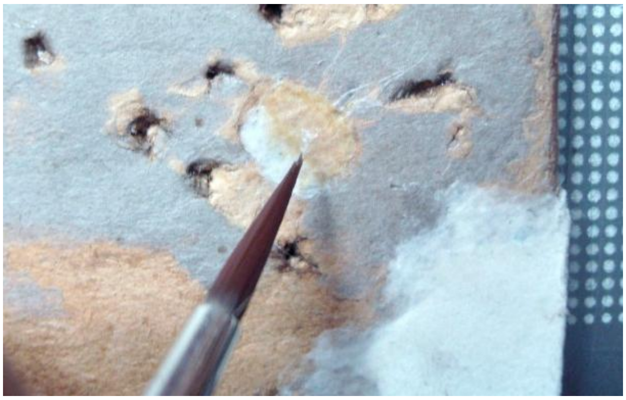

Fig. 21. Inpainting fills within the secondary support.

COMPLETED TREATMENT

The majority of the conservation work was done on the secondary support, not the photograph. However, for a mounted photograph the physical stability of the support guarantees the physical stability of the photograph. Both elements constitute the unit, and is one is lost or damaged, the other suffers accordingly.

Fig. 22. Recto, after treatment.

Fig. 23. Verso, after treatment.

Cineteca Nacional México©.

4. CONCLUSIONS

The lobby card, a once common form of motion picture advertising, is now virtually unknown outside of a small group of film historians and collectors. Despite having been created for an ephemeral purpose, enough lobby cards have survived the passing of time to now transcend their original commercial advertizing function. Lobby cards can be displayed and enjoyed as works of art, provide information regarding no-longer extant motion pictures, and serve as a source of delight for film aficionados.

The difficulties in establishing a chronology of the changing functions and aesthetics of motion picture lobby cards within the scope of Mexican cinematographic history are enormous. Many of the existing lobby cards are in poor condition, and significant conservation treatment would be necessary in order to stabilize them in preparation for access by scholars, even in digital formats. Also, a significant portion of both film-based and paper-based materials were lost in the 1982 nitrate film fire at the old Cineteca Nacional. The material lost, which constituted a considerable part of the Mexico's cinematographic heritage, has never been completely recovered.

The permanence of such materials can only be guaranteed by ensuring that they are properly documented and preserved. Proper documentation would include tasks necessary to maintain intellectual control: describing, identifying, and cataloguing the material. Preservation entails recording conditions and exhibition histories, documenting all conservation treatment, and maintaining storage and exhibition environments that will slow the deterioration of such fragile materials.

The conservation treatment of these lobby cards is intended to ensure their preservation for future generations and to inform scholars and the public of their value as documentary objects of film history.

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Digital Fills for Photographs with Glossy Surfaces

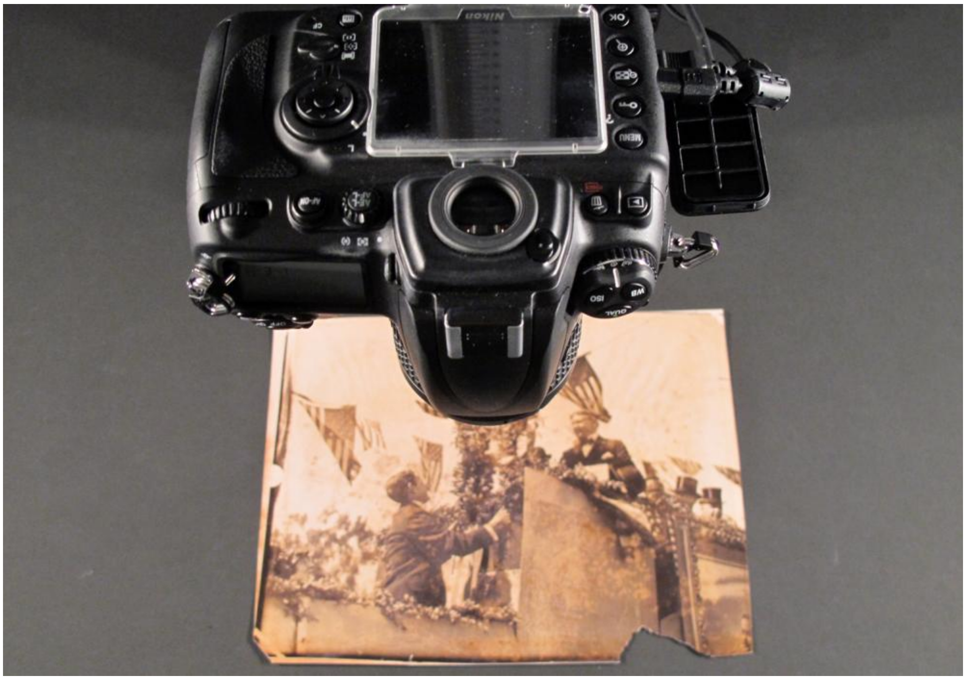
Victoria Binder

Presented as a poster at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Introduction

Filling and inpainting losses in photographs with glossy surfaces can be challenging, particularly when the loss is sizable. The process is often difficult, time consuming, not easily replicated, and ultimately unsatisfactory. The surface of glossy and luster inkjet papers can be a remarkable match for smooth photographic emulsions. With Adobe Photoshop® skills and a good inkjet printer, good quality digital fills can be achieved in a relatively short period of time. This article shows a step-by-step approach to filling a loss in an early 20th century gelatin silver print including reproducing and resizing the loss area in Photoshop®, choosing paper, printing multiple versions of the fill in various tones, shaping and manipulating the printed fill, and attaching the fill. Of course, technology is always changing, and there are many approaches and possibilities for creating digital fills for different kinds of photographs. The purpose of this article is to serve as a jumping off point in which these possibilities and approaches can be explored, discussed, and hopefully put to good use!

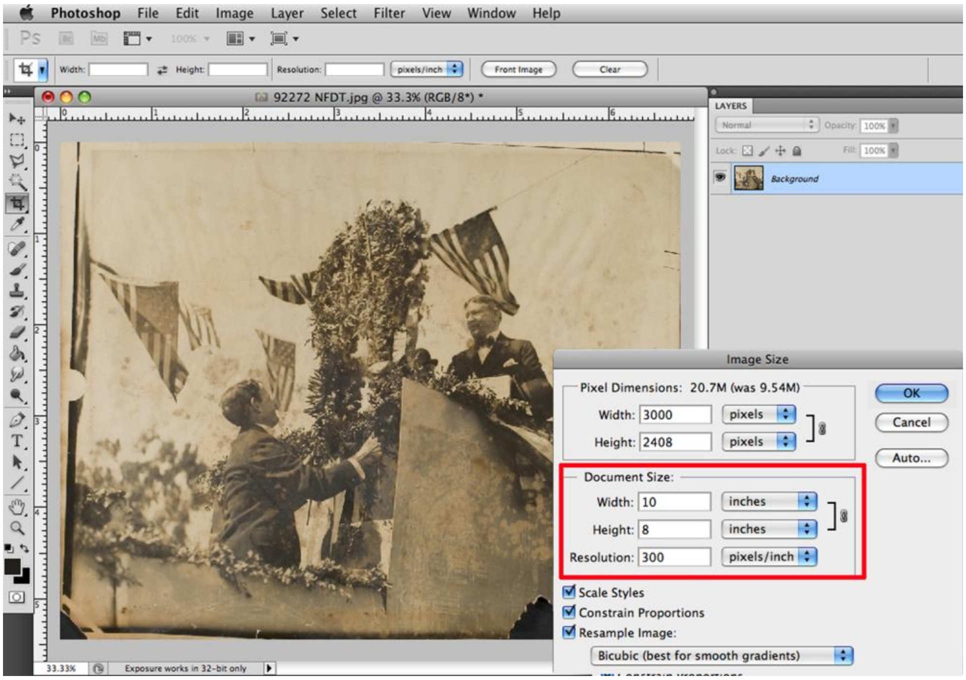
Start
Start with a high-resolution digital image of the entire photograph.



Get the Dimensions Right
To get the measurements of the photograph and digital image exactly the same, measure the height and the width of the actual photograph.

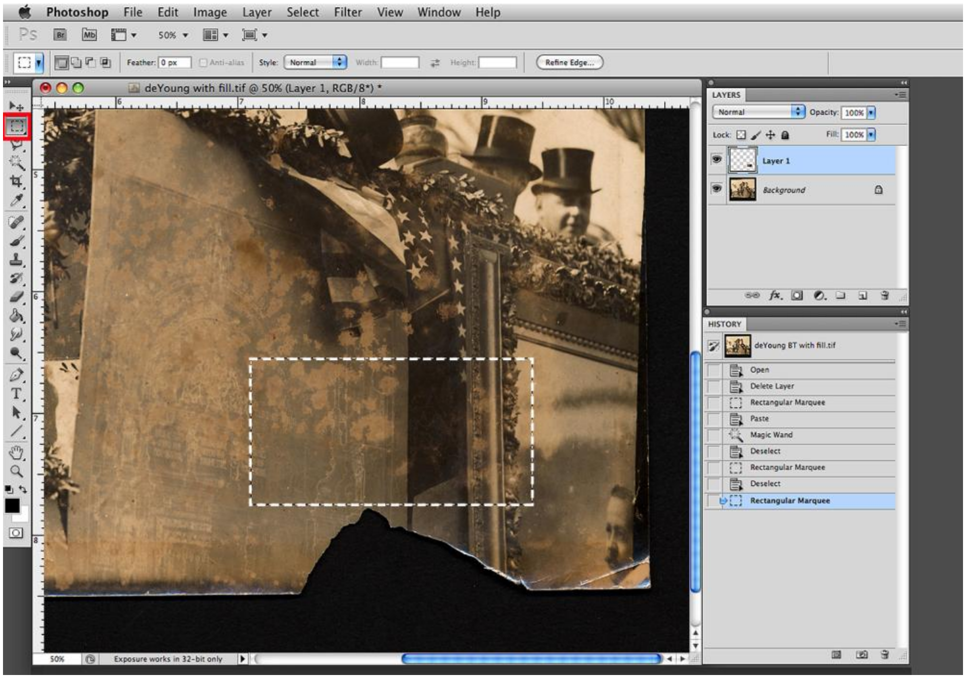
Next, in Adobe Photoshop® crop the digital image to the outer edges of the photograph.

Size the cropped digital image to the exact dimensions as the actual photograph.

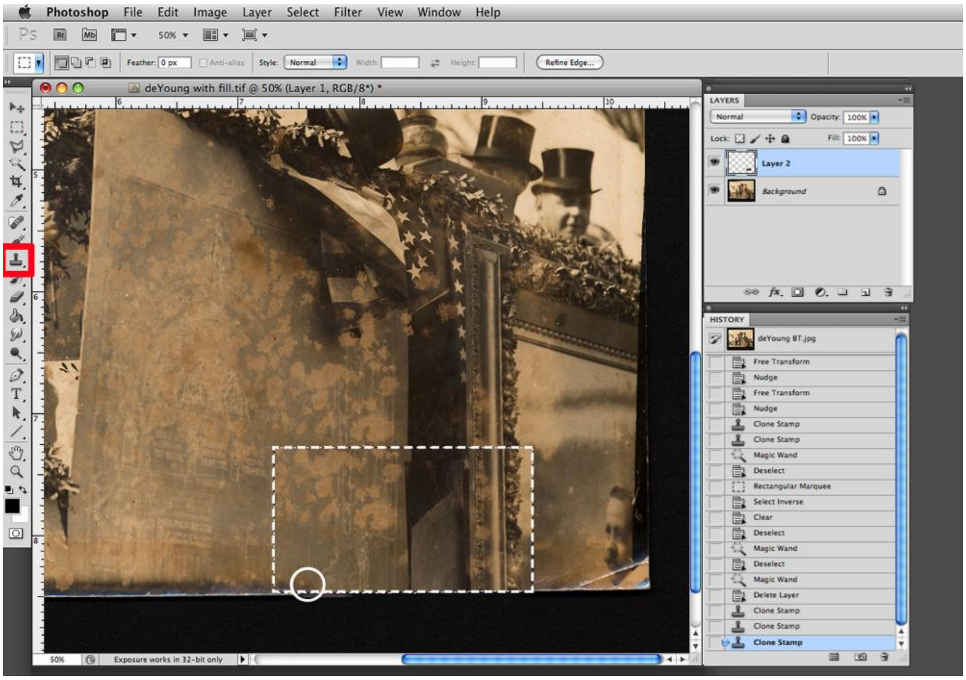


Create the Fill in Photoshop®

To create the fill area, use the rectangular marquee tool in Photoshop® to select an area similar to that of the loss. Copy the area and paste into a new layer.



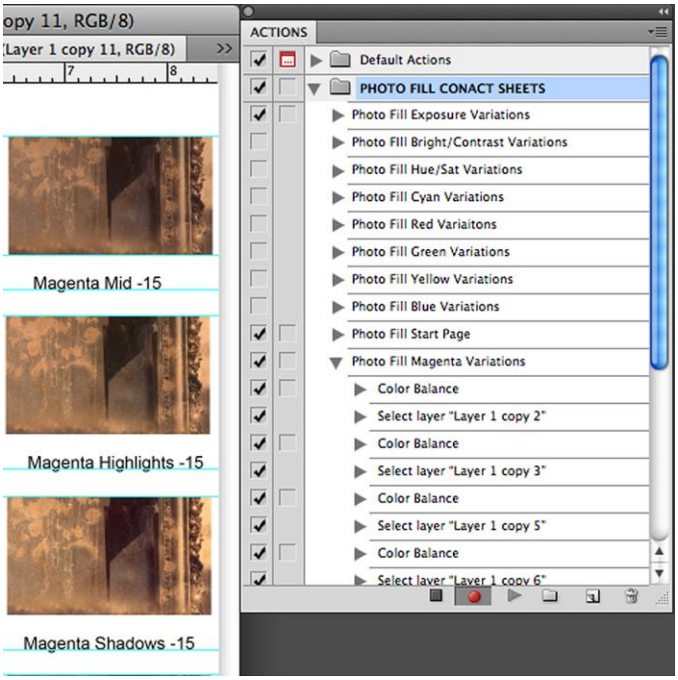
Manipulate the fill in Photoshop® to complete the composition and make a more seamless transition from fill to original object. The clone stamp tool is often helpful. In the picture below, the clone stamp tool was used to replicate the dark gradation along the bottom edge.



Get the Tone Right

Once your fill is made and saved, the next step is printing. Even with good color management it can be difficult to immediately get a print of your fill that is accurate in tone. It will likely take some adjustments in Photoshop® (using features such as levels, exposure, and color balance), and a number of printouts. A system that works well involves creating a contact sheet that depicts variations of the fill. From this, the best match can be chosen. For example, in the image to the right, the fill has been reproduced on the contact sheet with variations of exposure (in increments of .1).

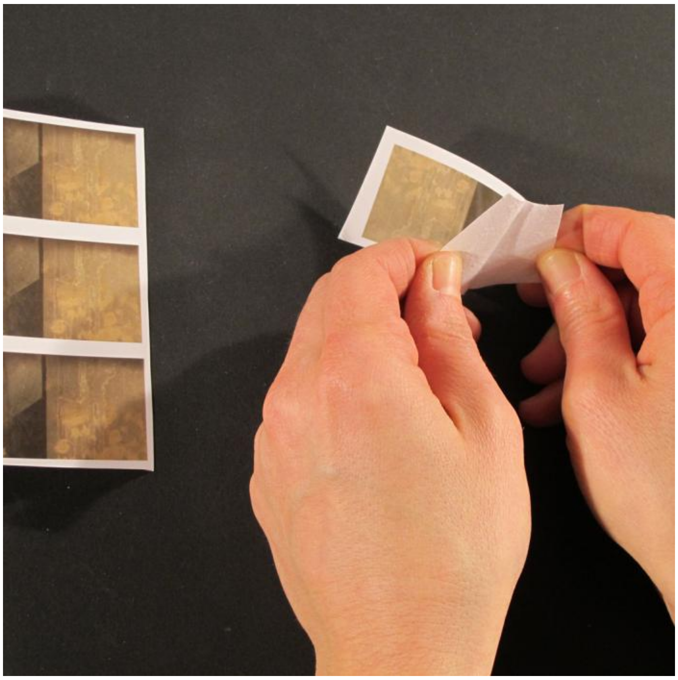
Making contact sheets can be a time consuming task in itself. To remedy this, the Actions feature in Photoshop® can be used. With Actions, a series of tasks can be recorded in Photoshop®, saved, and reapplied. For example, Photoshop® Actions can be used to record and save all the steps it takes to make a contact sheet that depicts variations in magenta. The creation of an initial contact sheet might take a bit of time, but once the steps are recorded as an Action, it can be simply applied to another fill generating a new contact sheet within seconds. Using this approach, a library of Actions can be built for various contact sheets.



Choose the Right Paper

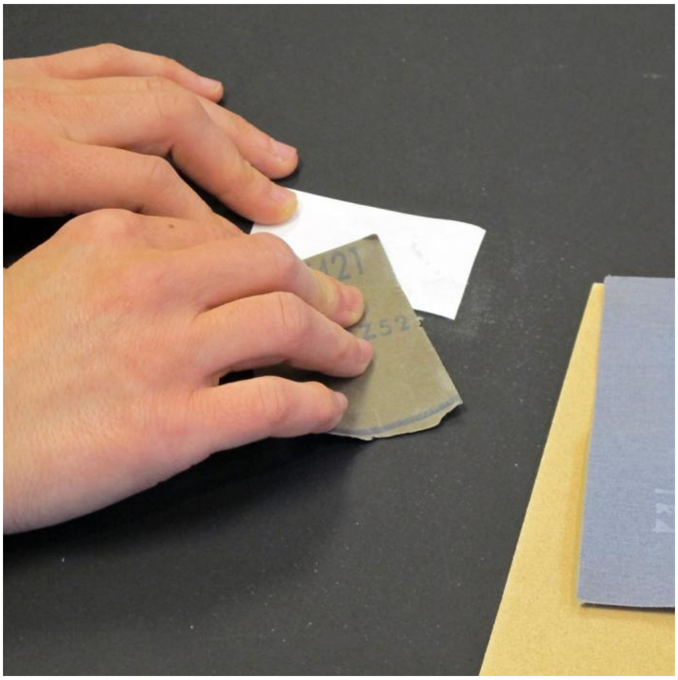
Making a sample set of various types and brands of glossy and luster papers can help you chose the paper and surface that best matches your object.

Delaminate, Shape, and Attach the Fill



The beauty of working with inkjet glossy and luster papers is that they can be delaminated right down to the thin image layer. This is very useful as inkjet papers are often stiff and incompatible with historic photo papers.

The back of the delaminated image layer can be thinned even further with fine grit sandpaper.



The fill can be backed with a paper that matches the thickness, texture, and tone of the photograph being filled. In the photograph pictured, the fill was attached with wheat starch paste to a piece of thin Japanese paper toned to a light beige color. The Japanese paper was made slightly larger than the fill to facilitate attachment to the back of the photograph.

If desired, the surface of the fill can be altered with various media such as acrylic paint, watercolor, and acrylic spray coatings.

Before Treatment

After Treatment

FINISHED!

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Acetate Base Stripping: A Preliminary Investigation into the Feasibility of Bulk Treatment

Caroline Garratt

Poster presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Objective

This remedial treatment was performed to remove the base layer of 25 severely deteriorated acetate negatives. In doing so the emulsion pellicle was returned to a flat plane allowing the image content to become accessible once more. An additional purpose was to investigate the feasibility of bulk base stripping, following the treatment methodology published by Munson (1997: pp. 55 – 65, 2010: pp. 96 – 109). The work was executed by Caroline Garratt at the Archives New Zealand conservation laboratory under the supervision of Mark Strange, Senior Conservator of Photographs, National Library of New Zealand.

Background

Archives New Zealand has significant holdings of photographic items transferred from government agencies, including major collections from the National Publicity Studios, Forestry and New Zealand Railways. These holdings include thousands of negatives on cellulose acetate supports.

The majority of Archives' known photographic negatives are stored in a controlled atmosphere vault at 2deg C, 35% RH without air purification. However, there are large quantities of negatives currently held in general repository climate conditions, awaiting processing and separation to cool storage.

In 2010 - 2011 Collection Care staff undertook initial indicative condition surveying of Archives' photographic acetate holdings, held in open stack areas, using IPI A-D strips. The survey indicated that 29% of the photographic negatives had reached level 3 deterioration (Jackson 2011, pp. 6 - 7). Whilst further comprehensive surveying is needed an immediate plan of action was required, addressing storage concerns, digitization and the remedial treatment of negatives already exhibiting acute acetate shrinkage. It was recognized that in order to slow down further deterioration, and effectively 'buy time', Archives would need to increase its controlled atmosphere storage capacity and make improvements to its existing still and moving image vaults. At the time of writing construction of a new climate controlled store, that will house the acetate holdings currently held in general stack conditions, is almost complete. A proposal to begin digitizing the acetate holdings has been initiated, following the success of a business case to purchase a Phase One iQ180 digital back to capture the negatives to preservation specifications.

The initial acetate digitization pilot project focussed on part of a collection of film stills and publicity shots taken by the National Film Unit, a government agency that operated from 1941 to 1990. From this pilot, 56 negatives (the majority of which are 4" x 5" format) were found to have severe base channelling from a total of 560 items. The negatives also exhibited varying degrees of plasticizer exudation, edge curl, warpage and localized de-lamination of the emulsion where channel furrows or plasticizer exudate were present. Small areas of antihalation dye had become visible on several of the negatives. It was decided to set aside the deteriorated negatives for treatment, to separate the image emulsion from the acetate base support. It was felt important to demonstrate that these severely deteriorated negatives could be returned to a legible state and negate any necessity to deaccession material that was considered to no longer be accessible. Digital retouching was not pursued as a viable solution as it was perceived it would involve a degree of reinterpretation and compromise the integrity of the original image.

Treatment Methodology and Observations

The treatment methodology was based on Munson's articles on acetate recovery. The only deviation from this method was the use of 97% Absolute Ethanol and 3% water in the final two baths, instead of 95% grain alcohol and 5% water. The negatives were interleaved with 34gsm Hollytex, which kept the items separated and allowed the negatives to be easily transited between baths.

Fig. 1. Before treatment image of 'Land From The Sky' production still, 1959, National Film Unit collection, Archives New Zealand/Te Rua Mahara o te Kāwanatanga [AAPG 24449 W3939 [1], R23583806].

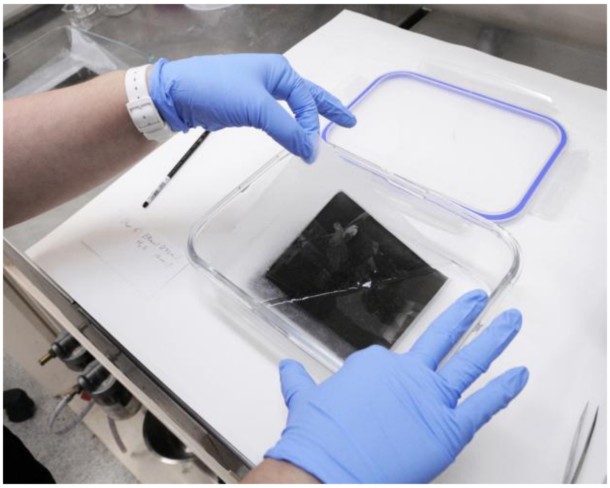

Fig. 2. Transferring a pellicle between solvent baths.

Prior to the commencement of treatment a condition report was produced for each negative and photography, both reflective and transmissive, was performed to record each image. These images would also aid identification post treatment. The treatment was carried out over a period of 8 days with an initial batch of 5, followed by a larger batch of 20 negatives. The smaller batch served to build confidence and experience and establish procedures before embarking on a batch of a size more representative of the trial objective to test bulk feasibility.

Following the first bath, the base layers from the initial batch remained in one sheet and were removed with relative ease, assisted by tweezers. The anti-curl layer in both batches of negatives removed easily and on occasion both the anti-curl layer and base could be removed as one piece.

However, the removal of the base supports on the second batch of 20 items proved more problematic and indicated a higher degree of base brittleness, with a number of the supports ‘shattering’ into shards that needed to be removed individually. Using a combination of the tweezers, a retouching brush and a spatula the base material was carefully separated from these image pellicles. It was hypothesized that the different formations of channelling observed prior to treatment, (e.g. longer chains versus shorter; circular patterns), could provide a visual indication to this physical response.

In the latter stages of treatment to the second batch a further small quantity of water (2ml) was added to the final ethanol:water bath as the pellicles retained a faint memory of channelling, indicating the need for further relaxation. In this second batch of negatives small crystals - possibly from the nitrate subbing layer or perhaps plasticizer residue - were observed on the image pellicles in the final bath. These were gently removed with cotton wool whilst in solution before placement of the pellicle into a blotter stack for drying and flattening.

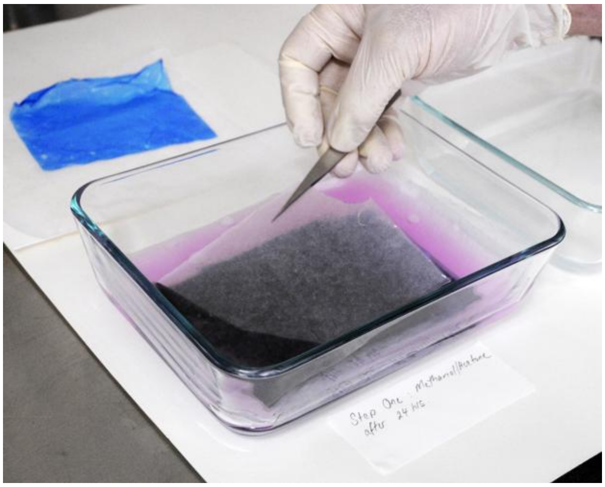

Fig. 3. Removing a base layer.

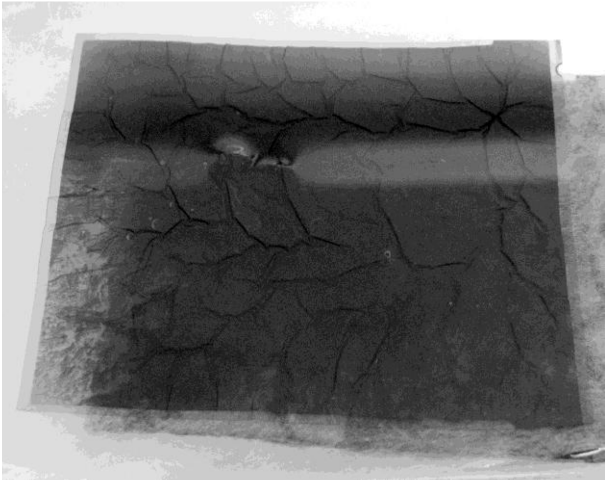

Fig. 4. Channel impressions visible on a pellicle in solvent bath.

It was decided not to re-adhere the pellicles onto a polyester support due to the extra costs, the labor intensiveness of this step and the physical risks imposed in the delicate manipulation of the pellicle. Once dried and flattened each pellicle was placed in a 4-flap enclosure, supported with a 2 ply, PAT tested board.

Findings

This trial treatment is considered a success with the bases of the negatives removed, resulting in 25 flat pellicles, which are ready for imaging and storage. In analyzing the treatment steps it is evident there could be future gains in efficiency and a reduction in costs by maintaining consecutive batches through the tray process. However, a gradual approach was adhered to in this trial in order for skills to be developed and confidence acquired. This initial treatment provided a firm basis for further trials of bulk base stripping and a deeper awareness of the materials’ properties was realized. For example, an ability to judge the evaporation of solvents and the pellicle’s reactions to moisture in the air was attained in the drying and flattening stages of the process. Future testing of increased batch sides would be of benefit to establish maximum parameters.

There are risks involved in this treatment and physical damage to the pellicle could occur, including tears and stretching causing distortion. Exposure to a higher concentration of water in the final stages can lead to the loss of the pellicle's dimensional stability (Munson, 1997, p. 56). Strict adherence to health and safety practice should be followed and the work must be performed under a fume hood. The treatment raises an ethical question in the removal of part of the item's original material. However, in regaining image clarity access to the original is restored. In addition the treatment removes the negative's inherent vice and ensures its longevity.

In future the Collections Care team will undertake more rigorous condition surveying of Archives' acetate holdings, which will enable accessions to be prioritized for digitization according to the severity of acetate deterioration. This survey will also serve to identify negatives requiring remedial treatment. The large scale of Archive's acetate holdings and the autocatalytic nature of acetate base deterioration mean a cost-effective and time-efficient bulk treatment process will likely become increasingly necessary.

Fig. 5. After treatment image of 'Land From The Sky' production still, 1959, National Film Unit collection, Archives New Zealand/Te Rua Mahara o te Kāwanatanga [AAPG 24449 W3939 [1], R23583806].

Acknowledgements

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Sole Survivor: Re-evaluating and Conserving Claude Cahun and Marcel Moore's Only Known Remaining Photomontage Used for Cahun's 1930 Publication *Aveux non Avenus* (Disavowed Confessions)

Anne O'Hehir and Andrea Wise

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand

Abstract

Claude Cahun (1894-1954) and Marcel Moore (1892-1972) were the pseudonyms used by Lucy Schwob and her life-long partner and step-sister Suzanne Malherbe. These women's lives were extraordinary and ground-breaking. Cahun, one of the few women whose work was taken seriously by the Surrealists, created theatrical and playful images which have attained cult status in recent years. Seen primarily as self-portraits, the collaborative nature of these works and Moore's contribution to them requires more in-depth examination. A large photomontage *Aveux non Avenus* in the collection of the National Gallery of Australia (NGA) is the artwork used as the basis for the reproduction for the frontispiece in the book of the same title. Published in a limited edition of 500 in 1930, the book contains Cahun's philosophical texts and literary aphorisms, interspersed with photogravures signed by Moore. The photomontage is complex in structure, being composed of a number of collaged photographic and printed pieces laid onto Bristol board; on top of this, Moore has then painted and drawn. The work is the only original artwork known to still exist, and as such it is one of the women's most significant pieces, with complex symbolic readings; Cahun represented as the writer, by the lips and Moore, the artist, by the eye. The women lived on the island of Jersey from 1937 and when Moore died in the early seventies her possessions and those of Cahun, piled into tea chests, were sold as one lot at auction. The provenance of the photomontage is not known but its fragile and damaged condition would suggest that it is likely to have been included in this batch. The work is frequently requested for loan and exhibition and it was most recently seen in a large retrospective which travelled to Paris, Barcelona and Chicago. It underwent conservation treatment in preparation for this loan, in order to stabilise the various components; and while it was necessary to improve its appearance, treatment decisions were agreed jointly by conservation and curatorial staff, in order to respect the unique nature and history of the work.

Introduction

Claude Cahun was a poet, essayist, literary critic, translator, actor, and political activist, as well as a photographer and sculptor associated with the Surrealist movement in France in the 1930s. 'Claude Cahun' was the pseudonym adopted by Lucy Schwob. Her autobiographical essay *Aveux non Avenus* (*Disavowed Confessions*) was published in Paris in 1930. Cahun and her lifelong partner Suzanne Malherbe, who took the name 'Marcel Moore', collaborated on the making of the ten photogravures that accompany the text. The work held in the NGA collection is the original artwork from which the photogravure plate used to print the frontispiece was made. It is the only known original artwork for the book to have survived the women's tumultuous lives, and as such it is of huge significance in the oeuvre. That she had been a prominent member of the Parisian avant-garde was, at the time of her death in 1954, largely forgotten. Cahun was rediscovered in the mid-1980s at a time when many artists were exploring issues of gender and identity. She has achieved a cult following for her photographic self-portraits, which have attracted the critical attention of curators and feminist theorists. In them she appears in enigmatic guises, playing out different androgynous personas, often using masks and mirrors.

Fig. 1. Before treatment: Claude Cahun and Marcel Moore *Photomontage for frontispiece for Aveux non Avenus (Disavowed Confessions),* 1929-30, gelatin silver photographs, offset lithography, gouache, pencil, intaglio. National Gallery of Australia, purchased 1993.

Claude Cahun

Claude Cahun was born Lucy Renée Mathilde Schwob on 25 October 1894 in Nantes, France. She grew up in an intellectual Jewish bourgeois family, part of the French literary aristocracy. Her father was the publisher Maurice Schwob, owner of the newspaper *Le Phare de la Loire*, her uncle was the Symbolist writer Marcel Schwob, founder of the prestigious literary review *Mercure de France*, and her great-uncle was the Orientalist David Léon Cahun. Her mother suffered from mental illness, spending time in an asylum, and Lucy was primarily raised by her blind grandmother Mathilde Cahun. Lucy attended school in Nantes and was, for a time, at boarding school in Surrey, England.

Fig. 2. Claude Cahun, *Self-portrait*, c.1929, gelatin silver photograph, Jersey Heritage Collection.

After trying out a number of pseudonyms, Lucy settled on adopting the gender ambiguous 'Claude Cahun' around 1917. It was also at this time she began living with Moore, whom she had met when she was fifteen. They also became stepsisters in 1917, when Cahun's father and Moore's mother married. The following year, she began studies in philology and philosophy at the Sorbonne in Paris. Cahun and Moore moved to Paris in 1920, settling in an apartment in Montparnasse, which in time became a meeting place for artists, actors and writers. They were friends with, amongst others, editors Adrienne Monnier, proprietor of the bookstore La Maison des Amis des Livres, a favourite hangout for the literary community; and with Sylvia Beach, a prominent lesbian expatriate and owner of the famous British-language bookstore Shakespeare and Company. Cahun was also an active member of a number of experimental theatre companies in the 1920s.

Cahun and Moore were fortunate in being independently wealthy. Cahun regarded creativity as not only a central pursuit but also a largely private one. She began making photographic self-portraits as early as 1912, when she was eighteen years old. Although she continued taking images of herself throughout her life, she felt little compulsion to exhibit.

Aveux non Avenus

Cahun worked on the text for *Aveux non Avenus* during the early part of the 1920s, and it was mostly complete by 1926. The meaning of the title is difficult to convey in English but implies confessions that are then cancelled or denied. It is a radical reconsideration of the biographical genre. It consists of autobiographical text fragments, poems, letters, the recounting of dream sequences and aphorisms in a number of different styles. It was influenced primarily by the Symbolists, to whom Cahun was linked through her uncle Marcel Schwob. There is a poetic and elegant preface by Pierre Mac Orlan, a French writer and admirer of Schwob. 'This almost cruel poem', he writes, 'is infused with a very peculiar light, emanating from emotional ingredients of perfectly human origin'.

Cahun's, however, is a deliberately difficult, fractured text full of statements that are then repudiated, full of biblical, mythic and literary allusions, full also of word play and punning. Cahun demonstrates the impossibility of locating a fixed, stable definition of self; and states in the text: 'the only way we know how to recognise ourselves, love ourselves, is through dreamlike, unrefined and fleeting reflection'. The book is divided into nine chapters preceded by an introduction entitled 'L'Aventure Invisible' (The Invisible Adventure). Each chapter explores notions around nine 'deadly elements', including fear, narcissism, sex, vanity, lying, greed and self-pride.

The Invisible Adventure

A photomontage appears before the introduction to *Aveux non Avenus* and between each chapter. Cahun's text presents female identity as constructed, multifaceted, and ultimately as having a nihilistic absence at the core. These themes are explored in a variety of ways in the photomontages. All present fragmentations of the body that float in a black visual space - mostly faces, but often hands, arms, legs and eyes. These were mainly collaged photographs made by, and of, Cahun but also drawings by Moore and appropriated imagery. One of the collages includes text that succinctly expresses Cahun's thoughts on identity and more specifically of being a woman: 'Beneath this mask, another mask. I will never be finished lifting off all these faces'.

The frontispiece is perhaps the most esoteric and difficult image to interpret. The image includes obscure symbols, which only become clear when decoded using one of Cahun's drawings for a bookplate featuring similar motifs: the eye represents Moore, the artist, and the mouth, Cahun, the writer and actor. Mirrors and mirroring occur throughout Cahun's writings and imagery, exploring notions of not only narcissism but also flux and change, as the image in the mirror is never fixed, an unattainable illusion. The word 'Dieu' (God) that appears above a dove-like, double-headed Holy Spirit motif in the top of the image is reversed as in a mirror. She wrote elsewhere, 'each time one invents a phrase, it would be prudent to invert it to see if it holds up'. Cahun confronts the idea of God in the text. The epigraph of the final chapter of *Aveux non Avenus* is 'We get the god we deserve, unfortunately for us'. That the highly unconventional Cahun found living in a predominately Catholic, patriarchal society difficult - she was unable to vote, for example, until the end of her life, is hardly surprising.

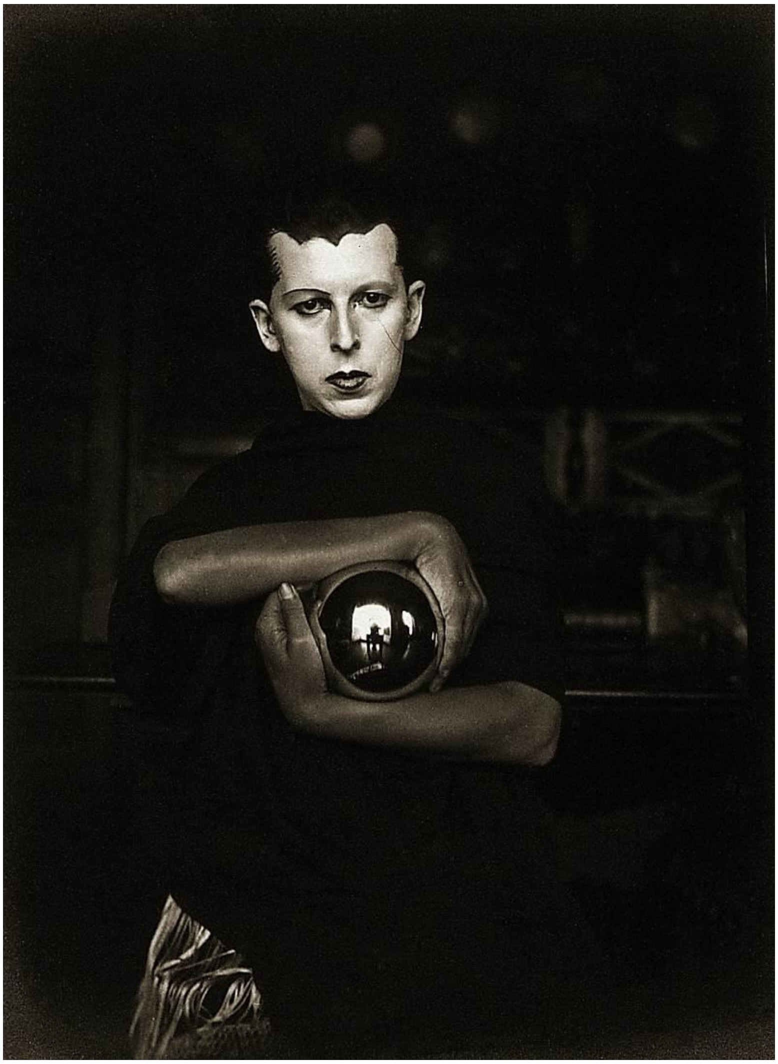

Fig. 3. Claude Cahun, Self-portrait, c.1927, gelatin silver photograph, Detroit Institute of Arts, Founders Society Purchase, Albert and Peggy de Salle Charitable Collection and the DeRoy Photographic Acquisitions Fund/The Bridgeman Art Library.

The nature of the collaboration between the two women is difficult to pin down exactly. On the title page, Moore is credited with making the heliogravures, or photogravures, after Cahun's designs ('projets'). This is supported by Cahun's signature on the drawings used as the basis of the photomontages. Moore's signature, however, is prominent on the photomontage for the frontispiece - it is the only image in the book she signed. Cahun refers to Moore as 'l'autremoi' (the other me). Certainly the notion of collaboration was one that Cahun actively pursued. It was a position that looked upon the cult of individuality and concepts of artistic sovereignty with doubt.

The Surrealists

Cahun became politically aligned to the left in the 1930s. Alarmed by the growth of Fascism, she briefly joined L'Association des Écrivains et Artistes Révolutionnaires (AEAR), a group of revolutionary artists, and through them met leading Surrealist artists and writers such as André Breton. In 1934 she became a member of Contre-Attaque, an anti-fascist political coalition founded by Georges Batailles and André Breton. In the 1930s she contributed sculptural constructions to a number of Surrealist exhibitions, including the London International Surrealist Exhibition at New Burlington Galleries in London and Exposition Surréalisted'Objets at Charles Ratton Gallery in Paris, both in 1936.

Women in the Surrealist circle most often occupied the role of model, muse and lover of the male artists. In Surrealist imagery, women appear as eroticised objects. Cahun was determined to elude cliché - her life was devoted to exploring different ways she could define herself and questioned if that were even possible. Cahun was fairly unique in being taken seriously by the Surrealists, in part, it must be said, because she came from such an illustrious literary family. She was even able to win the grudging admiration of Breton, who wrote to Cahun: 'You have extensive magical powers at your disposal. And it is essential that you write and *publish* - you must keep telling yourself this. You are well aware that I consider you one of the most curious spirits (among four or five) of our times'.

End of life

Sadly, Cahun was only to publish a few articles in the many journals of the Surrealist group and one more book after *Aveux non Avenus* - *Le Coeur de Pic* (*The Heart of Spades*), a book of Cahun's photography and Lise Deharme's poems with a preface by Surrealist poet Paul Eluard, published in 1937. *Aveux non Avenus* remains her most important work. It was released in a limited edition of 500 copies. In keeping with French publishing tradition, the edition consisted of one example on *Japon nacré* with original plates, nine examples on *Japon impérial* with original sketches for the plates, forty examples on Madagascar, 425 examples on *Vélin pur fil Lafuma* and twenty-five copies designated for the press. (The NGA owns a copy of the book, numbered 149, which was gifted by GalerieZabriskie, Paris, in 1994.) When released, although admired by her friends, it was met mostly with hostility and indifference and was soon forgotten.

Fleeing the looming Nazi threat, Cahun and Moore settled on the Isle of Jersey, part of the Channel Islands off the coast of Normandy, in 1938. The women had spent their holidays there since their teenage years. In a cruel twist of fate, Jersey was occupied by German troops in July

1940 (the Channel Islands were the only English part of the British Isles to be invaded during the war and were the last to be liberated). Instead of fleeing to the English mainland, like half the Jersey population, the women embarked on an extraordinary clandestine guerrilla propaganda campaign that led to their arrest and imprisonment by the Gestapo in 1944. They were sentenced to death and only saved by the end of the war. Cahun, whose health had always been fragile (she most likely suffered from anorexia nervosa at times in her life), never fully recovered from the ordeal and died at the age of sixty on 8 December 1954.

History of the work

After Moore's suicide in 1972 her possessions, and those of Cahun, piled into tea chests and cartons, were sold cheaply at auction. Ten lots, which ended up the basis of the Jersey Heritage Trust, sold for just £21. The provenance of the photomontage is not known but its fragile and damaged condition suggests it may have been included in the batch sent to auction. Why this photomontage survived when the other nine apparently have not, is not known. For the book's launch, some of the originals, but not the frontispiece, were included in a window display in Paris. Perhaps that is when they went missing? Sadly, most of Cahun's works were ransacked and destroyed by German troops during the war.

Fig. 4. Photographer unknown, *Window display of the bookshop José Corti, 6 rue de Clichy, Paris,* June 1930, launch of *Aveux non Avenus,* gelatin silver photograph, Jersey Heritage Collection.

Description

The support is lightweight Bristol board with an oval blind stamp including the words 'Bristol Extra Fin' and 'AU' in the top left corner of the sheet. The upper third of the sheet is painted in black gouache with highlights in white and grey gouache. The lower third is almost exclusively photographic collage, with the exception of the globe, which is intaglio with hand-applied watercolour. The central area has two sections of collaged intaglio print on paper, on the left and right sides. The photographic collage elements are all gelatin silver on fibre-based paper, sometimes with additional painting in gouache. The signature in the lower right is in white gouache.

Condition

The work has suffered extensive mechanical damage: the top left corner has been crushed, and across the entire surface are scratches and indentations. There are some small losses and edge tears to the Bristol board. Bristol board is regarded as being good quality, usually hot pressed and fairly white in tone. This board, however, is slightly textured and the cream tone appears to have discoloured and darkened to a light brown. Associated with the mechanical damage, there is loss of media, both paint and photographic emulsion. Other surface loss has resulted from insect attack and above the central eye emulsion loss had occurred where a collaged element has detached. The photogravure in *Aveux non Avenus* shows that the lost element was an upper eyelid.

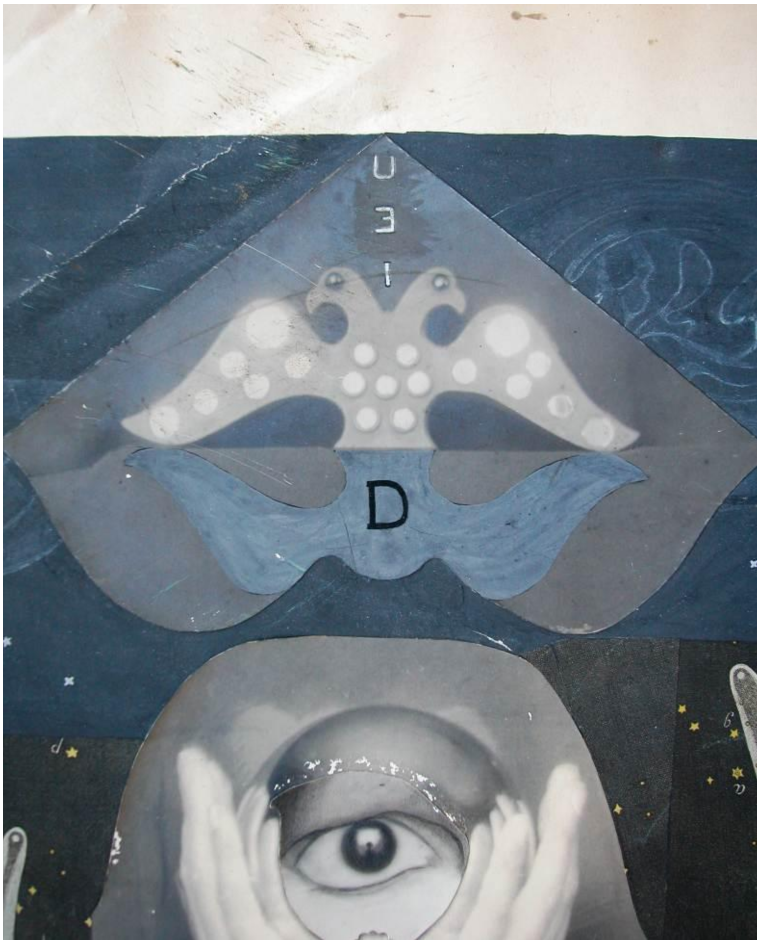

Fig. 5. Before treatment, detail, area of collage loss and lifting, silvering out, abrasion, surface dirt and creasing.

There is general surface dirt, much of which is ingrained. The photographic collage varies in tone, some areas slightly warmer and others cooler, which would indicate that different pieces have been used from a range of photographs. Consequently, the degree to which these pieces have oxidised also differs, with the darker areas, in particular, exhibiting strong and visually disruptive silvering out. An interesting feature of the photomontage is its three-dimensionality; this results from the nature of the composition and the build-up of layers and it is further enhanced by the delaminating edges of the collaged elements. This effect, although probably not intentional on the part of the artists, was carefully considered during treatment.

Fig. 6. After treatment: Claude Cahun and Marcel Moore *Photomontage for frontispiece for Aveux non Avenus (Disavowed Confessions),* 1929-30, gelatin silver photographs, offset lithography, gouache, pencil, intaglio. National Gallery of Australia, purchased 1993.

Treatment

After photography and documentation the work was carefully surface cleaned using a soft brush, taking care around areas of flaking or loose media. A Mars Staedtler plastic eraser was used to reduce the ingrained surface dirt on the edges of the Bristol board. The same eraser, grated, was used to reduce the surface dirt on the photographic collage. Flaking paint in the upper left corner was consolidated using a 1% solution of ethylhydroxyethyl cellulose (EHEC) in water. The loss to the edges of the photographic collage was consolidated with 1% gelatin in warm water. The most severe areas of silvering out were reduced by surface cleaning with 50:50 ethanol and water. A 0.5% solution of methyl cellulose in water was applied to the surface of the same areas, resulting in much greater image detail being apparent. Local pressing using water-moistened blotter was completed in the top left corner. The edges of the collage that were dramatically lifting were re-adhered using dilute wheat starch paste. These edges, however, were largely only partially adhered and other less noticeable areas were left untouched to ensure that the three-dimensionality and immediacy of the image was not affected. Orthello pastel pencils were used for minimal retouching in the paper collage and painted background. Artist's quality Winsor and Newton watercolours were used to retouch losses in the photographic collage; these areas were first isolated using 1% gelatin in warm water. Microcrystalline wax in white spirit was tested as another method by which surface gloss could be restored; however, the saturation proved too difficult to control and the wax was removed from the test area.

Conclusion

The photomontage by Claude Cahun and Marcel Moore remains in high demand for exhibition and loan. It was most recently seen in a large retrospective organised by the Jeu de Paume, Paris, subsequently travelling to Barcelona and Chicago. The work underwent conservation treatment to stabilise the various components in preparation for this loan. While it was necessary to improve its appearance, decisions were made jointly by conservation and curatorial staff to respect the unique nature and history of the work. Given the extraordinary lives of Cahun and Moore, it is remarkable that any of their works should have survived. It is to be hoped that more are eventually discovered and that there is further insight into the ambiguous creative collaboration between the two women.

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L'Atelier de Restauration et de Conservation des Photographies de la Ville de Paris (ARCP): Activities of the Preventive Conservation Section 2002- 2012

Aurélie Perreux and Claire Tragni

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

ABSTRACT

Over the past ten years the *Atelier de Restauration et de Conservation des Photographies de la Ville de Paris* (ARCP) has developed a number of key preservation plans, all managed and supported by a program named *Plan de Sauvegarde et de Valorisation du Patrimoine Photographique Parisien* (PSVPP). This program provides for the preservation and access of Parisian photographic patrimony, and was established in 2002 by the City of Paris' Department of Cultural Affairs. Originating from the cellulose nitrate negatives plan, the PSVPP allows participants to develop common interventive strategies, to pool resources, and to secure dedicated funds in order to deal with the extensive Parisian photographic patrimony of more than eight million items. In addition to the physical exhibition of photographs, this program includes the digital reproduction of a large number of photographic materials: digitization is done yearly by a semi-public company, and allows for the diffusion of the collections to a wide audience. As one of the main collaborators, the ARCP is in charge of the collection assessments, providing technical specifications, and implementing preservation measures. Preservation surveys are carried out in order to prioritize conservation campaigns: an example of this is the Charles Marville glass plate negatives project. Within the PSVPP, the laboratory launched a comprehensive project dedicated to the preservation of color photographs, addressing the need for climate controlled vaults as well as the related identification and preservation issues of contemporary photographic materials.

INTRODUCTION

In 2002 the City of Paris launched a municipal program dedicated to providing for the preservation and access of Parisian photographic patrimony, the *Plan de Sauvegarde et de Valorisation du Patrimoine Photographique Parisien* (PSVPP). These collections represents more than eight million artifacts, ranging from early photographic processes to contemporary photographic images, belonging to 27 cultural institutions, and include items of high historic and cultural value. Originating from the Nitrate Plan developed and implemented by *L'Atelier de Restauration et de Conservation des Photographies de la Ville de Paris* (ARCP)[1], the PSVPP involves several large-scale projects whose purposes are to highlight, preserve, and provide access to collections through exhibitions and online release of reproductions, whichever is in accordance with the preservation requirements. Substantial funds were dedicated by the Department of Cultural Affairs (DAC) to ensure the success of this plan, which involves major collaboration between different sections of the Department. The *Parisienne de Photographie*, a semi-public compagny, was created in 2005 to take charge of the digitization and accessibility of the photographic patrimony. Within the PSVPP, the ARCP is in charge of collection assessments, providing technical specifications, and implementing preservation measures within the collections, all of these being performed in conjunction with the curators and the *Parisienne de Photographie*. Over the past ten years as part of this project, the ARCP has developed several major preservation plans and performed extensive preventive and interventive conservation campaigns.

THE NITRATE PLAN: A COMPREHENSIVE PRESERVATION PROJECT BEHIND THE CREATION OF THE PSVPP

The Nitrate Project was launched in 2002, a few years short of the centennial anniversary of the last major flooding of the Seine: substantial portions of important photographic collections are stored in flood-prone areas. The biggest photographic collections in the city, like the Roger-Viollet collection, include a large number of cellulose nitrate films and could not be stored in the storage facilities where other works of art had been secured. The City of Paris had to provide a fitting solution that would meet the specific needs of the photographic collections and, more particularly, with the security and conservation issues of cellulose nitrate negatives (autocatalytic decay, toxicity, risks of fire, etc.). According to the French legislation, cellulose nitrate films and negatives are subject to laws regarding nitrocellulose materials (loi n°76-663 du 19 juillet 1976). The legislation states that institutions holding more than 50 kg of cellulose nitrate must notify the police headquarters, and that institutions with more than one ton of cellulose nitrate must be granted a special storage authorization. Within the framework of the Nitrate Plan, the ARCP and the City of Paris' Health and Security Bureau worked together in order to address both the conservation and the health and safety issues.

The preventive conservation team carried out surveys in all institutions likely to own cellulose nitrate negatives. The goal of these surveys was to locate, identify, and assess the condition and any risks associated with the nitrate films, as well as to evaluate the weight of material present. It was decided to assess each collection at a high level, even when the institutions did not consider their nitrate negatives of high importance. The films were identified by visual examination, using notch codes and manufacturers' edge printing, as well as signs of deterioration if present. When no manufacturer data or signs of degradation permitted identification of the film support, a diphenylamine chemical test was performed. In order to simplify the visual assessment of the films' condition, the number of degradations levels referenced in the literature was narrowed to four. A database was created specifically for the Nitrate Project and was used in all of the participating institutions. Each institution was given a report including survey data, emergency preservation recommendations, treatment planning as required, and health and security requirements to serve as a guideline. Due to the diversity of the collections, the methodology was adapted according to the typology, scale, and homogeneity of the collections: the surveys would be done at an item-level or through representative items, as was appropriate. The major difficulty was managing large, sometimes unprocessed, and often mixed collections. Most nitrate negatives were stored alongside glass plates, acetate films, or prints in the same envelopes or boxes.

The result of this work is the identification and assessment of approximately one million nitrate negatives, representing more than two tons of material, in 16 different institutions. The negatives are mixed with 3 million photographs of other types. The number of nitrate negatives in each institution ranges from several hundred to the 700,000 negatives held by the Roger-Viollet collection. Approximately 24% of the total number of nitrate negatives is at an advanced degradation level.

To address the problems of film degradation, toxicity, and fire risks, it was decided to place the nitrate films in dedicated, shared climate-controlled storage facilities. Several factors had to be taken into account in choosing these storage facilities: the mixed nature of the collections, the necessity for easy access to the artifacts, the requirement of obtaining special authorization for large-scale cellulose nitrate storage, and the difficulty of obtaining real-estate in downtown Paris. In the end, two separate storage facilities were located. The first storage vault is a temporary facility with cool climate conditions set at 59°F/15°C (±1 over 24 hours) and 35% relative humidity (± 5) that meet the required safety standards (air renewal, fire resistant walls, anti-deflagration system, etc.). Such environmental conditions are appropriate for the storage of all types of photographs involved, and allows for easy and regular access to the artifacts by avoiding the potential for condensation. Furthermore the staff can perform inventories, sort, rehouse, and digitize in an adjacent laboratory, preparing the nitrate negatives for relocation to the second vault. The second facility needed is a permanent facility with cold climate conditions set at 36°F/2°C (±2 over 24 hours) and 25% relative humidity (±5). This vault must also meet all safety standards for the long term storage and preservation of cellulose nitrate negatives (ISO 10356; NFPA 40 of the National Fire Protection Association).

Fig. 1. Rehousing nitrate films from the Roger-Viollet collection. © ARCP / Mairie de Paris.

Fig. 2. The temporary cool storage for nitrate films. © ARCP / Mairie de Paris.

Staff members for institutions containing cellulose nitrate were instructed in the inherent risks of such materials and in safe handling procedures, including the use of personal protective equipment. The ARCP also trained them to carry out any necessary cleaning and rehousing: the City of Paris allots a specific yearly budget to provide institutions with housing materials and protective equipment for staff.

It is the negatives' degradation level (1= low, 4= high) that determines the priority for processing, treatment, rehousing, and digitization. Negatives at levels 2 – 3 are the first treated and digitized. Nitrate negatives are only destroyed when the ARCP assesses them as at the last stage of film decay (level 4), when the image is no longer visible. The Health and Security Department transports these negatives to a laboratory which specializes in the elimination of toxic and hazardous wastes.

Processing and rehousing have been completed for all of the institutions, with the exception of the larger collections at Roger-Viollet and *Bibliothèque Historique de la Ville de Paris* (BHVP), for which the treatment of the negatives is still in progress. The cool storage vault, located in downtown Paris, is readily accessible to the institutions and is limited by law to a weight of one ton of nitrate material. To date approximately 470,000 nitrate negatives have been treated and are stored in the cool storage facility. The long-term storage facility is not yet available and should be set up in a near future. Within the scope of the nitrate plan, 85,000 negatives have been digitized. The need for digitization of a large number of historic film negatives is one of the factors that initiated the creation of the *Parisienne de Photographie*.

THE DIGITIZATION PROGRAM

The Digitization Program, launched in 2006, gives the public access to the collections through websites and also allows for their commercial use. The *Parisienne de Photographie*, in charge of the digitization of the city's collections, works closely with the ARCP and all institutions.

Fig. 3. Dust removal on an album at the Cernuschi museum. © ARCP / Mairie de Paris.

Fig. 4. Dust removal on a Marville print at the Musée Carnavalet. © ARCP / Mairie de Paris.

Each participating institution's involvement is defined based on an annual schedule. Once the curator has selected photographs to be digitized, the ARCP provides process identification if necessary, assesses the condition of the selected photographs, and determines the needs for cleaning, rehousing, and any minor conservation treatment. Stabilization treatments, if necessary, are performed by ARCP staff. As in the Nitrate Plan, the ARCP oversees the preservation campaigns carried out by institutional staff members. Once the photographs are stabilized and rehoused, the *Parisienne de Photographie* performs the digitization work, mostly in situ. Following a strict protocol established by the ARCP Reproduction section, the photographs are digitized with their margins included, so that the public has a better understanding of the original objects. The target is set for 60,000 photographic items per year, among which 20,000 are nitrate films. The Preventive Conservation Section provides recommendations for the method of digitization and gives assistance in the handling of fragile objects if necessary.

Since the beginning of the digitization project, approximately 20,000 photographic items (not including nitrate negatives) have been stabilized through preventive conservation campaigns. The digital collections are available to the public on Specialized Libraries' intranet and on the website *Paris en image*.

THE COLOR AND DIGITAL PRINTS

Beside the issues surrounding the preservation of nitrate films, the issue of color and digital prints preservation is also considered as a priority. Only the Modern Art Museum (MAM) and the Maison Européenne de la Photographie (MEP) are prepared to house such items: in most municipal institutions these prints are stored without climate control, even though some of them require cold climate. The main goal of the Color Plan, launched in 2006, was therefore to improve the environmental conditions for highly sensitive color materials such as chromogenic processes or ink jet prints, by creating a common color storage vault for collections held by the Cultural Affairs Department. Surveys undertaken by the ARCP also permit the precise process identification and condition evaluation of the collection, and allow for the prioritizing of conservation interventions according to the level of urgency.

Addressing the Evaluation Issue of Contemporary Photographic Works of Art

The constant technical evolutions in the field of digital printing and proprietary nature of trade secrets prevent photograph conservators from accessing key information on this imaging technology. Also, conservators have to adapt their conservation methods according to the nature of the objects.

In 2007, Anne Cartier-Bresson and Françoise Ploye, former head of the Preventive Conservation Section, organized two research sessions on the identification, sensitivity, and cleaning of digital prints. These workshops were carried out by the *Institut National du Patrimoine* (INP) and a digital printing laboratory, Studio Franck Bordas. To increase its expertise with contemporary photographic objects and to better answer the needs of the contemporary collections, in 2007 the ARCP developed a questionnaire to be filled before each new acquisition[2]. The questionnaire gathers technical information on the process (such as the paper, the photographic laboratory, the printer, or the type of ink) and on the type of mounting system used. For work acquired prior to 2007 and when visual examination is not sufficient to identify the process or mounting technique, the gallery, the photographic laboratory, the printer, the mounting laboratory, or the author himself is contacted to gain further knowledge. In order to facilitate discussions and to better describe the artifacts, the ARCP also developed a shared terminology and a technical glossary.

The Specific Case of the Fonds Municipal d'Art Contemporain (FMAC)

The FMAC is a municipal cultural institution dedicated to the promotion and diffusion of contemporary art. Its main missions are to encourage artistic creation and to exhibit to a wide public the works of art acquired by the City of Paris. The FMAC's collection is exhibited in public places such as city halls, councilors' offices, public libraries, and schools, and consequently in conditions that do not meet with preservation requirements. Therefore, knowing printing processes and their sensitivity, and the potential exhibition locations and their environmental conditions (humidity, light, pollution sources, etc.) becomes essential. Beginning in 2007 the ARCP has assessed these environmental parameters, which are collected in a FileMaker Pro database. Used as a monitoring tool, the database includes colorimetric readings collected by the ARCP before and after exhibition, and is also enriched by the FMAC's staff with data from the exhibiting places.

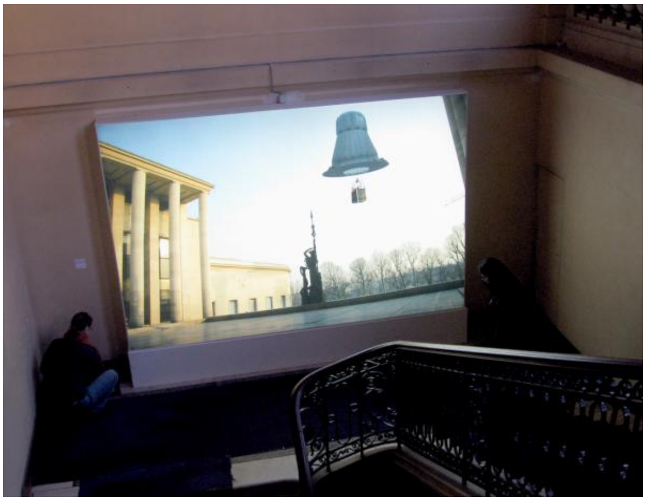

Fig. 5. Loris Gréaud, *Sans titre (une prophétie)*. Ink jet print on backlit canvas. Wedding stairs, 13th district City Hall.

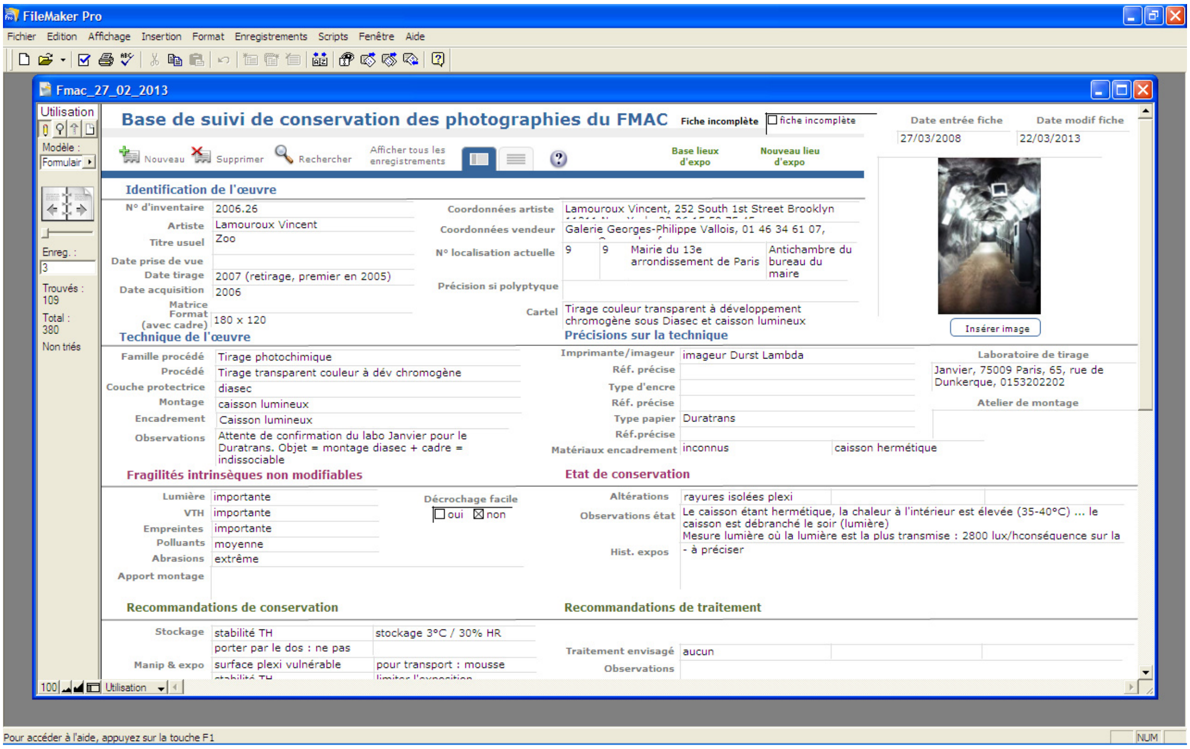

Fig. 6. The FMAC FileMaker Pro database.

Since 2007 each artifact is examined upon acquisition and the most suitable hanging location is selected, according to the object's mode of presentation and fragilities.

In the framework of contemporary art preservation, collaboration with the artist may also be sought when seeking to improve the preservation capacity of a frame or mounting system while remaining in accordance with the artist's intent. For example a more protective frame was proposed for the Jimmy Robert's work *Untitled (period drama)*, which was acquired by the FMAC in 2011. The inkjet print on fine art paper arrived in the collection with precise instructions on how it should be exhibited. The artist's initial intent was to simply hang the print with two pins fixed at the two upper corners so that the lower edge would roll up. The print was also to be shown in a frame without protective glazing. We proposed two different frames: a frame without glazing as desired by the artist, for exhibition areas that met preservation standards, and a deep frame with protective glazing for exhibitions in other public places. The second frame is deep enough to allow the print's lower edge roll up as desired. Also, as the original pins used to attach the print to the wall were not strong enough to support the weight of the paper, they were replaced by similar-looking magnets.

Fig. 7. Jimmy Robert, *Untitled (period drama).* Ink jet print on paper. The FIAC exhibition, Grand Palais, 2011. FMAC Collection © Jimmy Robert/FMAC,Ville de Paris/Christophe Noël.

Since 2007 the color and digital print collections at the MAM, the MEP, the Musée Carnavalet, and the FMAC's collection have been examined: this represents the majority of the City's contemporary color photography collections. The other smaller collections will be surveyed within the next two years. Thanks to these first studies, it is already possible to estimate the space requirements necessary for the future storage facility, which will meet the current conservation environmental standards for very fragile processes (ISO 18920: 2011 (E)). Moreover, this survey substantially improves our understanding of the different processes that can be found in the collections, as well as our knowledge for the digital photographic processes.

Fig. 8. Taking light readings in a school. © FMAC/Mairie de Paris.

Fig. 9. The FMAC's storage space. © FMAC / Mairie de Paris.

GENERAL PRESERVATION CAMPAIGNS: THE MARVILLE GLASS PLATE NEGATIVES PROJECT

In parallel with these specific plans, the ARCP Preventive Conservation Section is studying portions or entire collections in order to prioritize for conservation treatments evaluate a potential biological contamination, or to organize a moving for a collection. In 2010 a preservation campaign at the BHVP was undertaken for the more than 800 collodion glass plate negatives by Charles Marville. The goal of the project was to develop a proper conservation treatment procedure and custom-made housings for this precious and highly fragile collection.

Charles Marville was an official photographer for the City of Paris, probably starting his work around 1860. It is around that time that he abandoned the paper negative process in favor of exclusively using the collodion glass plate technique. As a municipal photographer, Marville's mission was to illustrate the major urbanization modifications undertaken by Georges-Eugène Haussmann (commonly known as Baron Haussmann) as well as the last remaining unhealthy neighborhood before being demolished. The BHVP's plates date from the mid-1860's and show the new urban structures, the capital's streets and buildings or the ongoing construction works.

The 800 glass plates, measuring 30 x 40 cm and 40 x 50 cm, were stored in 39 vintage wooden boxes and in a few cardboard boxes. A representative survey indicated that the majority of the glasses used were convex and that their dimensions were not standardized. Graphite pencil or watercolor retouching, varnished masks and fake painted skies were applied to numerous negatives. A few paper masks were also applied on the glass side of the negatives. Marville occasionally drew characters with a graphite pencil in order to populate some of his pictures. More than 500 negatives exhibited glass deterioration, which was responsible for the degradation and adhesive failure of the collodion binder. Of the negatives, 10% of the plates were either broken, incomplete, or exhibited flaking of the binder.

Thanks to the survey, the ARCP was able to organize the cleaning and rehousing of the negatives in situ at the BHVP. As the plates were convex and in non-standard sizes, a mat board case with spacers was specially designed in one size that would fit all the plates. Negatives that were cracked or broken or that had flaking collodion binders received conservation treatment in the laboratory. In order to properly house the 10% of the glass plates that were severely damaged, the ARCP adopted a frame designed by Fabien Cannarella, photograph conservator, as part of his INP Master's thesis in 2010. This sealed, semi-hermetic frame offers protection against the variations in relative humidity that speed up glass deterioration. Its transparency enables the examination and digitization of the plate without having to handle it directly. The flaking and lifting collodion was consolidated using a solution of ethanol, gelatin and water. As of publication, all the plates have been stabilized and the main part of the collection is digitized.

Fig 10. Original wooden boxes of the Marville collection. © ARCP / Mairie de Paris.

Fig. 11. An opened wooden box from the Marville collection. © ARCP / Mairie de Paris.

Fig. 12. Charles Marville, *Place du Châtelet, théâtre du Châtelet*, (ca. 1865), collodion glass plate. 30 x 40 cm. The BHVP collection. © ARCP / Mairie de Paris.

Fig. 13. The conservation frame in the reinforced conservation card box. © ARCP / Mairie de Paris.

CONCLUSION

The PSVPP has led to a great collaborative effort between a number of cultural institutions. This collaborative project enables the stakeholders to strategically address the treatment needs of the collections, which include millions of photographs. It has provided the opportunity to plan and schedule long-term on-going preservation projects, with shared resources, such as storage vaults. Although the methodology used is always adapted to the specificities of the institutions, the comprehensive approach of the ARCP guarantees consistent, coherent, and thorough managements procedures.

The Color and Digital Prints Plan and the Nitrate Plan are current priorities though the general conservation survey and preservation work continue: a survey of the France Soir newspaper collection is planned for the coming year (2014). This collection of the eponymous newspaper, the full importance of which is yet unknown, is presently thought to contain hundreds of thousands of items with a great historic interest. Ultimately, dealing with the eight million photographs that are part of the city's cultural heritage will remain a work in progress on the long term.

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NOTES

1. The ARCP works with more than eight millions photographs, including more than four millions negatives, held in the collections of 13 museums, four major libraries, archives, a photographic agency collection (Roger-Viollet) and specific institutions such as the *Maison Européenne de la Photographie* or the *Cinémathèque Robert Lynen*.

2. The French version of our acquisition questionnaire evolved further when the AIC developed the Photograph Information Record (PIR), to which the ARCP contributed: (http://www.paris.fr/politiques/atelier-de-restauration-et-de-conservation-des-photographies-de-la-ville-de-paris/documentation/documentation/formulaire-de-renseignements-sur-les-materiaux-et-techniques-des-photographies-contemporaines/rub_7833_dossier_29674_port_18051_sheet_13478).

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Preserving Underserved Historically Significant Photographic Collections: An Overview of the Andrew W. Mellon Funded Photographic Preservation Project with the Historically Black Colleges and Universities

Jessica Keister, Rachel Wetzel, and Barbara Lemmen

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Abstract

The role of the photograph conservator has evolved from a solo individual conducting conservation treatments to include advisor, advocate, surveyor, and teacher. From 2007 to 2013, photograph conservators at the Conservation Center for Art & Historic Artifacts (CCAHA) have been participating in a major project involving Historically Black Colleges and Universities (HBCUs) that reflects the current, expanded responsibilities of the photograph conservator.

This Andrew W. Mellon Foundation-sponsored HBCU Photographic Preservation Project is now in the second cycle of the program, which is currently drawing to a close. The primary goals of the project were to empower the institutions to care for their photographic collections and to involve minority students in preservation and conservation activities. Each institution was provided with specialized education and training for the staff and students and a generous grant that was used to improve the overall environment and housing for their historically significant collections. This project illustrates how outreach programs can benefit underserved collections and provide basic training to those who otherwise do not have access to it. It can also serve as a model for interactions between conservators and affiliated professionals as well as fostering creative and beneficial teamwork within a group of conservators. Other participating institutions include LYRASIS, the HBCU Library Alliance, the University of Delaware Art Conservation Department, and the Image Permanence Institute.

This paper will focus on the roles and experiences of the CCAHA photograph conservators. For further information on the first cycle of the HBCU Photographic Preservation Project, please refer to *Topics in Photographic Preservation*, Volume 13 (Gutierrez, 2009).

The HBCU Photographic Preservation Project

Historically Black Colleges and Universities are institutions of higher education in the United States that were established prior to 1964 with the specific intention of serving the African-American community. As of 2013, there were one hundred and five HBCUs and all but five are in the former slave states and territories.

These institutions, several of which existed prior to the end of the American Civil War in 1865, hold some of the most important primary documents relating to the history and cultural identity of African Americans. However, when it comes to preservation knowledge and awareness, the

Southern states - where the majority of HBCUs are located - are one of the more underserved regions of the United States.

Project Goals
The goals of the HBCU Photographic Preservation Project were to provide practical training in photograph preservation and environmental monitoring and control, to stabilize at-risk photographic collections at the selected HBCUs, and to build preservation capacity within HBCU institutions. Further project ambitions included involving HBCU students in the grant projects and introducing them to careers in preservation and conservation, strengthening connections between individual HBCUs, and creating connections between HBCU library and archives staff and preservation and conservation professionals.

Grant Summary
There were two rounds of grants. Each round was approximately three years in length, and each included ten HBCUs. The first round of the project began in the summer of 2007 and the second round in the summer of 2011.

Each HBCU received conservation assessments of their photographic collections, multiple training programs, assistance in establishing an environmental monitoring program, and funding to execute a number of demonstration projects. In each round, institutions selected were able to apply for up to $50,000 to complete their demonstration projects. A summary report and subsequent public presentation were expected at the conclusion of each round. The selected HBCUs were also expected to involve at least two student workers in the completion of these projects.

A consulting photograph conservator helped each HBCU to identify and execute these projects. Four photograph conservators (Barbara Lemmen, Rachel Wetzel, Jessica Keister, and Laura Wahl) from the Conservation Center for Art & Historic Artifacts were involved in this initiative. Photograph conservator Jae Gutierrez from the University of Delaware's Art Conservation Department also served as a consultant in the initial phase of each round.

The Role of the Conservation Center for Art & Historic Artifacts
CCAHA's photograph conservators were involved in both rounds of the project. Each consulting photograph conservator was assigned three to four schools for the duration of a grant round. Consultant consistency allowed for a relationship to develop between the conservator and the HBCU, ideally one of mutual trust and respect. This was especially true for schools selected for both rounds. In these cases, it was decided that the conservator who worked with them as the consultant in 2007 would continue in 2011.

This continuity was a definite advantage to both the HBCUs and to CCAHA, especially for the institutions that were selected for both rounds. Familiarity with the institution's staff, strengths, limitations, and particular needs, allowed for consultants to make the most efficient use of each institution's time and money. In the second round, consultants could pick up where the previous round had left off.

Collection Surveys

The consultants' involvement began by conducting surveys of the photographic collections held by the HBCU libraries and archives. This typically took one full workday, and included meeting the library and archives staff and student workers, and touring the storage and exhibition facilities. A small number of items were usually pulled from the collection, allowing for the assessment of the storage enclosures, the secondary housings, and the physical condition of the collections. Talking with the staff allowed consultants to get an idea of the HBCU library/archives experience in archives and in dealing with photograph collections. The level of experience proved to range widely.

The goals of the survey were to identify the needs of the collection and to assist the archivists in developing projects for their grant proposals. Possible projects for the grant may include the following: a pilot rehousing project for a well-defined portion of the photographic print collection; a project to remove original photographs from permanent display, to replace them with high-quality facsimiles and safely house the originals; the conservation treatment of a few highly significant items; or the purchase of a freezer and packaging film for cold storage.

In order to assist the HBCU staff, the consultants needed to know a number of facts, including the most significant portions of the collection and what the HBCU's own goals for the project were. So that suggestions were practical, it was necessary to be aware of any limitations each archive might have. Was staffing sufficient? Were there physical space restrictions? Did they have careful and reliable student workers or volunteers? Was the HVAC system operating correctly? Did they have security issues? Did their institution support professional development activities?

The typical HBCU archive has a number of beautiful and important objects, but staff are challenged by overcrowded storage spaces, limited intellectual control of collections, staff shortages, and large backlogs of material. And like many libraries and archives, they have limited funding for supplies and for professional development activities. However, what was especially striking and universal was the pride that HBCU staff take in their institutions and in their collections.

Workshops

Teaching workshops was a major component of the photograph conservators' role in the project. Because every year CCAHA hosts more than 45 workshops on a variety of topics, CCAHA was in an ideal position to bring a great deal of teaching experience to the table. And once again, CCAHA's involvement in both rounds of the project was also an advantage in designing the workshops: the photograph conservators were able to evaluate the effectiveness of the workshops and to tailor them to better fit the needs of each HBCU.

Differences between Round One and Round Two Workshops

In 2007, a major multi-day symposium opened the project. This involved lectures on topics such as process identification, storage enclosures, and environmental monitoring, as well as smaller, hands-on sessions. It was followed up a year into the project with site-specific workshops at each institution.

In 2011, the project began with a one-day workshop taught by the consultant photograph conservator in combination with the one-day photograph collection survey at each school. While the workshop did include a brief lecture on the history of photography and process identification, the focus was on identifying and selecting appropriate storage materials and on defining terminology such as alkaline buffered, neutral pH, and Photographic Activity Test. This knowledge was essential for planning projects and budgeting for supplies.

Most of the archivists had minimal experience with selecting appropriate storage enclosures. However most had trained as librarians, not as archivists, and were quick learners with good instincts.

In the 2007 and 2011 rounds, each follow-up set of workshops was tailored to the site, often incorporating hands-on lessons in rehousing or unframing, whatever was most vital for the HBCU to accomplish its demonstration project.

Standardized Workshops
To make the workshop process as efficient as possible and to ensure that the workshop content was consistent from site to site, standardized workshops were developed and utilized by CCAHA conservators. The same PowerPoint lectures, handouts, and hands-on or group activities were done at each participating HBCU. The workshop materials were stored online in a Dropbox (a free online file-storage and sharing system) folder accessible to all consultants and could be accessed anywhere there was an Internet connection.

Workshop Development
The workshops were based on pre-existing CCAHA workshops. CCAHA evaluates workshops before and after each event in order to monitor its effectiveness. Over time, this has allowed for the refinement of CCAHA-sponsored training sessions.

CCAHA photograph conservators worked together to select the topics that that would be offered as workshops to the HBCUs, and then divided the tasks of developing handouts, activities, and presentations. In designing the workshops, it was important to include a hands-on component for each session.

Workshop Example: Storage Lecture and Activity
During the initial workshop, a session on selecting storage enclosures began with a thirty-minute PowerPoint lecture. The lecture concluded with photographs of actual, but unidentified, archive collections surveyed by CCAHA staff. The workshop participants were encouraged to discuss the archive pictured: Was there a clearly visible problem? How could it be addressed?

After the lecture and discussion, the participants were split into small groups of four-to-five people. Each group was supplied with multiple archival supply catalogues and a typed card outlining a storage scenario. There were five different scenarios that were designed to reflect the conditions and collections of an HBCU archive. The members of each group needed to work together, using the supply catalogues, to design a housing solution for their scenario. They could be as detailed as they wanted, some choosing to outline multiple options, some giving themselves budgetary constraints and carefully calculating quantities and prices. Afterwards each group shared its scenario and its solution with all of the participants. They were encouraged to explain the reasoning behind their decisions and to use the appropriate preservation terminology.

This lecture/discussion/activity was based on a workshop session that CCAHA has been doing for over two years. After the appropriate terminology is introduced in a separate lecture and activity, it is reinforced through repetition. Using up-to-date catalogues from archival suppliers introduces participants to their existence, to navigating the catalogues, and to critically evaluating product descriptions. The various scenarios prompt discussion of collections in a similar condition or of past experiences.

Reaching Beyond the HBCUs
During both rounds of the project, whenever an HBCU was hosting an on-site training session, they were strongly encouraged to invite archives and library professionals from neighboring institutions, as well as individuals from other departments on campus. Opening the workshops beyond the HBCU strengthened connections between archives and library professionals within the wider community. Because the workshops are designed to start dialogues, a group from diverse backgrounds makes for better discussions and a better learning experience for all involved. And because these workshops were free and in their area, archives and library professionals in underserved areas of the country were able to attend a workshop they might not have had the opportunity to otherwise.

Conservation Treatment

Conservation treatment was one of the options under the umbrella of the grant guidelines. While not required, those HBCUs that had items in great need of conservation treatment were allowed to send their materials out to conservators. Since the South is an underserved area for photograph conservation, and because CCAHA staff had made such close connections with the staff of the HBCUs, many of them decided to ship their items to Philadelphia for conservation treatment.

CCAHA was an ideal setting for those treatment projects. In addition to having four photograph conservators on staff, CCAHA was able to offer imaging and housing services and treatment for objects such as photographic albums, as there are a number of book conservators on staff.

One of the most popular items for conservation treatment was the rolled panoramas. The HBCUs take pride in their school alumni, so these panoramic images of former classes are of great value to the schools. Having the panoramas humidified, mended, and flattened was a high priority for the schools, even though these often posed housing challenges post-treatment. Custom storage folders or boxes were made for these oversized pieces, ensuring their safe storage upon return to their HBCU.

Almost all of the schools had handmade class photo collages in their collections. Due to the poor quality materials used in their construction and their large sizes (up to 40 x 60”), these presented both conservation and housing challenges. In some cases full treatments were performed, while others were stabilized in situ.

In addition to these materials, conservation was also done on a number of cabinet cards and carte-de-visites, crayon enlargements, photo buttons, and photograph albums. In the cases of the albums, the photographs were treated by the photograph conservators and the pages, covers, and binding components were treated by the book conservators. One of the most exciting artifacts discovered within an HBCU collection and treated at CCAHA was a very rare ambrotype campaign button of Abraham Lincoln.

Conclusion

For the CCAHA conservators, the most rewarding part of the project was the relationships formed between the people involved in the project. Having the opportunity to work intensively with the staff at several institutions over time has been invaluable, and has enabled all parties involved to look holistically and long-term at preservation goals and outcomes. Helping the HBCUs to form support networks, not only within their own communities but with related professionals and preservation specialists across the country, has been an extremely gratifying endeavor. For the HBCUs, knowing that they all face similar challenges, no matter the geographical location or contents of the collection, is a very reassuring thing.

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Effective Advocacy and Partnerships: Lessons Learned from Global Photograph Preservation Initiatives

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Presented at the 2013 AIC-PMG & ICOM-CC Photograph Conservation Joint Winter Meeting in Wellington, New Zealand

For nearly two centuries, the emergence and ascendancy of photography have sparked exchange and linked societies around the globe. In the nineteenth century in particular, photographs brought peoples of other cultures into one's living room and permitted glimpses of landscapes and cityscapes beyond imagining. Photographic images continue to this day to be highly valued across cultural, religious, ethnic, and socioeconomic divides. From Benin to Beirut, Bogota, Beijing, and Boston, photograph collections worldwide have an astonishing capacity to connect humanity and strengthen cultural identity. Photography is recognized as an art form, but in addition, these visual materials can promote reconciliation, enhance creative traditions, encourage societal improvements, foster exchange in countries where literacy remains low, and spark remembrance and appreciation where cultural heritage is endangered or lost.

Today, photograph preservation serves as a stimulus for broader community, enlightened policy-making, economic development, and an incentive for smaller nations whose cultural identify may be threatened. As global societies suffer from increased and near catastrophic economic and other crises, the need to preserve their tangible and intangible heritage is elevated. And while often underfunded, memory projects of all kinds are mounting in numbers, with many cultural leaders fully committed to their cause.

Photographic collections are essential documents of our history and cultural identity, yet these holdings are often at risk, located as they are in storage environments with inadequate controls to temper the effects of a broad spectrum of climatic conditions – from temperate desert to unrelenting monsoon. High relative humidity and temperature conditions, mold, insects, pollutants, poor storage enclosures, and indelicate handling practices all represent invasive agents of deterioration and are universal. The need to preserve born-digital and reformatted collections further dilutes attention and resources to care for irreplaceable originals. Accelerating the urgency are the recurrence and cost of natural disasters globally. Tsunamis and hurricanes underscore the vulnerability of cultural institutions in areas at or near sea level, while tornadoes, mudslides, floods, and earthquakes devastate collections in all regions of the world. Human conflict internationally can be a final source of devastation and destruction. We must work in partnership to promote the vital importance of emergency planning and the ongoing need for better coordinated response worldwide, especially within the developing world, where photographic collections are threatened by neglect and immediate degradation.

As photograph conservation professionals, we have the capacity, and indeed the responsibility, to engage with others and to serve as global ambassadors connecting projects to resources while promoting shared decision-making and cost-effective, indigenous solutions. We must use emerging technologies to establish innovative platforms for multi-lingual networking and focus on on-the-ground training while building new collaborative partnerships worldwide. Our work – in association with others – makes photographic collections of all kinds accessible now and in the future.

Lessons learned from the study of photograph preservation projects are invaluable. Initiatives over the past 5 years involving two countries or more are charted at http://goo.gl/maps/UL5S7. This evolving Google map[1] documents a wide range of photograph preservation activities, including collection assessments, training programs, workshops, courses, and collaborative scientific investigation. Data gathered outline the type of project, participants, goal, time frame, and funders, and may be used to assess progress and identify opportunities. An investment by the European Union, for example, has strengthened applied research in this region. Educational projects, from workshops to webinars and hybrid models, serve as educational models that can be repeated and copied to populate numerous cultural centers, as they should and must. However, many projects remain uncharted, and entire continents of the world – such as Africa, Asia, and South America – are underserved.[2]

While best practices in photograph preservation continue to evolve, a study of many successful projects worldwide reveal the following essentials for success:

- Connect preservation initiatives to broader efforts in energy, environment, and economic development. People connect around emergency response and recovery. (Prior planning and emergency mitigation, however, are vital to prevent catastrophic loss.)

- Projects promoting reconciliation and shared understanding resonate with many and may garner increased attention and resources. Peace-building projects are powerful and link beautifully with the preservation of shared photographic heritage.

- Identify regional partners with a track record for leadership, creative thinking, advocacy, and capacity building.

- Sustained interaction is essential to building lasting and effective professional and personal networks centered on trust and shared understanding. Use e-mail, social media, and voice over internet (VOI) systems where available to control costs and ensure regular contact.

- Limitations on global travel mandate effective use of new communication tools and technologies. Many interesting and effective platforms for information exchange are available for use in many parts of the globe.

- Engage local and regional decision makers to ensure that they are connected to preservation project development and implementation as soon as possible.

- Build visibility through effective public relations and marketing. Document clearly the project significance and need. Establish value in preserving both tangible and intangible heritage. Use cultural heritage and its care as a symbol for an engaged and empowered society.

- Share goals and establish a short- and long-term implementation time frame. Ensure this plan is well communicated to others. Do not operate in isolation.

- Photograph preservation training and curriculum development require time and careful attention to project realities. Focus on strong education and skill development to better ensure project sustainability and enhanced impact. Train-the-trainer or continuous learning initiatives are typically more effective than traditional workshops and seminars. Recorded webinars have merit as powerful educational tools – and this delivery system may allow for more direct translation into other languages.

- Deliverables must be measurable, requiring concrete expectations and outcomes. Many funders demand accountability. Project assessment is essential.

We cannot achieve all of these goals alone. Nor would we want to. Collaborative partnerships are essential to our progress as we work to document, analyze, and preserve photographic materials worldwide. These relationships may reveal new insights not easily predicted and rewards often impossible to fully imagine or appreciate. To be successful they require:

- Mutual respect and understanding among all partnering individuals and institutions

- Awareness of and respect for cultural differences and motivations

- Various perspectives, skills, and talents with full representation for all and inclusion of differing institutions

- Flexibility and willingness to always learn from each other

- Flexibility to adjust experience and standards based on local conditions and resources

- Open and frequent communication via conference call or email where available

- Shared vision and common mission

- Competent leadership

- Sufficient funds and time

- An implementation team

Weak institutional assets, discomfort with risk, poor follow-through, and limited accountability will deter progress. And while funding may be only one component of this equation, it is typically essential. Project monies must be invested wisely but without hesitation to ensure momentum and sustainability. Funding proposals should be well integrated within themes such as cultural diversity or identity, intercultural dialogue, global cooperation, and cultural access. In addition to the more traditional arts and humanities grants, science and technology funding streams and strategies that may further advance an understanding of photographic materials and their vulnerabilities must be pursued. Review targeted agency and foundation websites, past awards, and annual reports; assess application procedures; and reach out to program officers for additional insight and guidance. In doing so, document why the proposed preservation initiative is important, what will be accomplished, when these activities will take place, and how the proposed partners are best positioned to lead and sustain these activities. Consult *Collaboration and Fundraising: Preservation of Photographic Materials* by Dr. Maria Gonzalez as an essential resource for future photograph preservation projects worldwide and to accompany the Google Map.[3]

While money is important, people are crucial. Only individuals will have a passion and a commitment to advancing shared knowledge and advocacy.[4] Find those people and partner with them! As projects develop, one must always NETWORK and:

- Be open to all challenges.
- Be proactive with cultural heritage leaders.
- Be resourceful and positive – be a change maker not a problem creator.
- Focus on education and dissemination. Develop new portals, wikis, and webinars.
- Offer engaging public presentations on the preservation of family photographic treasures at all project venues.
- Develop a track record of collaboration.
- Share knowledge by reaching out using social media.
- Leverage community engagement and involve many constituencies at all times.
- Join IIC and ICOM-CC, and follow the work of ICCROM and UNESCO.
- Consider Fulbright opportunities.
- Offer TED-like talks internationally, and connect to global agendas of all kinds.

The loss of our photographic heritage is felt by all. Whether housed in museums, libraries, archives, news agencies, archeological repositories, or private dwellings, photographic collections worldwide are at risk. We hope the tools, resources, and guidelines provided here will catalyze and strengthen collaborative efforts to engage communities in the preservation of these materials for the enrichment of our world now and in the future.

Notes

1. This Google map is a work in progress. Any projects connecting two or more countries are welcome to be represented. Please organize your project information according to the format below along with your project's web link if available, and email this information to Debra Hess Norris (dhnorris@art-sci.udel.edu) or Megan Kirschenbaum (meganjane123@gmail.com).

    Example Format
    1. Location (city/country)
    2. Project Title
    3. Type of Project (preventive care or education and training or treatment and documentation or research and analysis)
    4. Engagement Dates
    5. Collaborator (agencies, institutions, etc.)
    6. Funders (if relevant)
    7. Project's Primary Goal (one sentence or so only)

2. For greater discussion on selected global projects see *From Russia to Laos: Building Global Partnerships To Preserve Photographic Heritage* by Debra Hess Norris, Martin Jürgens, Nora Kennedy, Bertrand Lavédrine, and Paul Messier, *Conservation Perspectives, The GCI Newsletter. 27.1 (Spring 2012).* http://www.getty.edu/conservation/publications_resources/newsletters/27_1/feature.html

3. See the following: http://www.connectingtocollections.org/wp-content/uploads/2013/05/Collaboration_and_Fundraising_for_Preservation_of_Photographic_Materials.pdf.

4. See the following publications for useful suggestions and best practices for general collections care advocacy. Much of this information applies to photographic holdings.

    Heritage Preservation. Capitalize on Collections Care To Increase Support, Generate Contributions and Donations, Increase Membership and Support, and Stimulate Earned Income. Washington DC: Heritage Preservation, Inc. 2003.

    Heritage Preservation. A Public Trust at Risk: The Heritage Health Index Report on the State of America's Collections. Washington D.C.: Heritage Preservation, Inc. 2005. Institute of Museum and Library Services (IMLS), *Connecting to Collections* initiative, National Commission for Culture and the Arts. Also see recorded webinars at the Connecting to Collections Online Community (http://www.heritagepreservation.org/c2c/) which include many sessions addressing various aspects of advocacy: (http://www.connectingtocollections.org/topic/recordings/).

    There are a myriad of excellent books on effective collaboration, including these two classics: *Principle-Centered Leadership* by Stephen R. Covey (1991) and *The Visionary Leader* by Bob Wall, Robert Solum and Mark Sobol (1992).

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Extending Our Reach: Effective Methods for Engaging Allied and Public Audiences with Photograph Preservation

Heather Brown

Presented as a poster at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Abstract

The *Extending Our Reach* poster offers tips for web-based outreach and advocacy methods that can be used to raise awareness about photograph preservation with collection caretakers and the public, both locally and globally. The poster is divided into four sections: traditional outreach methods-enhanced, media libraries, content-sharing services, and professional networks, with a bonus section on consolidation to help manage all of your social media sites.

Introduction

While traditional outreach techniques, such as printed literature and live presentations, can be successful, this poster emphasizes new directions that conservators can take to engage allied and public audiences. With the help of social media, we can share information through a blog, collaborate on a project using a wiki, or comment on a question via a professional forum. To help measure the effectiveness of our efforts, many web-based platforms include analytic features to track the number and location of all participants.

The poster is divided into four sections: traditional outreach methods-enhanced, content-sharing services, professional networks, and media libraries, with a bonus section on consolidation. The traditional outreach methods section shows examples of websites that can creatively enhance powerpoint, image, and video presentations and increase interactivity. The content-sharing services section explores wikis, webinars, blogs, and microblogs, including Wordpress and Twitter. The professional networks section covers the various applications for Facebook and LinkedIn. Finally, the media libraries section describes sites that store video and audio materials, for example, YouTube and iTunes. Using a consolidation tool like IFTTT, you can aggregate many of your social media sites to expand your impact with a fraction of the effort.

Why use social media?

Social media platforms offer new directions that photograph conservators can take to engage allied and public audiences, all from the comforts of home. Not only are these methods easy to use, they are also wide reaching, allowing knowledge to be distributed at a rapid pace.

These outreach methods broaden our knowledge and collaborative opportunities. They strengthen our impact and allow us to reach new audiences to teach about effective preservation strategies. Looking toward the future, it is important that conservators take advantage of all tools and technologies available to better ensure the long-term preservation of our photographic heritage.

How do I start?
All of the platforms below present unique and useful tools to engage audiences about photograph preservation. The best way to get started using social media is to choose one of the following goals: to enhance your current outreach materials, to share new research, to organize audio/visual media and make it available to the public, or to connect with other conservators and allied professionals. Now, choose one of the websites in that category below.

Once you feel comfortable with one social media site, you can start another, and another. You can even discover new web-based platforms on your own and adapt them to serve your purpose of conservation outreach.

Tips
1. Stay consistent with your tone and usage to build a regular audience.
2. If your site has analytical features, check them often to better understand your audience.
3. Gain permission before posting any materials that belong to someone else.
4. Make the best use of your time by implementing a consolidation tool (see IFTTT below).

Traditional Outreach Methods – Enhanced

historypin

www.historypin.com

In place of a printed leaflet, this site allows you to share photographic history by posting images onto a map in their original geographic location. All images are searchable by place, date, or subject, and organized into worldwide projects or personal collections.

slideshare

www.slideshare.net

When you are unable to give a live presentation, SlideShare lets you distribute your materials electronically. You can add a script or voice recording to a presentation, conduct a live meeting, and adjust settings to private or public.

Google+ Hangouts!

https://plus.google.com/hangouts

Using the new Broadcast feature, you can present a webinar to an unlimited number of viewers. Rather than holding a conservation clinic for a handful of people, this platform makes it possible to answer frequently asked preservation questions online.

iTunes

www.apple.com/itunes

Traditionally, museum labels were used to make conservation-related information available in a museum. Now, iTunes allows you to present a narrative, facts, interviews, and more as a podcast that is available through the visitor's personal electronic device.

YouTube

www.youtube.com

With YouTube, you can record a lab tour and make it available to millions of viewers online. Uploading videos to a channel (e.g. "conservation", or an institution) provides easy access for anyone interested in the topic. Viewer's can also ask questions through the comments feature.

Media Libraries

CONSERVATIONREEL http://conservationreel.org

Conservation Reel was established in 2011 by the Balboa Art Conservation Center in San Diego. Use this public-accessible site to share videos about a conservation treatment or research project. All content can be organized by series, contributor, or tags.

flickr www.flickr.com

This site, created by Yahoo!, allows you to upload all of your project or workshop images to one central location, and then share them through your own personal gallery, or by adding them to a public or private group.

Content-Sharing Services

WIKIPEDIA
The Free Encyclopedia www.wikipedia.org

A Wikipedia entry is often the first source that appears when we search for a keyword online, so why not take advantage of the site's popularity, and enter accurate information about photographs and preservation? Other Wikimedia projects, such as Commons (images) and Wiktionary (terms) give the editor the power to control what viewers will associate with a particular topic.

weebly www.weebly.com

WordPress http://wordpress.com

tumblr. www.tumblr.com

Blogging software is becoming more advanced, allowing you to create a professional-looking website with no previous web-building skills. Whether posting text, images, audio or video—or a combination—blogs are surprisingly easy to create and go a long way in terms of sharing information.

twitter www.twitter.com

While many social media platforms allow you to share information quickly, Twitter provides the means to share up to 140 characters *immediately*. Twitter followers can receive your tweets like text messages on their phones, making it possible to send up-to-date news from a conference or workshop.

Dropbox www.dropbox.com

Dropbox is a smart way to save and share files because they are automatically backed up onto an online server when they are saved. You can make teaching materials available to a class or collaborate on a project without having to email an updated draft each time a file is edited.

Professional Networks

www.facebook.com

Facebook can be an easy way to connect with specific people or audiences, by either tagging friends in a post, or posting directly to a group's wall. As more people sign up for Facebook, it becomes a central hub for sharing information from the other social media sites.

www.linkedin.com

Where Facebook is considered a true "social" network, Linkedin offers more professional connections that may help in meeting allied professionals. By joining a group (e.g. Conservator-Restorer), you can hold a conversation with members from around the world about a specific question or topic.

Consolidation

https://ifttt.com

This site will help you multi-task with your social media outreach tools. Create custom recipes that will automatically publish to multiple sites when you add content to one.

Conclusion

These outreach methods broaden our knowledge and collaborative opportunities. They strengthen our impact and allow us to reach new audiences to teach about effective preservation strategies. Looking toward the future, many of these websites will likely change, but it is important that conservators continue to take advantage of all tools and technologies available to better ensure the long-term preservation of our photographic heritage.

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The Middle East Photograph Preservation Initiative 2011-2013: Mapping Photograph Archives and Training Collection Keepers

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Presented as a poster at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

Abstract
The Middle East Photograph Preservation Initiative (MEPPI) is a unique project that has, since 2009, identified nearly 300 photographs collections in the broad Middle East, and provided training for 38 collections in 14 countries, helping to preserve over 15 million photographs.

1. Introduction

The Middle East Photograph Preservation Initiative (MEPPI) was launched in 2009 as a pilot project encompassing networking, educational and awareness raising functions. Starting in 2011, MEPPI has developed into a full program incorporating a mapping component and a training component, both contributing to a better understanding of the state of photograph collections in the region, and building a strong network of photograph preservation professionals in the broad Middle East – extending through North Africa, the Arabian Peninsula and the Eastern Mediterranean to Iran and Turkey. MEPPI was initially conceived in response to two observations: that the region was home to many undervalued photograph collections, and that the custodians of these collections unanimously expressed a need for access to preservation education and resources (see Kennedy *et al*., 2010). The project is led jointly by the Arab Image Foundation (AIF), the Art Conservation Department at the University of Delaware, Photograph Conservation at The Metropolitan Museum of Art, and the Getty Conservation Institute. It is funded by a generous grant from The Andrew W. Mellon Foundation, with additional funding from the Getty Conservation Institute (GCI).

2. The MEPPI Survey: Mapping Photograph Collections in the Arab World and Beyond

In 2011, the Arab Image Foundation initiated a one-year survey to locate and document photograph collections in North Africa, the Arab Peninsula and the Eastern Mediterranean. Three scholars were hired with Mellon funding, and assigned a region each. Art historian and researcher Jean-Gabriel Leturcq assessed collections in Libya and the Arab Peninsula, identifying over 80 repositories. Dr. Mark Westmoreland, a visual anthropologist and professor at the American University of Cairo, researched Egypt, Jordan and Palestine, visiting and mapping over 90 collections. The third researcher, Marie Moignard, contributed 30 names to the list of collections in North Africa. As of September 2013, nearly 300 photograph collections have been surveyed, with a focus on institutional collections held in national libraries and archives, museums, universities, press agencies, as well as some significant private collections.

The researchers contacted collections via e-mail or telephone, visiting where possible to meet and interview staff and to see holdings. Basic information was collected for each institution, using a form available in Arabic, English and French that included questions about the photographic formats and time periods represented, the collection's history and plans for the future, its storage conditions, and its availability to the public. The completed survey form was submitted to the AIF.

The results of this important work are centralized at the Arab Image Foundation, where staff members added to the collections surveyed and updated information, through encounters with collection keepers at the AIF's premises in Beirut, or during research trips to Jordan, Egypt, Morocco, Turkey, and the United Arab Emirates. Collections have proved easy to approach and open to discussion, particularly when presented with the benefits of connecting with other collections from the region and with preservation experts. Some have had questions about the future use of collected information and voiced concerns over the risk they might incur in case that information was made public, particularly in Egypt, Iraq and Syria. This is an understandable response in countries undergoing recent and current socio-political upheaval.

Taking into account the needs and concerns expressed by the collections approached, the Arab Image Foundation is currently developing a directory that will be published online, on the project website, by the end of 2013. In the trilingual directory, collections will be listed by type (archive, library, etc.) and will be searchable by country, time period and topics covered. Each entry will be illustrated with representative sample images, accessible with the owner's approval. With this platform, MEPPI project partners hope to create a regional hub for research about the region's photographic heritage. Specific mapping projects led by third parties in Egypt, Jordan, Palestine, Qatar, and others yet to be identified, will be associated to the directory, with their permission.

3. MEPPI Courses: Training Those Responsible for Photograph Collections in the Broad Middle East

Following the pilot workshop held in Beirut in 2009, the MEPPI partners developed a cycle of three photograph preservation courses. Each course welcomes 14 to 18 participants representing a variety of photograph collections from the broad Middle East. Participants are selected after answering a call for applications, which was answered in 2011 by 41 applicants; in 2012 by 61 applicants; and in 2013 by 85 applicants. MEPPI Courses start with an eight-day bilingual workshop offering theoretical and practical sessions on process identification, best practices in housing, storage, exhibition and climate control, as well as sessions presenting common forms of deterioration and damage and suggested responses. Core instructors of the course are Debra Hess Norris (University of Delaware), Nora Kennedy (The Metropolitan Museum of Art), Bertrand Lavédrine (Centre de Recherche sur la Conservation des Collections) and Tram Vo (Getty Conservation Institute). Guest instructors offer additional sessions on the history of photography in the Arab world, digitization practices and standards, artistic practices using photographic archives, as well as fundraising and advocacy for collections. Workshops typically include site visits to local institutions, either identified through the MEPPI Survey, or with MEPPI participants or alumni among their staff. One public lecture in each host location provides local audiences with perspectives on museum practice, contemporary art, and practical options for preserving family collections.

Following the workshop, participants engage in the distance-learning phase of the course, which is coordinated by the Getty Conservation Institute and lasts nine months. During this period, assignments range from assessing a collection to preparing an emergency plan. Participants disseminate information collected from the MEPPI workshop and online resources within their institutions and beyond. Some give public talks on photograph preservation. Clare Davies and Ibrahim Abdel-fattah engaged the public during an evening lecture and discussion of photograph preservation at the Contemporary Image Collective in Cairo in February 2012. In September 2013, Ziad Rajab shared his views about MEPPI goals and their impact on the Rajab Museum at Dar al-Athar al-Islamiyyah in Kuwait. Others participants from Egypt, Jordan, Lebanon, Morocco and the UAE were inspired to create working groups and collaborate on preservation and digitization projects, some informal and others on a formal level. The distance-mentoring phase is important for participants to implement the acquired skills and knowledge in their own institutions while still benefiting from a GCI advisor's input. It also is key to the MEPPI network's sustainability, as participants and alumni deepen their working and personal relationships and are able to view and learn from each other's assignments.

Finally, the course participants and instructors reconvene in a new location for a follow-up meeting – usually hosted by one of the course's participating institutions. At follow-up meetings, participants discuss their accomplishments and share their challenges. Tailored theoretical and practical sessions are offered – often with groups working collaboratively on solutions – such as the creation of specialized housings, the design of a storage area, or the evaluation of the process, condition, and storage and exhibition parameters of specific groups of sample photographs.

Since 2009, MEPPI has provided training for 38 collections in 14 countries, helping to preserve over 15 million photographs. Workshops and follow-up meetings have been held in Lebanon at the American University of Beirut and Arab Image Foundation; in Morocco at the Bibliothèque Nationale du Royaume du Maroc; in the UAE at New York University Abu Dhabi; and in Turkey at SALT Galata. Upcoming venues include the National Library of Jordan in Amman. Figure 1 below highlights the countries where institutions benefitted from training, and cities where workshops were held. A detailed list of MEPPI alumni is provided in Figure 2.

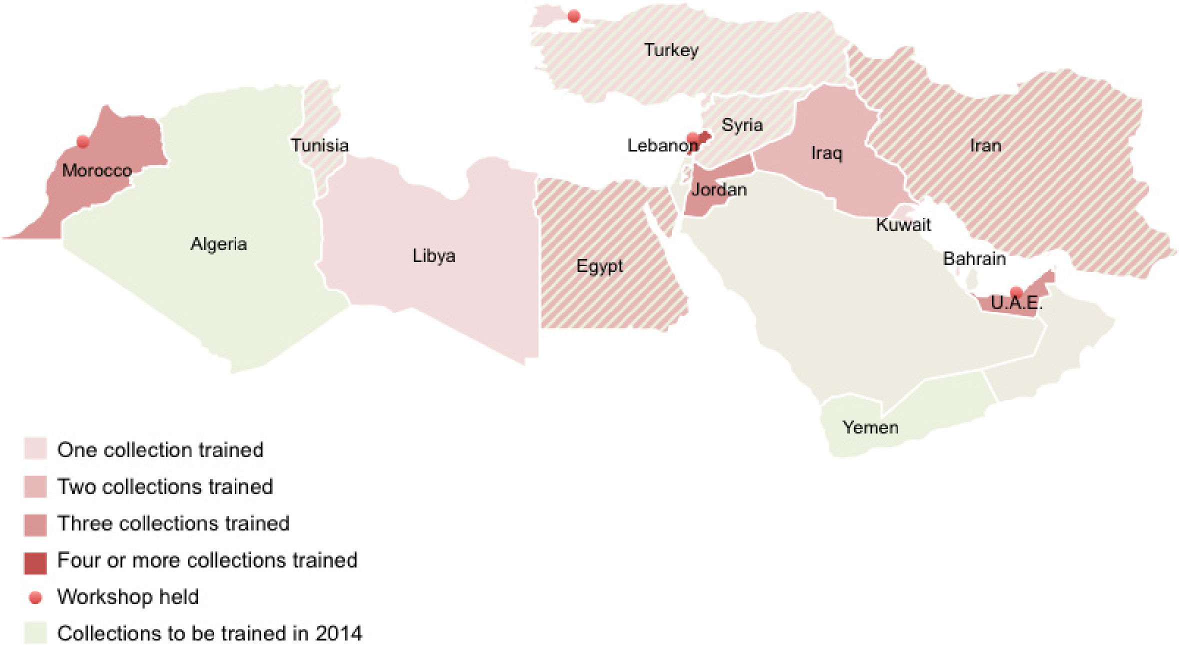

Fig.1. Participating and host countries of MEPPI Courses, 2009-2013.
Source: MEPPI project, map by author.

Figure 2: Alumni of MEPPI Courses, 2009-2013.

Country	**Institution**	**Type**	**Alumni**
Bahrain	Bahrain House of Photography	Archive	Hussain Mahroos
Egypt	American University in Cairo	University	Ola Seif
Egypt	CULTNAT	Public Research Center	Doaa Mohamed and Heba Farid
Egypt	Grand Egyptian Museum	Museum	Ibrahim Abdel-fattah
Egypt	The Qasr el Doubara Institute for Historical Research	Private Collection	Clare Davies
Egypt	Visual Cultural Heritage	Research Center	Mohamed Wishahi
Iran	Cultural Research Bureau	Research Center	Rana Javadi
Iran	Independent researcher	Private Collection	Mohammadreza Tahmasebpour
Iran	Kamran Collection	Independent Researcher	Kamran Najafzadeh
Iraq	Iraq National Library and Archive	National Library	Nahid Fadhil Mahdai
Iraq	Photographic Memory	Private Collection	Kifah Amin
Jordan	Department of Antiquities	Government Agency	Hala Qasem Abdallah Alsyouf
Jordan	National Library of Jordan	National Library	Muntaha Ibrahim Ayesh Aldiri
Jordan	Royal Court: Royal Protocol	National Archive	Salma K. Al Shuhail
Jordan	Yarmouk University	University	Atef Shiyab
Kuwait	Tareq Rajab Museum	Museum	Ziad Rajab
Lebanon	American University of Beirut	University	Kaoukab Chebaro
Lebanon	American University of Beirut	University	Samar Mikati Kaissi
Lebanon	An-nahar	Press	Nabila Bitar
Lebanon	Arab Image Foundation	Research Center	Ralph Nashawaty
Lebanon	Arab Image Foundation	Research Center	Sana Chkeibane
Lebanon	Arab Image Foundation	Research Center	Tamara Sawaya
Lebanon	Arab Image Foundation	Research Center	Walid Sader
Lebanon	Arab Image Foundation	Research Center	Yasmine Eid-Sabbagh and Fadi Soleiman
Lebanon	Daralhayat Information Center	Press	Nada Itani
Lebanon	Fouad Debbas Collection	Research Center	Yasmine Chemali
Lebanon	Institute for Palestine Studies	Research Center	Jeannette Sarouphim
Lebanon	Institute for Palestine Studies	Ministry	Mirna Kalash Itani
Lebanon	Ministry of Tourism	Museum	Ibtissam Fawaz
Lebanon	Musée National, Direction Générale des Antiquités	Museum	Carole Atallah
Lebanon	Musée National, Direction Générale des Antiquités	Private Collection	Rana Andari

Lebanon	Université St Joseph, Bibliothèque Orientale	University	Levon Nordiguian
Libya	Department of Antiquities	Government Agency	Farag Mohammed el Ferrjani
Morocco	Bibliothèque Générale et Archives de Tetouan	City archive	Ahmed Teimi
Morocco	Bibliothèque Nationale du Royaume du Maroc	National Library	Fatima Zohra Bouallaga
Morocco	Ecole Nationale d'Architecture	University	Touriya Elazri Ennassiri
Palestine	WAFA	Press	Nawaf Hamed
Palestine	Riwaq	Research Center	Iyad Issa
Syria	City of Aleppo archive	City Archive	Hala Hamcho
Tunisia	Centre de Documentation Nationale	National Archive	Kaouther Dridi
Turkey	Koç University Library	University	Huseyin Eski
UAE (Abu Dhabi)	Abu Dhabi Tourism and Culture Authority	Government Agency	Abdalla Mohamed Bastaki
UAE (Abu Dhabi)	Abu Dhabi Tourism and Culture Authority	Government Agency	Daniel Suarez
UAE (Abu Dhabi)	Abu Dhabi Tourism and Culture Authority	Government Agency	Fatima Al Dhaif
UAE (Abu Dhabi)	Abu Dhabi Tourism and Culture Authority	Government Agency	Jo-Fan Huang
UAE (Abu Dhabi)	El Etihad	Press	Tareq Al-Ghoul
UAE (Abu Dhabi)	Noor Ali Rashid archive	Private Collection	Safdar Rashid
UAE (Sharjah)	Sharjah Museums	Museum	Amna Al Humairi

Source: MEPPI project, table by author.

4. New Resources

Since 2009, the MEPPI partners have sought to make educational resources available throughout the region through the translation to Arabic of a number of key publications on photograph preservation. These include an English-Arabic-French glossary of photograph preservation terms, and a number of key scholarly articles on photograph preservation and preventive care. In 2010, the AIF – with the permission of the United States-based organization Heritage Preservation – produced an Arabic version of “The Emergency Response and Salvage Wheel”™, a tool outlining procedures for safeguarding heritage, including photograph materials, in times of natural or man-made disasters.

5. Impact and Main Successes

In order to assess participants’ satisfaction with each course, to improve the MEPPI curriculum, and to ensure, year after year, that collections’ needs and expectations are met by the MEPPI courses, the MEPPI partners have designed a course evaluation process, whereby participants fill out short questionnaires at the end of the initial workshop, and a more extensive course evaluation after the follow-up meeting. The latter contains a section assessing the impact of the course on participants' day-to-day work. Evaluations are completed anonymously and participants are encouraged to be honest and constructive. Participants will be contacted three years after "graduating" to once again assess the impact of the course they attended.

In the feedback from the 2011-2012 and 2012-2013 courses, 100% of participants said they would recommend the course to others in their profession. As one participant reported 'it's been an extraordinary experience of strategic importance for my institution'. 85% reported being familiar with the basic functions of photograph preservation and being able to apply the information confidently to their collections. When asked about what they were most proud of, many of the participants mentioned the network they are now part of, and the possibilities of regional collaboration. One participant wrote 'the outcomes of this workshop are quite amazing: with only a small group from different backgrounds we were able to understand and develop so much in the field'.

Among MEPPI alumni's most impressive achievements are the following:

Participants have reported the establishment of clearer objectives and policies for preservation. For example, alumni from CULTNAT in Egypt have developed image policy guidelines for their member institutions. An alumnus from the Tareq Rajab Museum in Kuwait has worked to clarify the objectives of the institution, in the course of which he has conducted a full inspection of the Museum, organized a thorough cleaning and reorganization of storage sites, and has developed an emergency plan.

Participants have reported major improvements in the housing and storage conditions of their collections. The collections of the Royal Court in Jordan were catalogued and rehoused. A micro-storage was created for the protection of early glass-plate negatives at the Grand Egyptian Museum. A rare degraded acetate film collection from Lebanon was assessed and the environment monitored using environment data loggers supplied by MEPPI. The Kamran Collection in Iran was organized and rehoused in custom-made individual enclosures, boxes and in cabinets. Three major archives in poor condition were reorganized and rehoused at the Bahrain Museum of Photography.

Projects were initiated for the protection of endangered collections of great significance in regions with political unrest. Plans were developed to move to safety a collection housed in rooftop storage units adjacent to the US Embassy in Cairo. Collections were salvaged and acquisition strategies developed for the National Library and Archives of Iraq and the WAFA News Agency in Palestine, following massive losses sustained during armed conflict.

Alumni also contributed to raising awareness in their respective countries about the importance of photography and photograph preservation. They gave public talks in venues such as the Contemporary Image Collective in Cairo (2012), the Turkish Librarian's Association's Istanbul branch (2013), and Dar al-Athar al-Islamiyyah in Kuwait (2013), among others. They published articles in newspapers in Lebanon, Palestine and Iran. An alumnus from the National Library of Jordan contributed to launching a weekly column in the country's most read newspaper where photographs from the National Library's archive are presented and documented. Archives in

Bahrain and Jordan invited members of the general public to contribute to their photograph collections. In addition, MEPPI colleagues have advocated forcefully with their supervisors and other high-level decision-makers to raise awareness and secure support, which helped ensure the safeguarding of important collections in Bahrain, Jordan, Tunisia, and in the UAE.

Participants engaged in research, and while working groups were created in Lebanon, Egypt, Morocco and the UAE, two institutions from Abu Dhabi even formalized common digitization standards. Meanwhile, one alumnus published his research on the history of the daguerreotype in Iran.

Finally, to date, two MEPPI alumni are pursuing graduate degrees in preservation and conservation following their participation in our courses. Ibrahim Abdel-fattah, from Egypt, is now a student at George Washington University in the Museum Studies Masters' program, while Fatima Al Dhaif from Abu Dhabi Tourism and Culture Authority is about to enroll at Camberwell University to pursue an MA in Conservation of Books and Archival Materials.

6. Challenges Ahead

While the successes of the MEPPI program are abundant, the organizing partners are also faced with a number of challenges.

Many participants reported that they had difficulty convincing their higher management that the institution's photograph archive should be a priority. Thanks to the first distance-mentoring assignment, requiring participants to present their accomplishments through MEPPI to their colleagues and supervisors, participants achieved some progress improving awareness at the management level. Others still feel they are fighting a lone battle within their institution, though gain courage from solidarity with MEPPI colleagues even from afar.

Additional difficulties are directly related to the region's sometimes unstable socio-political situation. Due to political complexities, participants from Egypt, Libya and Syria were unable to participate in all aspects of the course, though they have remained in touch with the cohort of alumni and with the instructors. All will be more than welcome to join a further edition of the course as the individual situation allows.

The final MEPPI course will take place in 2014, and MEPPI partners are preparing for the next steps for photograph preservation in the Middle East. Those include to more broadly raise awareness, at the decision-making level, of the importance of preserving the region's valuable photographic heritage. On the institutional level, this will allow for a better safeguarding of collections, and on the regional level, for improved policies for the protection of intangible heritage in general, and photographic heritage in particular. Related to this, the Arab Image Foundation will present a policy brief for intangible heritage in Lebanon later in 2013. In the meantime, MEPPI partners will continue their efforts to build capacity and sustain the network of committed and engaged preservation professionals recently established across the region. Alumni updates and updates from the field will be posted regularly on the MEPPI website. Participants will continue to connect through social media, and alumni and instructors will actively engage in the mentoring of new participants as well as others learning of the initiative.

Looking to the future, MEPPI partners are currently developing a series of shorter advanced workshops to be offered in 2015 and 2016 to MEPPI alumni. These workshops will focus on specific areas of photograph preservation as well as access, to include the preservation environment, safe exhibition practices, emergency preparedness and response, and digitization standards and practices. Though not a preservation theme *per se*, digitization is widely practiced and has an impact on how collections are used and appreciated.

A symposium to bring together all participants, instructors and photography enthusiasts is being planned as a culmination to MEPPI. This will feature speakers from a wide range of countries and collections, and will be a celebration of the new community devoted to the appreciation and long-term preservation of photography in the region. More information about the event will be announced soon.

Notes

1. Ongoing Photographic Memory of Egypt project at Center for Documentation of Cultural and Natural Heritage (CULTNAT), Cairo.

2. A survey conducted by UNESCO (United Nations Educational, Scientific and Cultural Organization) Office in Amman, Jordan.

3. Research led by the Institute for Palestine Studies, Ramallah, Palestine.

4. Ongoing Qatar Unified Imaging Project (QUIP), Doha, Qatar.

5. See references below for a list of translated publications.

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Further Readings

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Papers presented in *Topics in Photographic Preservation, Volume Fifteen* have not undergone a formal process of peer review.

Abstract: Faking It in Analog Terms

Nora W. Kennedy

Presented at the 2013 AIC & ICOM-CC Photographs Conservation Joint Meeting in Wellington, New Zealand.

We have surely and definitively left the analog age and are fully engrossed in the digital era of imaging. No more does one wait with anticipation to pick up those holiday snapshots from the photo finisher on the corner, uncertain whether the classic shots under difficult lighting conditions came out or not. The transition has been more rapid and complete than expected by some, the era of analog photography not even a memory for many now in their formative years. Terms are forgotten, concepts lost, meanings altered. In preparing a technical glossary for the exhibition catalog for *Faking It: Manipulated Photography Before PhotoShop*, interesting discussions led to the selection of terms from the analog era essential for the general public to understand photography from the past. Words like "darkroom" and "negative" are quaint and all but meaningless in today's world. Others have been adopted by image editing software such as Photoshop, introduced by Adobe in 1990. What is "combination printing" and how does it differ from "multiple exposure"? What are "composite prints" and how do "composite portraits" set themselves apart? This talk will review past terminology and explore some now forgotten techniques and materials used during the first 150 years of photography to create and manipulate images. All will be illustrated with photographs and details of photographs from the *Faking It* exhibition, opening at The Metropolitan Museum of Art in October 2013.

Fig. 1. Image above: Detail from the photomontage by George Washington Wilson: **Aberdeen Portraits No. 1**, 1857. Albumen silver print from glass negative. The Horace W. Goldsmith Foundation Fund, through Joyce and Robert Menschel, 2011. 2011.424 The Metropolitan Museum of Art.

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Francesca Woodman's *Untitled* Diazotype

Dana C. Hemmenway

Presented at the PMG session of the 2002 AIC Annual Meeting in Miami, Florida.

INTRODUCTION

In 1996 The Metropolitan Museum of Art (MMA) acquired a photograph by Francesca Woodman as a gift from a friend of the artist. It belongs to larger body of work that culminated in *Blueprint for a Temple* a work Woodman showed at the Alternative Museum in the spring of 1980. The image depicts an over life-size standing female nude, the artist herself, in tones of brown.

As the first diazotype to enter the collection of the Department of Photographs, curatorial and conservation staff sought confirmation of the photographic medium along with information about the process and its vulnerabilities. The author undertook this research as part of a 1996 student project for the Winterthur Museum/University of Delaware Program in Art Conservation. The objective was to provide background information on the history and chemistry of the process, perform scientific analysis to confirm process identification, seek a technical explanation of how diazotypes were made, and propose how Francesca Woodman was able to use the medium for her artistic purposes. Empirical tests were conducted on small samples of a similar diazotype material to provide some preliminary information as to what, if any, treatment techniques could be undertaken.

Fig.1. Francesca Woodman (American, Denver, Colorado 1958-1981 New York), *Untitled*, ca. 1980. Diazotype. The Metropolitan Museum of Art. Purchase: The Herbert and Nannette Rothschild Fund Gift, in memory of Judith Rothschild, 1996, (1996.322), 187 x 93.4 cm (73 5/8 x 36 ¾”). Courtesy of Betty and George Woodman.

THE HISTORY OF DIAZOTYPES/ USE IN INDUSTRY

The development, production and expansion of the synthetic dye industry is inextricably linked with the achievements of chemists working in the 19th century. They were applied to a multitude of fields where inexpensive color was desired. Diazo or azo dyes are a class of synthetic dyes that can produce many different colors by manipulating the fundamental coupling components. Kalle and Co. in 1920 introduced a dry process paper that contained the necessary two coupling components in the same paper (Brown 1944,146). It was this product, a dye line on white background, processed without wet chemistry, which proved most successful for the reprographic industry.

There are several good reasons for the diazotype's overwhelming commercial success and great appeal for the architect or engineer in the 20th century. They were simple to produce, inexpensive, offering speed, efficiency, and the ability to reproduce any number of copies from a single run. Dry processing ensured no dimensional change. A special class of diazotypes, called Sepia Line, was manufactured to function as a draft or intermediate copy. Corrections could be made directly onto the brown-toned sepia copy and then it was used to generate final copies available in colors such as blue, purple and black. By the turn of the 21st century the diazotype industry was largely supplanted by computer-based technology.

CHEMISTRY OF A DIAZOTYPE

Producing a diazotype relies on two basic chemical reactions. First, a diazonium compound (an aromatic ring with two nitrogen atoms) will yield a dye molecule when combined with an appropriate coupler under alkaline conditions. The combined compound contains an extended conjugated bond. Second, a diazonium compound can be chemically altered or deactivated through photodecomposition by ultraviolet (UV) radiation so that in alkaline conditions it can no longer combine with the coupler to produce a dye. The diazonium compound then is either deactivated by exposure to UV (losing it's ability to conjugate), or it will create a colored dye.

According to a representative of the Azon Corporation in 2002, the chemistry and formulations employed to manufacture diazotypes had not changed much since the late 1940s when the company was founded. There were several features critical to making the dry diazo system work for commercial purposes: adequate shelf life, non-yellowing paper, dyes with high tinctorial strength in various colors, and the addition of chemicals used to stabilize the coupling compounds to prevent premature coupling or discoloration (Lay, 2002).

The paper support needed to be hard sized, dense and resistant to penetration of upper coatings, and free of impurities that could react with dye forming compounds. To serve its function as an intermediate, the paper furnish of a sepia diazotype needed to be UV transparent in non-image areas. Fibers were made of highly beaten cotton and/or purified wood pulp (low lignin content) and were further transparentized by the addition of an oil or resin. The sepia paper supports also were manufactured to be thinner than the opaque varieties (Moser 1950, 232 & Lay 2002).

The paper base was pre-coated with a silica dispersion to enhance image quality by dramatically increasing the surface area for dye molecules to deposit onto, creating a dense velvety appearance. The pre-coat hindered diffusion of the acidic, image-coating layer into the support (feathering). This layer also provided tooth to facilitate the addition corrections directly to the intermediate. (Lay, 2002).

The final coating layer consisted of a solution of a diazonium salt, a coupling agent and numerous additives. Final image color was derived from carefully selected combinations of the diazonium molecule and coupler compound. The nature, number and position of the substituents influenced the color of the azo dyes blue, black, purple and sepia (Kosar 1965, 215). Sepia diazotypes contained a combination of resorcinol and its derivatives as couplers. A combination of yellow and red dyes produced a brown or sepia tonality. The resulting dyes needed to be dark enough for use in office conditions and opaque to UV radiation in order to produce the next generation of copies (Lay 2002).

Numerous compounds were added to improve diazotype keeping abilities and appearance. Zinc chloride was included to stabilize the diazonium compound, increased coupling speed, and chelate with the dye producing a stronger image (Kosar 1965, 294). Chelation of the dye further functioned to reduce the mobility of the relatively small sepia dye molecules (Lay 2002). Citric acid was included to maintain the acidic environment in the paper necessary to retard premature coupling and increase the light sensitivity of the diazonium compound (Brown 1944, 186). Thiourea was added as an antioxidant to counter yellowing of the background areas caused by oxidation of phenols. Optical brighteners were added to paper stock to promote brightness and visually counteract yellowing.

CAUSES OF DETERIORATON

Diazotypes display significant deterioration problems in part from inherent vice and their sensitivity to environmental factors. Since the print is processed dry, compounds used to create and stabilize the dyes were never removed within the processing sequence. This is manifest in three ways: background darkening, dye discoloration, and increased base layer brittleness.

Deterioration can begin prior to exposure and development. It is caused by the decomposition of the diazonium compound itself as well as the premature coupling of diazo compounds with couplers. Unconsumed coupling components (typically phenols) and photodecomposition products (deactivated diazonium) remain on the paper surface. Oxidation of these compounds produces unwanted background discoloration turning non-image areas yellow and eventually brown. This is promoted by excess of alkali retained from the development (Kosar 1965, 293).

Azo dyes are susceptible to loss of color through oxidation and photolysis. Dry diazotypes often remain acidic after production and this can affect the stability of the paper support. Finally, the transparentizing medium added to the paper base of the sepia diazotype can age and may affect the stability of the paper support. (Kissel 1999, 39 & 66).

WOODMAN'S *UNTITLED* DIAZOTYPE

The figure in the MMA diazotype depicts the artist herself as a standing nude that begins at the neck and concludes just below the knees (Figure 1). She is holding a bulb release to trigger the shutter and capture the image from a distance. The image tone is dark reddish brown. Image density is the darkest at the top and bottom margins that lie outside the image proper. Rounded corners, defining image from non-image areas, are found on the lower and upper left margins. They mimic, perhaps, the format of a slide used to enlarge the image. Texturing was expressed and enhanced through smudge-marks and huge fingerprints superimposed around the body and across the background. The print measures approximately 73-5/8 inches high by 36-3/4 inches wide (187 x 93.4 cm) and is roughly cut at the top and bottom edges. The sides are even, indicating that the photograph dimensions are bound by width of the paper as manufactured. Paper fibers can be seen on the recto surface with magnification. The paper support is thin and partially translucent.

CONDITION

On examination in 1996, the image layer appeared to be in fairly good condition. However, horizontal bands of lighter and darker areas across the print were visible from the recto and verso. The photograph was likely rolled for storage and the banding revealed where a poor environment may have affected the print. The result was loss of image density and yellowing of the background color.

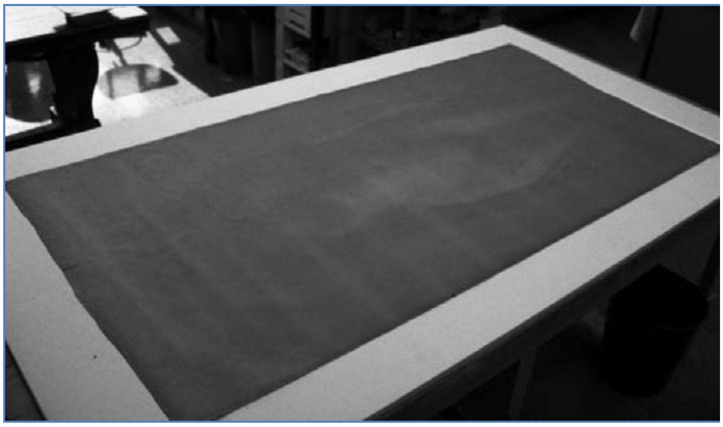


Fig. 2. Verso of F. Woodman's *Untitled* diazotype. Courtesy of Betty and George Woodman.

The support was somewhat brittle. White V-like creases in the paper support were evident along the left and bottom right sections of the print. These were probably the result of physical distortion from handling. The verso surface showed yellowing and darkening.

CONFIRMATION OF THE PHOTOGRAPHIC PROCESS

The Woodman print displays key hallmarks of a sepia diazotype. These characteristics have been clearly laid out by Kissel and Vigneau in their publication on 20th century architectural reproductions (Kissel, 1999). They include: the brown image tonality, translucency of the support, yellowing, and white handling dents.

A small sample from the Woodman photograph, containing high image density, was provided by the MMA for destructive and non-destructive analysis. In 1996 the author worked with Kate Duffy, then Assistant Scientist at the Winterthur Museum Analytical Laboratory, to seek analytical confirmation of the photographic process. The instruments used were: an X-Ray Fluorescence Spectrophotometer (XRF), Scanning Electron Microscope (with energy dispersive detector) (SEM-EDS), and a Fourier Transform Infrared Spectrometer (FTIR) (Duffy 1996).

XRF was used to detect the presence of typical photographic metal image formers such as: silver, iron, platinum, palladium, or chromium, however only Zinc was detected in the print. SEM was then used to confirm XRF data with the possible additional detection of elements lighter than potassium. The largest peaks were attributed to silicon and zinc, with sulfur and chlorine in lesser amounts. For comparison, an additional sample, obtained by an architect who retained samples from the early 1980's, was run under the same conditions. Again, silicon, sulfur, chlorine and zinc were detected. FTIR analysis was performed to detect organic materials present. Cellulose peaks (the paper support) were found as were peaks that strongly suggested the presence of oil. Additional peaks may indicate an additional material such as silicates (Duffy 1996).

Finally, Debora Mayer, a fiber identification expert, performed analysis on the last remaining portion of the original sample. She concluded that the sample fibers were highly beaten cotton. In addition, fine particulate material was detected on and around the fibers. This may indicate a protein, oil, resin, or synthetic component. The combination of materials and processes used to manufacture the paper yielded a paper that was tough, difficult to tear, did not take up water easily, was semi-translucent, and heavily sized (Mayer 2002).

RESULTS AND CONCLUSIONS OF ANALYSIS

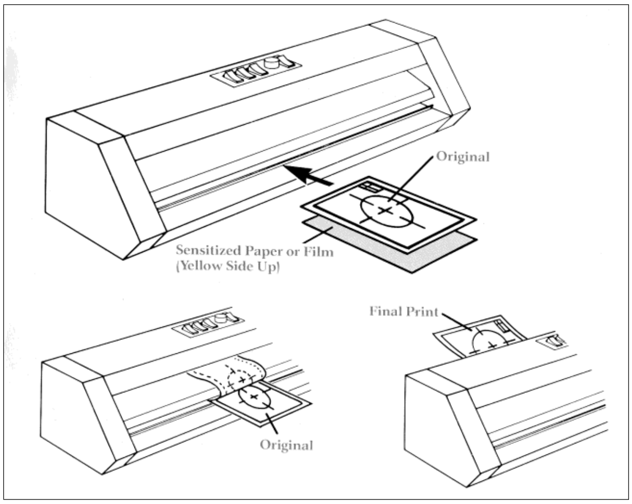
Diazo prints of any color make use of organic dyes to provide hue, and so the absence of a metal image-former was not surprising. The presence of zinc and chlorine was also not surprising as Zinc Chloride ($ZnCl_2$) was often added to the sensitizing solution as a stabilizer. Some diazotype formulations employed a colloidal dispersion of silica. Sulfur may be present as thiourea was typically added as an antioxidant to offset the tendency of diazotypes to yellow. The presence of transparentizing oil was consistent with all technical descriptions of sepia line diazotypes. Shelly Lay at Azon Corporation later confirmed that a synthetic resin was employed for papers they manufactured in the 1980's (Lay 2002). Heavily beaten fibers further enhanced the transparency of the paper support. Thus, the presence of each of the elements detected through analysis can be explained - as can the absence of others, such as iron or silver.

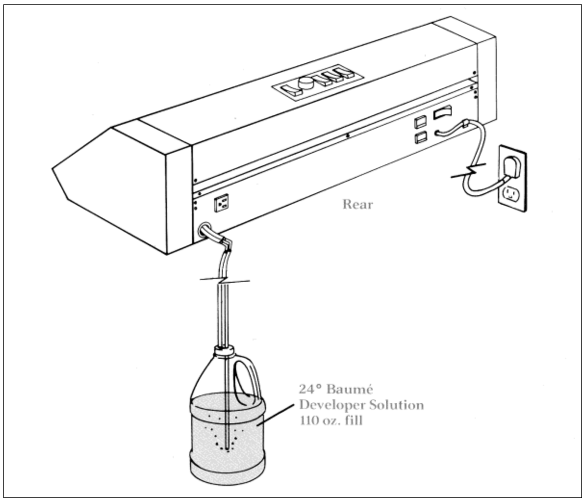
HOW TO MAKE A DIAZOTYPE

In order to understand the techniques Woodman used to make her prints, it is helpful to know how a typical diazotype was made. The schematic drawing (Figures 3 & 4) illustrates the two necessary components of a desktop processing unit, the exposing unit and developing chamber.

Depending on the model, an operator inserted the original face up on top of a bright yellow sheet of unexposed of diazo paper or the original was met with a continuous roll of the diazo paper once inside the machine. Both were transported by conveyor belts through an exposure chamber, typically equipped with a high-pressure mercury-vapor lamp as the source of UV radiation. The original was then fed out of the unit and the copy was automatically taken into and through the developing chamber containing heated aqueous ammonia vapor. The whole process took no more than a minute (Kosar 1965, 253).

Unlike blue prints or cyanotypes, diazotypes are a positive rendering of an original. During exposure, UV radiation that penetrates clear or minimum density of an original destroys the diazonium compound directly. Dark or opaque areas of the original will block UV waves and protect the diazonium compound below. The preserved diazonium compound can then go onto to form a colored dye when exposed to ammonia vapor. Thus, it is a direct positive copy of the original.





Schematic rendering of a diazotype processing unit. (From Rotolite 1987).
Fig. 3. Entry point for original. Fig. 4. Source of ammonia.

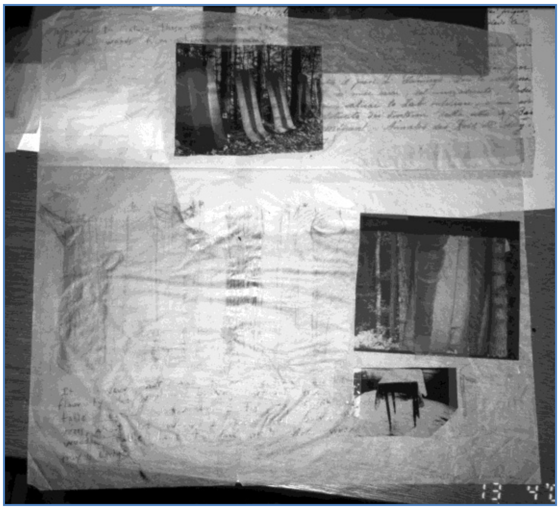
ARTIST'S WORKING METHOD

Woodman was well versed with gelatin silver technology from image capture to printing, it was the predominate photographic process for artists of her time. Diazotypy offered a very different look, scale, and cost. However, it also posed technical hurdles that needed solving.

According to Betty Woodman, the artist's mother, Francesca had been experimenting with diazotypes after graduating from art school. She used a print shop located somewhere near Union Square in New York City to process her pictures. Further, she had worked with one particular employee who assisted her with large-scale diazotype papers in blue and brown (Kennedy, 1997). In fact the family kept a diazotype box owned by artist. The label information was as follows:

> Sepia Line/ Diazotype Paper for Ammonia Development
> Azon, Johnson City, NY
> Cat 4516 Size 36 x 100
> Lot No. 0535444.

Woodman created diazotypes using two different methods. In a 2002 interview, George Woodman showed the author several examples of "templates" his daughter assembled that were later used to produce diazotypes (Woodman 2002). Figure 5 shows an example containing gelatin silver positive transparencies attached with pressure sensitive tape to a thin sheet of translucent paper. Some of these assemblies combined photographs with sketches and writing. The template would have been superimposed onto a sheet of diazo paper, then exposed and developed in a commercial processing machine. The resulting diazotype was a contact print of the original. Figure 6 illustrates the finished sepia diazotype.



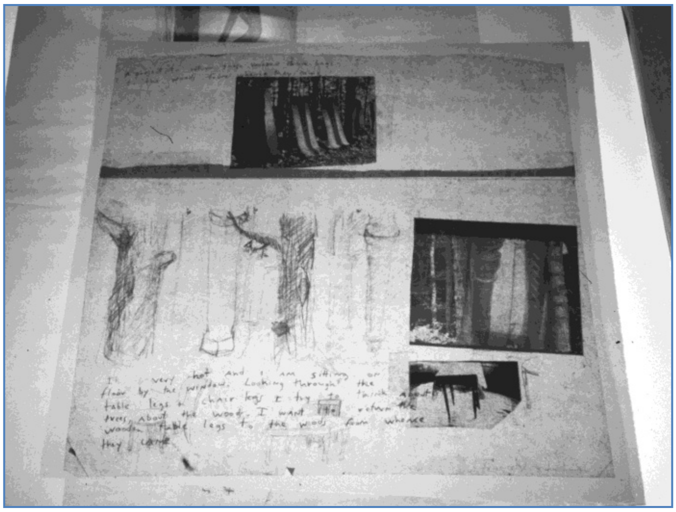


Fig. 5. F. Woodman, assembled template. Fig. 6. F. Woodman, sepia diazotype.
Courtesy of Betty and George Woodman.

Woodman used projection to achieve the large-scale human figures by exploiting the size potential of diazo rolls of paper (36 inches wide and many yards long,). According to her father she experimented at first with 35mm positive slides and a projector to enlarge the image. A sheet of diazotype paper was taped or tacked to a wall in a darkened room either in her studio on Duane Street or in parents' apartment on 17th Street. The distance between the projector and the wall determined the scale of the image.

As has been mentioned previously, diazonium compounds are most sensitive to ultraviolet radiation and professional printers used a high-pressure mercury-vapor lamp for exposure. Fortunately, diazo papers will also respond, if slowly, to tungsten bulbs. Betty Woodman estimated up to 12 hours of exposure in some cases, along with burnt out bulbs and distorted slides. The author experimented with blue and sepia diazotype paper in 2002 and was able to produce an image using a projected black and white 35mm slide for several hours and development with ammonia vapor.

Francesca's ally in the blueprint shop near Union Square gave her a Beseler lantern projector that could accommodate Francesca's larger format transparencies. It also contained a more powerful lamp, which may have improved magnification ratios and decreased exposure times. Her father further suggested that she would trim large format film to fit into this projector format. The rounded corners and a darkened non-image area could have been introduced through the lanternslide holder itself or through the addition a typical lanternslide mask. A series of images published in a 2011 exhibition catalogue bear a striking resemblance to the MMA's *Untitled* diazotype, and were likely taken in the same photographic session (Keller 2011, 130 & 131). These related images bear the hallmarks and proportion of a sheet of 4 x 5 inch film. What might have been sacrificed in contrast or detail through enlargement has been remedied by the addition of the smudge marks added directly to the film by hand.

Development, on the other hand had, to be carried out in the blueprint shop by a knowledgeable technician. Processing the already exposed enlargements required bypassing the exposure unit by feeding the prints directly into the ammonia chamber.

Since diazotypy relied on a positive to create a positive, Woodman needed to convert her negatives into positives for source material (see Figure 5). In the early 1980's, there were several ways to produce positive transparencies from camera negatives. A roll of Panatomic-X 35mm film could be processed using reversal chemistry. Or, for larger film sizes, a fine grain duplicating film (such as Kodak's 7302 Fine Grain Positive film) made for creating movie prints, could be used to produce silver gelatin positive transparencies through contact printing or enlargement (Sampson, 2013). Woodman used a variety of film sizes: 35mm, medium and large formats; any of these sizes could be converted to a positive using typical darkroom equipment.

TREATMENT OPTIONS

To explore options for the treatment of diazotypes, simple empirical tests were carried out on study collection samples taken from a sepia diazotype from the early 1980's. The print bore similar characteristics with Woodman: image color, yellow discoloration at the edges, translucency of the paper support, and white crease marks. (Please see appendix for procedural details.)

The results point out some noteworthy changes. While this test did not try to replicate exhibition conditions, the sample displayed significant dye fading and background discoloration. Image color changes were noted in immersion testing. Loss of color was observed with both ethanol and acetone baths and shift in color was noted particularly in the alkaline baths. This latter change could indicate a loss of overall yellowing as a result of aging, or an actual shift in the color of the dye itself or both. Organic solvents appeared to extract the solvent-soluble resin from the paper base and increased opacity in the print. Water-soluble optical brighteners were lost in aqueous baths.

CONCLUSIONS

There is an interesting contradiction between the more ephemeral aspects of Woodman's chosen photographic medium for this project and the monumentality of her subject matter, a caryatid, intended for a temple. It provides some insight into the ingenuity and creative power of an artist who repurposed a medium designed to be quite literal. Industry's intended function for the sepia diazotype, or second original, was incidental for Woodman, she merely appropriated the medium's potential and effect for her powerful expressive purposes. As a consequence however, Woodman left behind a body of work that was fragile, and environmentally sensitive Conservators are now faced with difficult task of preserving artwork that was developed for the short term. Additional research is needed to further investigate the possibility of safely removing the residual chemistry that leads not only to the deterioration of the print itself and its visual impact.

ACKNOWLEDGMENTS

I would like to thank the following individuals for their help with this research project that has now spanned many years: Nora Kennedy, George and Betty Woodman, Malcolm Daniel, Lois Price, Judith Reed, Kate Duffy, Debora Mayer, Dana Mossman Tepper and Mark Sampson.

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APPENDIX

TREATMENT TESTS OF A SAMPLE OF DIAZOTYPE PAPER

The test samples were acquired from an architect in New York City who had sepia diazotypes from the early 1980's at his disposal. Upon visual examination it contained similar characteristics to the Woodman print: image color, yellow discoloration at the edges, translucency of the paper support and white crease marks.

The sample was used in a number of destructive tests in order to gain insight into its stability in response to exposure to light and various immersion baths such as: water at various pH levels, ethanol, acetone, toluene, and VM&P Naptha solutions.

Small samples were cut to approximately 2 x 5 cm and then cut again lengthwise to yield two strips of diazo paper. The right half was used for testing and the left was retained as a control. Each sample was immersed for five to ten minutes with agitation unless otherwise noted.

Evaluations were made on the basis of visual comparison to the control. The top half was laid over white paper for color comparison, and the bottom half was laid over black paper to evaluate translucency.

Water Bath 1 The bath contained deionized water (pH 5 – used in all aqueous baths) and the sample was immersed for three minutes with agitation. Little if any change was observed.

Water Bath 2 The same conditions as above were used but the sample was left for 10 minutes. A minor lightening of the image color occurred in the washed sample.

Alkaline Bath 1 The pH of this bath was adjusted to 10 with NH_4OH. The sample noticeably changed. The image color shifted toward a redder brown, and lightened appearing less yellow.

Alkaline Bath 2 The pH of this water bath was adjusted to 12 with NH_4OH as above. The change between sample and control as described above was more enhanced.

Acid Bath 1 The sample was immersed in water (pH adjusted to 2 with HNO_3) for five minutes. The image color became lighter and the paper more yellow.

Ethanol Bath The image color changed; it became much lighter and more yellow. The paper appeared whiter, and there was a loss of the dye density. When viewed against black paper there did not seem to be any change in translucency.

Acetone Bath The image material in this sample changed considerably. During the test, a brown color was observe floating away from the sample. After evaporation of the solvent, some of the released dye remained on the watch glass. Compared to its control, this sample lost a significant amount of color, and the paper appeared brighter. A small portion of its translucency was lost.

VM&P Naptha There was a slight shift in color toward brownish red, the paper base lightened, but the most noticeable change was the loss of translucency.

Toluene Bath The sample shows a shift in color toward a brownish red. The paper base lightened a good deal of its original translucency was lost.

Light Exposure Two samples were prepared; one was encapsulated in polyester to see if the effect of light was in any way related to atmosphere. Each was placed between two pieces of 20pt lignin-free board and secured with a clamp. The board covered half the sample leaving the other half exposed. The test samples were placed in a south-facing window in Texas for approximately one month. The result was a loss of image density and a shift in hue toward yellow. No difference was discerned as a result of encapsulation. Under long-wave ultraviolet radiation, the optical brighteners had diminished in the exposed sample.

Humidification The control and the sample were folded together to create planar deformation for later comparison. The sample was placed in a high humidity chamber for approximately one half hour and then dried under weight. The sample responded quite well to flattening creases with no other noticeable changes.

The Graphics Atlas

Ryan Boatright

Presented at the 2011 PMG Winter Meeting in Ottawa, Canada.

Introduction

This paper will describe the development of the Image Permanence Institute's Graphics Atlas and will discuss its practical uses in both professional and mainstream environments. The website was designed for anyone needing to know more about the object-based nature of prints and photographs. With various web applications, Graphics Atlas guides users through the quintessential physical attributes of the most popular mainstream printing processes dating back to the 1400s with an emphasis on the medium of photography and its contemporary digital output. With special images, users may visually observe and compare characteristics such as image color, image structure (e.g., halftone patterns, photographic grain, etc.), paper texture, and sheen. Furthermore, it is possible to examine layer structures via highly magnified cross-sections.

Print Characterization at the Image Permanence Institute

The print identification flowchart tucked into the back of James Reilly's book *Care and Identification of 19th Century Photographic Prints* hangs in many photograph conservation labs and institutions charged with the care of photographs. It provides a constructive framework of the processes that existed during the time and intuitively guides you through the main characteristic traits of 19th Century photographic and photomechanical print processes. This chart embodies much of IPI's current mission with the Graphics Atlas- to provide reliable and concise information about the object-based nature of prints and photographs to those needing to properly identify and preserve them.

Beginning in 2000, print characterization projects trickled down the Mellon Foundation's Advanced Residency Program in Photograph Conservation (ARP). It was the object-oriented understanding of photography necessary in the conservation and preservation worlds that inspired much of the research by these fellows. For example, Tania Passafiume's capstone project provided an infrastructure for the understanding of Edward Weston's silver gelatin prints held in the George Eastman House collection. The project included a swatch book with paper samples that illustrate common silver gelatin print traits (e.g., tints, tones, textures, and sheens). The introduction of basic photo-documentation techniques to illustrate and characterize silver gelatin prints was seen later in 2005 via the ARP/IPI joint research project *The Characterization of Black and White Silver Gelatin Fiber Based Photographic Prints*. Another project by Gawain Weaver explored the various aesthetics of silver gelatin print deterioration. All of the ARP fellows' projects can be downloaded as PDFs on the George Eastman House's Notes on Photographs website (notesonphotographs.org).

Fig. 11: Kodak Polycontrast Paper Smooth Glossy

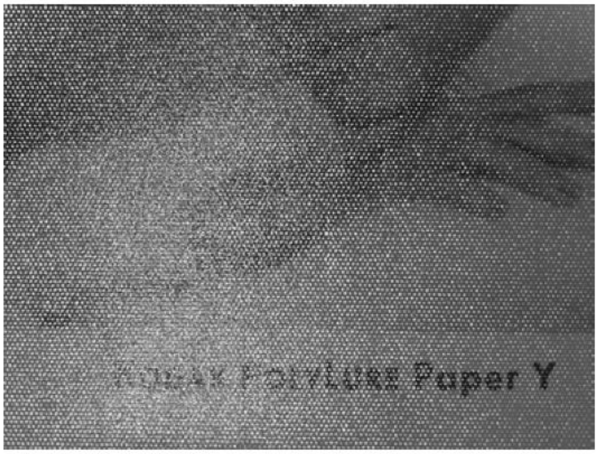

Fig. 12: Kodak Polylure Paper Silk Lustre

Fig. 1. Images made with axial illumination illustrating the different sheens of two once popular Kodak papers. From *The Characterization of Black and White Silver Gelatin Fiber Based Photographic Prints* by Corinne Dune, Lene Grinde and Ralph Wiegandt.

Because of such research the interrelationships between the appearance, structure, and manufacture of silver gelatin prints are better understood, and documented. Another side effect was the beginning of IPI's ongoing query into the world of inkjet prints and other digital print technologies. It's now clear that inkjet papers are just as diverse as photographic papers were 50 or 60 years ago, and have very different stability characteristics. IPI's Digital Print Preservation Portal (dp3project.org) provides the information, skills, and tools to better identify and care for digital prints.

The Microscopy Lab

During the last few years of the ARP, IPI made a push to further develop its imaging capacity, broaden its research scope, and invested heavily in the development of didactic print characterization web applications. The major advancements in IPI's photo-documentation techniques and the development of a comprehensive "visualization suite" to be used on the web began in 2006. Previously, the microscopy lab contained one copystand and a stereo-binocular microscope that was retrofitted with a low-resolution digital microscope camera. In was clear that a more standardized infrastructure and larger more informative set of images would play a vital role in the development of a print characterization website. A Canon 5D DSLR, compound microscope, fiber optic light line, and an additional copystand were purchased. Custom light holders and vacuum easels for the copystand were built. Ralph Wiegandt, a former ARP fellow, also made important modifications to IPI's microtome, which greatly sped up cutting cross-sections. Later, a third copystand was installed and dedicated to a HD video camera. A lot of time was spent calibrating lighting setups, standardizing imaging techniques, and researching the most appropriate levels of magnification. Photographing physical traits such as texture and sheen also required more complex thinking in regards to camera exposure and RAW image processing. IPI's large didactic prints and photographs collection came in quite handy for image tests. These imaging techniques are still methodically used when photographing each new object that makes it on graphicsatlas.org. Currently, the visualization suite contains 15 standardized images and 1 video.

Fig. 2. IPI's microscopy lab in 2006.

The Digital Sample Book

Digital Sample Book was the predecessor of Graphics Atlas, and is still accessible on the web. At its debut, it served as an expansive catalog of various inkjet papers that could be browsed by contemporary photographers. But, once the potential of the newly invented web structure was understood, the scope of materials that would be added to the Digital Sample Book expanded to include pre-photographic, photographic, and photomechanical prints. For the first time, it was possible to objectively compare physical traits across many process types with a Google Earth like experience! You could zoom in and out, change the lighting to the side or top, or flip the prints on edge to examine their layer structures underneath very high magnification.

The Digital Sample Book's newly invented toolbar also marked an important shift away from using highly technical terms to describe lighting and magnification conditions used in the digitization process. For example, an image of a print that was photographed with a DSLR connected to a large compound microscope using bright-field illumination was not entered into the online database as "100X Cross-Polarized Bright Field View". Instead, a graphical toolbar was created that more intuitively describes this scenario. And, because of the toolbar, users become aware that the way we perceive photographs and prints is actually highly influenced by how they are lit, whether it be on a copystand, under a microscope, or in the gallery.

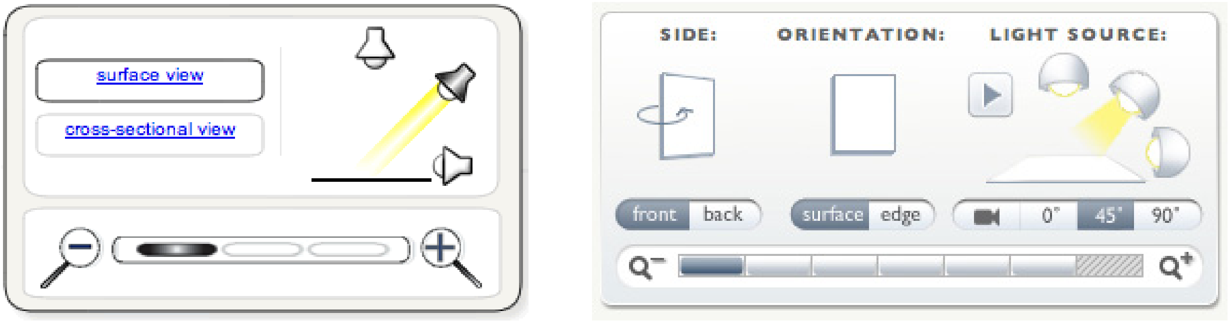

Fig. 3. The Digital Sample Book and Graphics Atlas toolbars.

In 2008 and 2009, under the guidance of James Reilly, a team comprised of myself, Zach Long, Gawain Weaver, Kate Palitsch, Ben Vanderburg, and the equip at the web design firm Jet A Studio in Louisville, KY set out to transform the website into a comprehensive didactic tool with new functions and content. Along with improvements to the comparison tool, step-by-step guided tours were added to teach users about the most important characteristics of each print in the database and provide important historical context. New identification pages would focus on telltale traits, and their common variations. These advancements marked the beginning of Graphics Atlas.

The Graphics Atlas

Graphics Atlas has three modes that are accessible from the home page: Guided Tour, Compare Processes, and Identification. Within each of the three modes a print from the database may be selected by process type, visual browse, or a timeline depicting major use.

The Guided Tour

This mode consists of carefully curated sets of images tailored to each print. The first images provide broad perspective and historical context. Subsequent images hone into visual and physical nuances, and are often entirely specific to the particular object. Text on a panel next to each image details what to notice. At any time users can compare the currently chosen process with others or learn more about how to identify the process.

Compare Processes

The highly standardized visualization suite is available in Compare Processes. The side, orientation, light source, and magnification can be adjusted via the central toolbar. A video of the prints tilting back and forth in front of a diffuse light source is also accessible. Under each print is a “What to Notice” list with links to views that depict the most important aspects.

Identification Pages

These free-form pages (not bound to a strict web infrastructure) offer the most direct and specific details pertaining to key identification traits. The major variations amongst processes are also shown in one place. This is especially useful in better understanding deterioration, which often manifests itself in many ways and takes on various appearances.

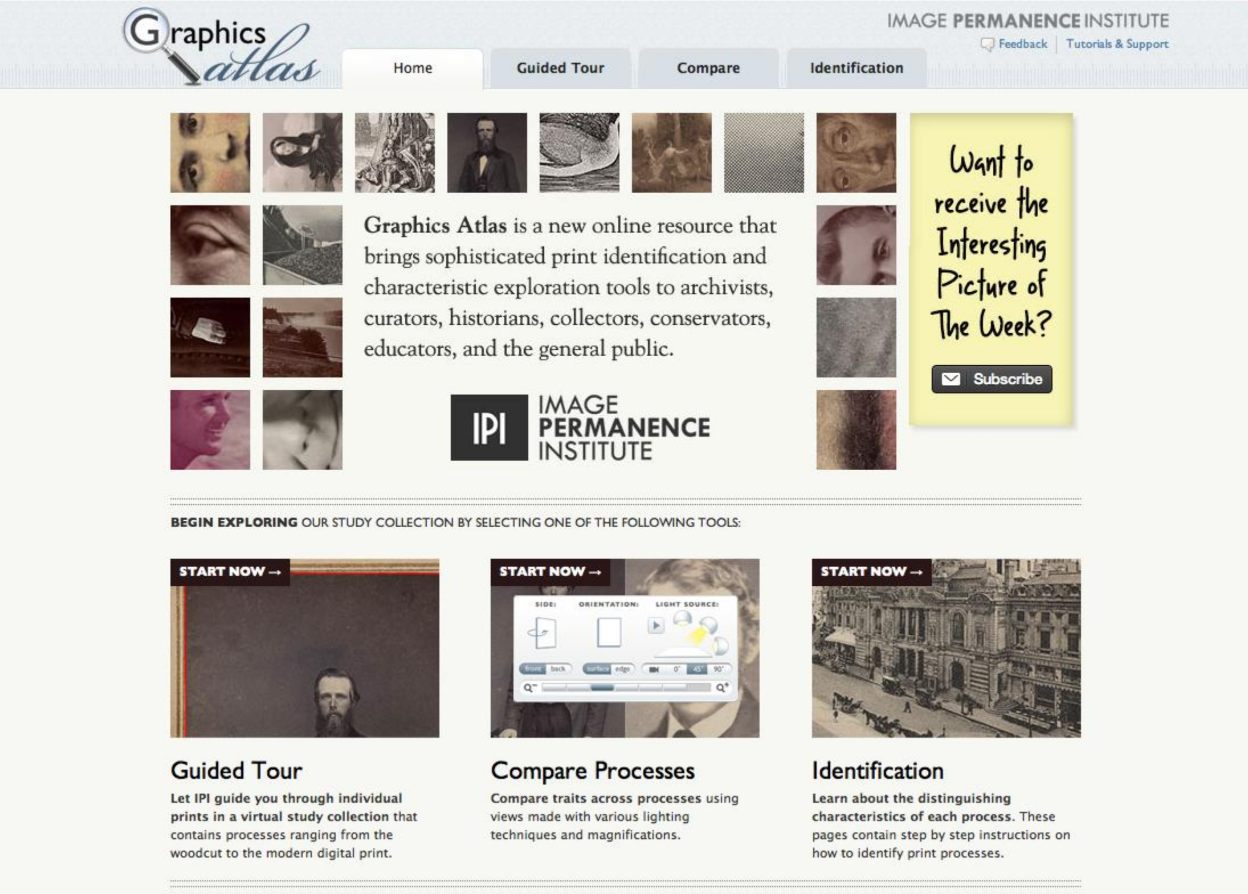

Fig. 4. The Graphics Atlas homepage, 2013.

The Graphics Atlas: Applied

The Graphics Atlas is certainly an invaluable tool when teaching courses on the care and identification of prints and photographs. But, beyond that it can be used in other public and professional domains. For example, a photograph conservator can use it to help identify prints in the field. Historians may use it as a reference while teaching on the evolution of printing or photography. A curator can use it to better understand the context in which a particular work of art was made. Contemporary photographers or printmakers can reference it to better understand how (and why) a traditional silver gelatin black and white print looks different than its inkjet counterpart.

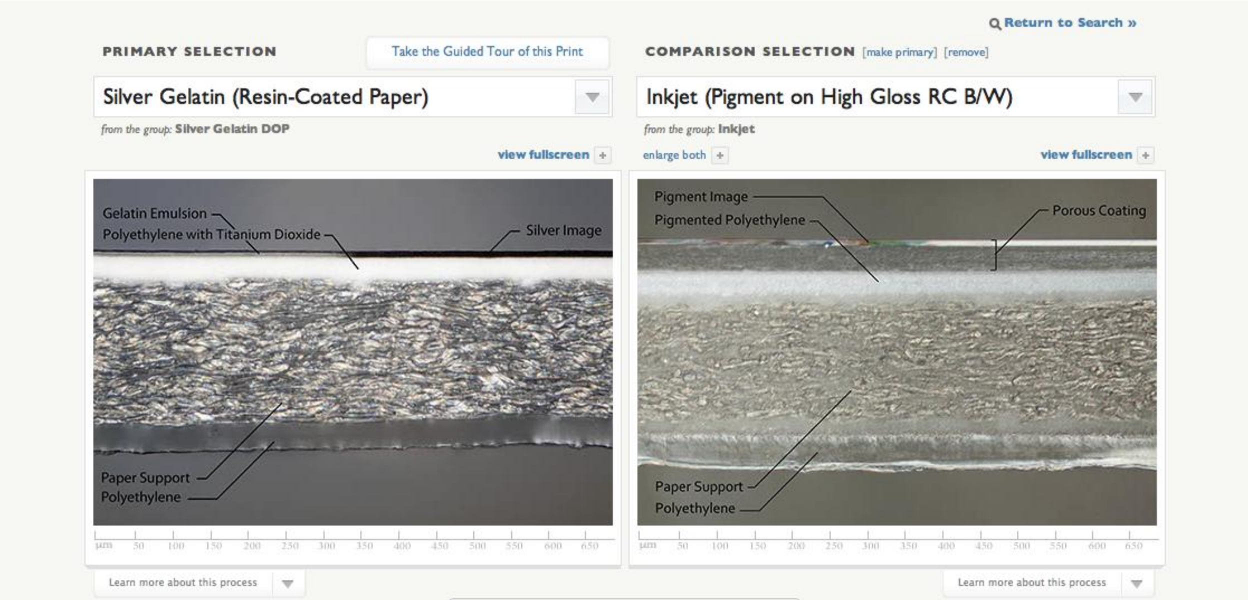

Fig. 5. Cross-sections depicting structural differences between resin-coated b&w silver gelatin prints and resin-coated b&w inkjet prints. These prints can look similar with the naked eye.

Recent Developments

Although made public in 2009, Graphics Atlas was officially launched in February 2010. At the time Zach Long was responsible for managing the project and after his departure Kristin Smith became project manager. In 2012, IPI received a grant from the Andrew W. Mellon foundation, *Sustaining Knowledge of the Materials of Photography through Research and Education*, to support the continued expansion of Graphics Atlas. Alice Carver-Kubik was hired as a Photographic Research Scientist to lead the project and Alyssa Marzolf was hired as the Imaging and Microscopy Technician.

The database on Graphics Atlas has greatly expanded over the past few years. Recent additions include color slide films and additional silver gelatin black and white prints. An "Interesting Picture of the Week" email newsletter was also introduced. In just a short paragraph or two, each newsletter summarizes important historical information and characteristic traits of an interesting print in IPI's study collection. Users can follow a link to learn more about these prints on graphicsatlas.org.

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Separate but Equal: Testing Treatment Techniques to Separate Water-Damaged Blocked Film-Based Negatives from the Henry Clay Anderson Collection of the Smithsonian National Museum of African-American History and Culture

Alisha Chipman

ABSTRACT

A group of 343 non-accessioned black and white silver gelatin 4 x 5 inch sheet film negatives from the Henry Clay Anderson Collection of the Smithsonian National Museum of African-American History and Culture (NMAAHC) served as experimental treatment objects for this research project. The goal of the project was to systematically evaluate treatment options for separating severely water-damaged and blocked film-based negatives. A comprehensive list of 23 treatment strategies was identified and the treatments were tested and evaluated. The most promising treatment technique identified involved immersing the blocked negatives in cold de-ionized water followed by freezing. Immersing the negatives in cold de-ionized water, slightly acidic water, and in a 3:1 ethanol and de-ionized water bath were also found to be satisfactory treatment options.

INTRODUCTION

A group of 343 non-accessioned black and white silver gelatin 4 x 5 inch sheet film negatives from the Henry Clay Anderson Collection of the Smithsonian National Museum of African-American History and Culture (NMAAHC) served as experimental treatment objects for this research project. The project was carried out from September 2010 through July 2011 during the author's graduate internship in photograph conservation at the Smithsonian Institution Archives (SIA) under the supervision of Sarah Stauderman, Collections Care Manager, with additional guidance from Andrew Robb, Department Head of Special Formats, Library of Congress. The goal of the project was to systematically evaluate treatment options for separating severely water-damaged and blocked film-based negatives. Multiple treatment strategies were identified, tested, and evaluated.

THE HENRY CLAY ANDERSON COLLECTION

Henry Clay Anderson (1911-1998) was a professional photographer who lived and worked in Greenville, Mississippi. He established the Anderson Photo Service Company in 1948. Throughout the 1950s, 60s, and 70s Anderson photographed the daily lives of the relatively prosperous yet segregated African-American community of Greenville. He created images of family and community gatherings including weddings, funerals, sports events, proms, and a wide range of professionals at work including nightclub musicians and itinerant entertainers. Anderson also documented the Civil Rights Movement in Greenville. Anderson's photographs provide evidence of "a virtually ignored chapter in African-American history, that of the proud, dignified community of middle-class African-Americans that existed throughout the South during the Civil Rights Movement" (Steven Kasher Gallery 2007).

In 1997 Shawn Wilson, a New York filmmaker, returned to his hometown of Greenville, Mississippi to meet Anderson and ask him about a portrait he had taken of Wilson's mother in her youth. Wilson and Anderson quickly became close friends. After Anderson's death, his archive was bequeathed to Wilson. Wilson then partnered with Charles Schwartz, a NY-based photography collector and dealer, to preserve, organize, and present Anderson's collection. In 2002, they published a book titled *Separate but Equal: the Mississippi Photographs of Henry Clay Anderson*. In March of 2007, the first exhibition of Anderson's work was presented at the Steven Kasher Gallery in New York City, in collaboration with Charles Schwartz and Shawn Wilson. The exhibition was also titled *Separate but Equal: the Mississippi Photographs of Henry Clay Anderson* and consisted of over 70 vintage prints as well as Anderson's camera and several artifacts from his studio. Concurrent with this exhibition the entire Anderson archive was offered for sale intact as a single lot.

In *Separate but Equal* it is explained that in 1998 Wilson and Schwartz "discovered more than 1,500 negatives in corroded cardboard boxes under the kitchen sink in Anderson's home. The negatives were in deplorable condition, damaged by water and compacted together with mold. Wilson and Schwartz had the negatives separated, washed, and archived in acid-free envelopes" (Anderson 2002, 142). In another section, it is stated, "many negatives had been damaged by water, dirt, and heat, leaving them ripped, curled, and scratched, or corroded. But when carefully washed and cleaned, the subjects were still visible, and we have included some of these images, judging that the damage was part of their story" (Anderson 2002, 1). Indeed, several images included in the book show severe emulsion loss and water staining located near the exterior edges of the negatives.

In 2008 the National Museum of African-American History and Culture (NMAAHC) acquired the Henry Clay Anderson Collection. The NMAAHC is a newly formed branch of the Smithsonian Institution in Washington, D.C. It was signed into authorization by President George W. Bush in 2003 and is dedicated to preserving the memory of the African-American experience. The museum building is currently under construction and will occupy the last available space on the National Mall. The museum is planned to open to the public in 2015. In preparation for the acquisition of the Anderson Collection, NMAAHC hired Sarah S. Wagner (private practice photograph conservator) in October 2007 to conduct a condition survey of the negatives in the collection. At the time of acquisition, a group of approximately 343 negatives was not accessioned into the NMAAHC collections due to their very poor condition. This group of negatives was transferred to SIA as expendable research materials to be used for treatment, experimentation, and/or as teaching tools. It is possible that some of the negatives in the NMAAHC Anderson Collection were treated in 1998, while in the care of Wilson and Schwartz. However, documentation of these past treatments does not currently exist.

The group of severely damaged negatives donated to SIA consists of approximately 343 4 x 5 inch sheet film negatives. Most of the negatives depict portraits of unidentified African-American sitters. Some of the negatives have two images per sheet indicating they were exposed with a rotating or sliding camera back. It is believed that these negatives were stored for several years under a kitchen sink in Anderson's Mississippi home (as described by Wilson and Schwartz in *Separate but Equal*). The negatives are in very poor condition. They are severely water-damaged, blocked together, and encrusted with a large amount of dirt, insect debris, accretions, and possibly mold. Because of the severe damage to these negatives and the nature of their long-term storage under a kitchen sink, it is difficult to positively identify the exact nature and extent of the various debris materials covering them. There are 33 groups of blocked negatives in groups of 2 to approximately 30 negatives each. Most of the negatives have minor to severe emulsion loss, water-based tide-line stains, minor planar distortions, and minor silver mirroring located near the edges. Some of the anti-halation dyes in the negatives have spread resulting in localized blue or red dye staining.

It is believed that the majority of the negatives in the collection are on a cellulose acetate or polyester base material. However, it is possible that some cellulose nitrate is also present. Many of the negatives have edge printing reading "Kodak Safety Film" or "Safety" suggesting a cellulose acetate base. The known dates for the negatives, 1950-1970, also suggests they are on cellulose acetate and/or polyester. Film pack sheet films were made on cellulose nitrate until 1949 but otherwise nitrate sheet film was uncommon after 1940 (Reilly 1993, 22). Kodak and most other manufacturers ceased production of cellulose nitrate after 1951 (Adelstein 1987, 33). In 2007, Nora Lockshin (paper conservator, SIA) performed Fourier-transform infrared spectroscopy (FTIR) analysis on seven sample negatives from the Anderson Collection and found evidence of cellulose acetate and polyester base materials.

Fig. 1. Alisha Chipman examining and sorting the Anderson Collection negatives at SIA.

A-D strips were used to evaluate the level of acetate deterioration to the negatives. A-D strips are acid indicator papers, developed by the Image Permanence Institute, to measure the approximate level of acetate degradation. After four days enclosed along with the negatives in a polyethylene bag, the strips showed no color change indicating a level 0, or good film condition with no deterioration. However, the age of the collection (30-60 years old) places it at the point of initial acetate deterioration.

LITERATURE REVIEW AND IDENTIFICATION OF TREATMENT TECHNIQUES

A wealth of information now exists that addresses the topics of disaster preparedness and recovery of damaged photographic collections. These sources provide excellent information about planning for emergencies as well as very practical advice about the salvage of damaged photographic materials. Guidelines for drying, freezing, and basic recovery treatment procedures are outlined. However, very few sources actually discuss options for the treatment of water-damaged blocked negatives.

Water-damaged negatives are very difficult to treat because they typically have very weak gelatin layers that are water sensitive or even water soluble. Gelatin is also prone to attack by mold under prolonged damp conditions and mold releases enzymes that further soften or dissolve gelatin (Reilly 1993, 17). Furthermore, if the negatives are on deteriorated cellulose acetate or nitrate base materials, they may already have weakened gelatin layers due to the damaging effects of off-gassed acid vapors. This makes the treatment of blocked water-damaged negatives particularly challenging since the weak deteriorated gelatin will need to be manipulated in some way in order to separate the gelatin layers of facing negatives. Hence, treatment often results in further loss of image material and gelatin emulsion layers.

A list of 23 different potential treatment strategies to separate blocked negatives was produced. The list was compiled through a literature search and communication (in person and via email) with several conservators including: Andrew Robb, Sarah Stauderman, Doug Munson, Barbara Lemmen, Mogens S. Koch, Greg Hill, Debra Hess Norris, Gary Albright, Nora Kennedy, Richard Stenman, Constance McCabe, and Sarah Wagner. The techniques chosen explore variations on the use of aqueous bathing, humidification, freezing, and solvents. All 23 treatment techniques were tested and evaluated on the Anderson Collection negatives at SIA.

1. Manual separation
2. Bathing in room temperature de-ionized water
3. Bathing in cold de-ionized water
4. Bathing in room temperature reverse osmosis water
5. Bathing in cold reverse osmosis water
6. Bathing in room temperature pH 8 de-ionized water with ammonium hydroxide
7. Bathing in room temperature pH 4 de-ionized water with citric acid
8. Bathing in room temperature de-ionized water buffered to pH 5.6
9. Bathing in room temperature de-ionized water with Kodak Photo-Flo
10. Humidification in chamber with room temperature de-ionized water
11. Humidification in chamber with hot de-ionized water
12. Placing into vapor proof packaging, freezing, removing from freezer, and immediately separating manually followed by brief bathing in cold de-ionized water
13. Placing into a polyethylene bag, freezing, removing from freezer, and immediately separating manually followed by brief bathing in cold de-ionized water
14. Placing into vapor proof packaging, freezing, removing from freezer, and placing into a 200 proof (absolute) ethanol bath
15. Placing into a polyethylene bag, freezing, removing from freezer, placing into 200 proof (absolute) ethanol bath
16. Bathing in cold de-ionized water, placing into vapor proof packaging while wet, freezing, removing from freezer, immediately separating manually followed by brief bathing in cold de-ionized water
17. Bathing in cold de-ionized water, placing into a polyethylene bag while wet, freezing, removing from freezer, immediately separating manually followed by brief bathing in cold de-ionized water
18. Bathing in cold de-ionized water, placing into vapor proof packaging while wet, freezing, removing from freezer, placing into 200 proof (absolute) ethanol bath
19. Bathing in cold de-ionized water, placing into a polyethylene bag while wet, freezing, removing from freezer, placing into 200 proof (absolute) ethanol bath

20. Bathing in a 3:1 solution of 95% (HPLC grade) ethanol and room temperature de-ionized water
21. Bathing in a 2:1 solution of 95% (HPLC grade) ethanol and room temperature de-ionized water
22. Bathing in a 1:1 solution of 95% (HPLC grade) ethanol and room temperature de-ionized water
23. Bathing in acetone

PREPARATION

Prior to treatment testing, the negatives were sorted into 33 blocks and 164 individual negatives. Each block of negatives was assigned to one of the treatment techniques to be tested during the project.

The exterior surfaces of all of the negatives were surface cleaned in order to reduce the large amount of loose dirt, debris, insect frass and mold present. Surface cleaning was performed on a down draft table while wearing nitrile gloves and an N95 mask. Use of a high-efficiency particulate air (HEPA) vacuum with and without a screen, a soft brush, cotton, a Pec-pad®, a Pec-pad® moistened with Pec-12® solution, cotton swabs moistened with de-ionized water, a metal probe, and a bamboo skewer were tested. An optivisor, a stereo-binocular microscope, a light table, and a raking light were used to evaluate the effectiveness of cleaning and to determine if any scratching or other damage was created as a result of the cleaning.

Fig. 2. Alisha Chipman dry surface cleaning with a Pec-pad.

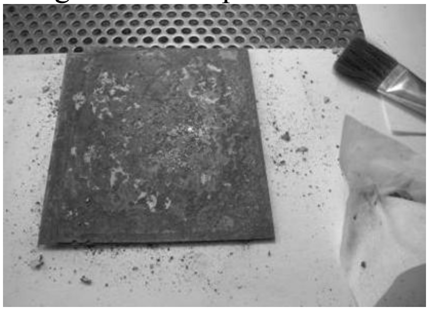

Fig. 3. During dry surface cleaning.

Most of the dirt and debris was well-adhered and water-soluble, thus use of the Pec-12® solution, the soft brush, and vacuuming were ineffective. The metal probe easily scratched the negatives. The use of cotton swabs moistened with de-ionized water was the most successful technique. Where tested (on the emulsion and the non-emulsion sides), this approach removed nearly all of the debris with minimal, if any, damage to the emulsion or the base material. However, it was determined that this approach would be too time-consuming to be used for this project.

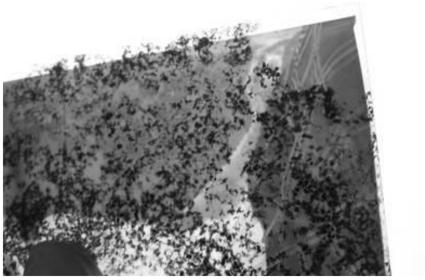

Fig. 4. Upper right corner – after cleaning with cotton swabs moistened with de-ionized water.

The most successful dry cleaning technique involved the use of cotton or a Pec-pad® to gently loosen large accretions, followed by selective use of a bamboo skewer to lift additional embedded accretions and a HEPA vacuum and a soft brush to remove the loosened debris. A minimal and acceptable amount of scratching did occur with the use of this technique. All of the Anderson Collection blocked negatives were cleaned in this manner.

PROCEDURES

During treatment testing, all pH readings were taken with a Accumet portable AP61 pH meter with a Thermo Scientific Orio 8235 BN PerpHect Ross Flat Surface pH probe. All negatives that were frozen were placed into gasketed cabinets inside the SIA walk-in freezer unit, which was set at 18° F with no humidity control.

1. Manual separation

This technique was used to establish a baseline in which to compare the other treatment techniques. While the blocked negatives were dry and at room temperature (approximately 70° F and 40% RH), they were initially separated using a Teflon spatula followed with pulling by hand.

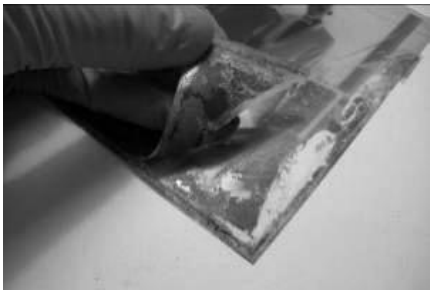

Fig. 5. Manual separation.

2. Bathing in room temperature de-ionized water

A plastic tray was filled with room temperature (68° F) de-ionized water. The negatives were immersed in the bath and manual separation was tested after 30 seconds of immersion and again after one minute of immersion.

3. Bathing in cold de-ionized water

A metal tray was filled with de-ionized water and placed into a larger plastic tray filled with ice water. The use of a metal tray was crucial in order to allow for thermal conductivity. Once the de-ionized bath water reached a temperature of 50° F, the blocked negatives were placed into the bath. Manual separation of the negatives was tested after 30 seconds, one minute, five minutes, and 10 minutes of immersion.

Fig. 6. Cold de-ionized water bath.

4. Bathing in room temperature reverse osmosis water

A plastic tray was filled with room temperature (68° F) reverse osmosis water. The pH of the bath was recorded at pH 8.02 prior to treatment. The blocked negatives were immersed. Manual separation of the negatives was tested after 30 seconds, three minutes, five minutes, and 10 minutes of immersion.

5. Bathing in cold reverse osmosis water

A metal tray was filled with reverse osmosis water and placed into a larger plastic tray filled with ice water. Once the reverse osmosis bath water reached a temperature of 50° F, the blocked negatives were placed into the bath. Manual separation of the negatives was tested after one minute, five minutes, and 10 minutes of immersion.

6. Bathing in room temperature pH 8 de-ionized water with ammonium hydroxide

A concentrated solution of ammonium hydroxide was added drop-wise to room temperature (68° F) de-ionized water until a pH of 8.03 was reached. A plastic tray was filled with the water and the negatives were immersed. Manual separation of the negatives was tested after 30 seconds, one minute, five minutes, and 10 minutes of immersion.

7. Bathing in room temperature pH 4 de-ionized water with citric acid

A concentrated solution of citric acid monohydrate was added drop-wise to room temperature (68° F) de-ionized water until a pH of 3.98 was reached. Manual separation of the negatives was tested after 30 seconds, one minute, and five minutes of immersion. The pH of the bath after treatment was 4.16.

8. Bathing in room temperature de-ionized water buffered to pH 5.6

Approximately 48g of citric acid monohydrate was added to 900 ml of room temperature (68° F) de-ionized water. 10% sodium hydroxide solution was then added drop-wise while stirring until a pH of 5.6 was reached. The solution was topped off with de-ionized water to a total volume of 1000ml. This buffer solution was prepared following a recipe in The Modular Cleaning Program database (Stavroudis 2009). This pH was desired because it is the approximate iso-electric point of gelatin, the pH at which gelatin has a net neutral charge and is its least soluble (McMurry 2008, 1024). The solution was transferred to a plastic tray and the blocked negatives were immersed. Manual separation of the negatives was tested after 30 seconds, two minutes, five minutes, and 10 minutes of immersion. The pH of the bath water after treatment was 5.6.

9. Bathing in room temperature de-ionized water with Kodak Photo-Flo

A 1:200 solution of Kodak Photo-Flo 200 in de-ionized water was made by adding 4 ml of Kodak Photo-Flo to 800 ml of room temperature (68° F) de-ionized water. The solution was placed in a disposable Mylar tray and the negatives were immersed. Manual separation of the negatives was tested after one minute, five minutes, 10 minutes, and 15 minutes.

Photo-Flo is a non-ionic surfactant which consists of 10% Triton X-100 (octylphenol ethoxylate) and 30% propylene glycol in water. It is commonly used as a rinsing aid for photographic negatives. This surfactant is classified as a xenoestrogen, or an estrogenic chemical, which mimics estrogen in the bodies of living creatures (Stavroudis 1995). For this reason it should be handled and disposed of as hazardous waste. During this treatment, nitrile gloves were worn and a disposable Mylar tray was used. The bath water and all contaminated solids were disposed of as hazardous waste.

10. Humidification in chamber with room temperature de-ionized water

A humidification chamber was set-up using a plastic tray with a metal screen inserted to elevate the object above a shallow layer of room temperature (68° F) de-ionized water. The blocked negatives were placed onto the screen over a sheet of non-woven polyester. A humidity indicator card was also placed in the chamber and the chamber was sealed by laying a sheet of Plexiglas and weights over the top of the tray. The chamber reached an RH of 80%. Manual separation of the negatives was tested after three hours in the chamber and again after a total of 4.5 hours.

Fig. 7. Humidification chamber.

11. Humidification in chamber with hot de-ionized water

A humidification chamber was set-up, as previously described, with a shallow layer of hot (175° F) de-ionized water in the bottom of the tray. In order to prevent condensation build-up from dripping directly onto the negatives, the Plexiglas was periodically flipped over and condensation was wiped off the surface. The negatives curled severely and touched the Plexiglas surface. Manual separation of the negatives was tested after one minute, ten minutes, and thirty minutes.

12. Placing into vapor proof packaging, freezing, removing from freezer, and immediately separating manually followed by brief bathing in cold de-ionized water

The blocked negatives were placed into vapor-proof packaging. The negatives were first placed into a sealed polyethylene bag, then into a marvelseal bag, which was folded over several times and sealed with small gator clips. This was then placed into a thick polyethylene bag along with a humidity indicator card. The outer polyethylene bag was folded over and sealed with J-Lar tape. The RH in the lab at the time of packaging was 25%. The packaged negatives were placed into gasketed cabinets in the SIA walk-in freezer. The packaged negatives were removed from the freezer after 7 days and the RH indicator still read 25% RH. The packaged negatives were taken into the lab and the packaging was opened and manual separation of the negatives was attempted immediately. As soon as the negatives were separated, they were placed into a cold (50° F) de-ionized water bath. The negatives were rinsed for approximately two minutes.

Fig. 8. Vapor-proof packaging.

13. Placing into a polyethylene bag, freezing, removing from freezer, and immediately separating manually followed by brief bathing in cold de-ionized water

Fig. 9. Packaging in polyethylene bag.

The blocked negatives were placed into a polyethylene bag along with a humidity indicator card. The bagged negatives were then placed into gasketed cabinets in the SIA walk-in freezer. The RH in the lab at the time of packaging was 25%. After seven days in the freezer, the interior of the polyethylene bags were at 45% RH, according to the Humidity Indicator Temperature Correction Chart (www.sud-chemie.com). After seven days in the freezer, the packaged negatives were removed from the freezer and taken into the lab. The negatives were immediately removed from the polyethylene bag and manual separation of the negatives was attempted. As soon as the negatives were separated, they were placed into a cold (50° F) de-ionized water bath. The negatives were rinsed in this bath for approximately two minutes.

14. Placing into vapor proof packaging, freezing, removing from freezer, and placing into a 200 proof (absolute) ethanol bath

The blocked negatives were placed into vapor-proof packaging, as previously described. The packaged negatives were then placed into gasketed cabinets in the SIA walk-in freezer. After seven days in the freezer, the packaged negatives were removed and taken into the lab. The packaging was opened immediately and the negatives were placed into a metal tray filled with 200 proof (absolute) ethanol. This step was carried out in the fume hood. While the negatives were in the ethanol bath, they were separated using metal tongs and a Teflon spatula.

15. Placing into a polyethylene bag, freezing, removing from freezer, placing into a 200 proof (absolute) ethanol bath

The blocked negatives were placed into a polyethylene bag and then placed into gasketed cabinets in the SIA walk-in freezer. After seven days in the freezer, the packaged negatives were removed. They were taken into the lab, opened immediately, and the negatives were placed into a metal tray filled with 200 proof (absolute) ethanol. This step was carried out in the fume hood. While the negatives were in the ethanol bath, separation was attempted using metal tongs and a Teflon spatula.

16. Bathing in cold de-ionized water, placing in vapor proof packaging while wet, freezing, removing from freezer, and immediately separating manually followed by brief bathing in cold de-ionized water

The blocked negatives were bathed in cold (50° F) de-ionized water for 10 minutes. The negatives were removed and placed directly into vapor proof packaging, as previously described. The packaged negatives were then placed into gasketed cabinets in the SIA walk-in freezer. After seven days in the freezer, the packaged negatives were removed, unpackaged, and immediately separated manually. The separated negatives were then rinsed in a cold (50° F) de-ionized water bath for two minutes.

17. Bathing in cold de-ionized water, placing in polyethylene bag while wet, freezing, removing from freezer, and immediately separating manually followed by brief bathing in cold de-ionized water

The blocked negatives were bathed in cold (50° F) de-ionized water for 10 minutes, then placed into a polyethylene bag and placed inside gasketed cabinets in the SIA walk-in freezer. After seven days in the freezer, the negatives were removed, taken out of the bag, and immediately separated manually. The separated negatives were then rinsed for two minutes in a cold (50° F) de-ionized water bath.

18. Bathing in cold de-ionized water, placing into vapor proof packaging while wet, freezing, removing from freezer, placing into a 200 proof (absolute) ethanol bath

The blocked negatives were bathed in cold (50° F) de-ionized water for 10 minutes, and then placed into vapor-proof packaging, as previously described, and placed into the freezer. After seven days in the freezer, the negatives were removed, taken out of their packaging, and immediately placed into a glass tray filled with 200 proof (absolute) ethanol. This step was carried out in the fume hood. While the negatives were in the ethanol bath, separation was attempted using metal tongs and a Teflon spatula.

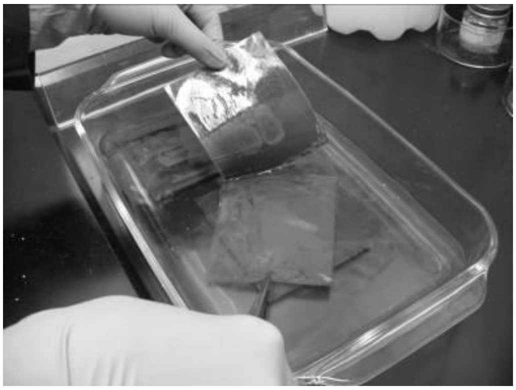

Fig. 10. Separating the negatives in the ethanol bath.

19. Bathing in cold de-ionized water, placing into a polyethylene bag while wet, freezing, removing from freezer, placing into 200 proof (absolute) ethanol bath

The negatives were bathed in cold (50° F) de-ionized water for 10 minutes, then placed into a polyethylene bag, and placed in the freezer. After seven days in the freezer, the negatives were removed, taken out of the bag, and placed into a glass tray filled with 200 proof ethanol. This step was carried out in the fume hood. While the negatives were in the ethanol bath, separation was attempted using metal tongs and a Teflon spatula.

20. Bathing in 3:1 95% (HPLC grade) ethanol and room temperature de-ionized water

A glass tray was filled with denatured 95% ethanol (HPLC grade) and de-ionized water in a 3:1 ratio of ethanol to water. This treatment was performed in the fume hood. The blocked negatives were placed into the tray. While the negatives were in the bath, separation was attempted using metal tongs and a Teflon spatula after 10 minutes and again after 15 minutes of immersion.

21. Bathing in 2:1 95% (HPLC grade) ethanol and room temperature de-ionized water

A glass tray was filled with denatured 95% ethanol (HPLC grade) and de-ionized water in a 2:1 ratio of ethanol to water. This treatment technique was performed in the fume hood. The negatives were placed into the tray. While the negatives were in the bath, separation was attempted using metal tongs and a Teflon spatula after 10 minutes and again after 15 minutes of immersion.

22. Bathing in 1:1 95% (HPLC grade) ethanol and room temperature de-ionized water

A glass tray was filled with denatured 95% ethanol (HPLC grade) and de-ionized water in a 1:1 ratio of ethanol to water. This treatment technique was performed in the fume hood. The negatives were placed into the tray. While the negatives were in the bath, separation was attempted using metal tongs and a Teflon spatula after 10 minutes and again after 15 minutes of immersion.

23. Bathing in acetone

A glass tray was filled with acetone in the fume hood. The blocked negatives were placed into the tray. The goal of this treatment technique was to separate the gelatin emulsion from the cellulose acetate base material. This treatment technique is typically used to remove a gelatin pellicle from a channeled and deteriorated cellulose acetate base. A negative that was on a channeled base which was tested with FTIR and known to be cellulose acetate was also tested as a control.

Drying

All of the aqueous treated negatives were hung with clips on a metal wire rack to air dry after treatment. Negatives that were treated with solvent were placed over non-woven polyester and left in the fume hood for approximately two hours in order to allow the solvent to evaporate. The negatives were then hung with clips on a metal wire rack for at least six hours with fume trunks placed nearby to continue to capture any residual solvent fumes.

RESULTS

Each treatment technique was tested and subjectively evaluated by comparing each technique's effectiveness to that of manually pulling the negatives apart while dry. When evaluating each treatment approach the overall ease of set-up and execution of the technique was considered in addition to the effectiveness of separation and the after treatment condition of the negatives tested. Please see the table of results at the end of the article. The treatment techniques rated as poor were not considered viable, those rated as fair may be viable in some situations if modifications are made, and those rated as good were considered viable options.

In general, aqueous treatments alone performed poorly. In most cases the introduction of water resulted in large loss of already deteriorated and fragile gelatin emulsion layers. The best options for introducing water to the negatives were with cold water, slightly acidic water, or in small amounts such as in a 3:1 ethanol and water bath. Immersing the negatives in chilled water provided increased stability of the gelatin while allowing for swelling, which aided separation. Immersion in a bath with slightly acidic water provided an acidic environment for the gelatin protein to become predominately positively charged. In this environment, charge repulsion may have aided in separation of the gelatin layers (Wolbers 2011). With the 3:1 ethanol and water bath the limited amount of water lessened damage to the gelatin, while allowing for controlled swelling of the gelatin.

The best treatment technique observed during this project involved a series of steps including immersion in cold de-ionized water followed by freezing. In all cases this treatment approach significantly improved the ease of separating the negatives. In most cases a thin layer of ice was seen formed between the negatives. It is believed that the negatives may have been gently pushed apart as the water trapped between the negatives expanded and froze. Once the negatives were removed from the freezer they were either separated immediately by hand or placed into a 200 proof (absolute) ethanol bath to allow them to thaw before being separated. Placing the frozen negatives directly into ethanol reduces the gelatin emulsion's exposure to water and also lowers the freezing point, thus increasing the speed of thawing. This thawing technique proved successful for Mogens Koch and his colleagues in Germany during recovery of frozen photographic materials after the 2002 flood in Dresden (Kochs 2011). During this research project, the results of the ethanol thawing and the manual separation while frozen were very similar and

Fig. 11a. Block #6 - before treatment.

Fig. 11b. Separated negatives from block #6 - after treatment – using technique #17.

Fig. 12a. Block #7 - before treatment.

Fig 12b. Separated negatives from block #7 - after treatment – using technique # 20.

equally good. In addition, there was little noticeable difference in the results between negatives that were packaged in vapor-proof packaging and those that were placed in a polyethylene bag before freezing.

The results from treatment technique #23, bathing in acetone, were surprising. The control negative known to be on a cellulose acetate base reacted as expected. After approximately 20 minutes in the acetone bath, the base material shattered into small pieces which could be separated from the gelatin pellicle using tweezers and a metal spatula. It was hoped that the block of negatives would react in a similar manner and that the pellicles could be separated once the base material was removed.

Fig. 13a. Block # 18 - before treatment.

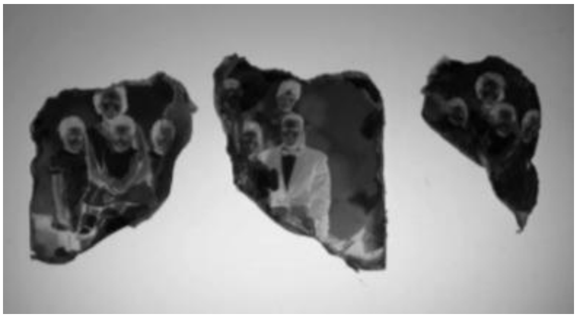

Fig 13b. Separated negatives from Block #18 after treatment - technique # 23.

After approximately 20 minutes the perimeter of the blocked negatives turned to a soft gelatinous material, which adhered to the bottom of the glass tray. This resulted in a large amount of complete loss around the perimeter of all three negatives in the block. This particular block of negatives was stuck together only along the outside edges, so once the blocked material was lost, the negatives were separated. It is believed that the negatives in the block were not on a cellulose acetate base and this is why they did not behave as expected.

This outcome shows that this treatment technique would not be an effective option for separating blocked negatives. Large negative collections are often a mix of cellulose acetate, polyester, and/or cellulose nitrate and this technique would only potentially be effective if all of the negatives in the block were on an acetate base. It is often impossible to clearly identify the base material of negatives that are blocked together.

CONCLUSIONS

This project was an experimental treatment research project. Conclusions were based on observations of the ease of separation of negatives and the condition of negatives after treatment. The rating system (located in the table at the end of the article) is subjective and strictly based on the limited results observed during this project. Treatment results will be highly dependent on the condition of the materials treated. The results of this project should not be considered a universal treatment protocol for all blocked, water-damaged, film-based negative materials.

Treatment Technique	Results	Notes
1. Manual Separation	Poor	Very difficult to separate Little loss of emulsion Some tearing of base
2. Bathing in room temperature (68° F) de-ionized water	Poor	Very difficult to separate Large loss of emulsion
3. Bathing in cold (50° F) de-ionized water	*Fair*	Moderately difficult to separate Little loss of emulsion
4. Bathing in room temperature (68° F) reverse osmosis water	Poor	Very difficult to separate Large loss of emulsion
5. Bathing in cold (50° F) reverse osmosis water	Poor	Very difficult to separate Large loss of emulsion Some tearing of base
6. Bathing in room temperature (68° F) pH 8 de-ionized water with ammonium hydroxide	Poor	Very difficult to separate Large loss of emulsion Some tearing of base
7. Bathing in room temperature (68° F) pH 4 de-ionized water with citric acid	**Good**	Significant ease in separation Little loss of emulsion
8. Bathing in room temperature (68° F) pH 5.6 de-ionized water buffered with citric acid and sodium hydroxide	Poor	Very difficult to separate Little loss of emulsion
9. Bathing in room temperature (68° F) de-ionized water with Kodak Photo-Flo 200	Poor	Moderately difficult to separate Large loss of emulsion Some tearing of base
10. Humidification in chamber with room temperature (68° F) de-ionized water	Poor	Could not separate Large loss of emulsion Some tearing of base
11. Humidification in chamber with hot (175° F) de-ionized water	Poor	Very difficult to separate Large loss of emulsion Severe curling of base
12. Placing into vapor proof packaging, freezing, removing from freezer, and immediately separating manually followed by brief bathing in cold (50° F) de-ionized water	Poor	Could not separate
13. Placing into a polyethylene bag, freezing, removing from freezer, and immediately separating manually followed by brief bathing in cold (50° F) de-ionized water	Poor	Very difficult to separate Large loss of emulsion Severe tearing of base
14. Placing into vapor proof packaging, freezing, removing from freezer, and placing into 200 proof ethanol bath before separating	Poor	Very difficult to separate Little loss of emulsion Some distortion of base
15. Placing into a polyethylene bag, freezing, removing from freezer, and placing into 200 proof ethanol bath before separating	Poor	Could not separate

16. Bathing in cold (50° F) de-ionized water, placing in vapor proof packaging while wet, freezing, removing from freezer, and immediately separating manually followed by brief bathing in cold (50° F) de-ionized water	**Good**	Significant ease in separation Little loss of emulsion
17. Bathing in cold (50° F) de-ionized water, placing in polyethylene bag while wet, freezing, removing from freezer, and immediately separating manually followed by brief bathing in cold (50° F) de-ionized water	**Good**	Significant ease in separation Little loss of emulsion
18. Bathing in cold (50° F) de-ionized water, placing in vapor proof packaging while wet, freezing, removing from freezer, and placing into 200 proof ethanol bath before separating	**Good**	Significant ease in separation Little loss of emulsion
19. Bathing in cold (50° F) de-ionized water, placing in polyethylene bag while wet, freezing, removing from freezer, and placing into 200 proof ethanol bath before separating	**Good**	Significant ease in separation Little loss of emulsion
20. Bathing in 3:1ethanol and de-ionized water	*Fair*	Moderately difficult to separate Little loss of emulsion Some distortion
21. Bathing in 2:1ethanol and de-ionized water	Poor	Could not separate Moderate loss of emulsion Some tearing
22. Bathing in 1:1 ethanol and de-ionized water	Poor	Very difficult to separate Large loss of emulsion Some distortion
23. Bathing in acetone	Poor	Separated with 50% loss of base and emulsion

This project provided an opportunity to compare many different treatment approaches to one collection of blocked water-damaged negatives. The information gained does begin to provide sound reasoning for the selection of treatment approaches to separate blocked negatives. Furthermore, this information can be added to the field's collective knowledge on this under-researched and difficult treatment topic. In many ways this project, like most research projects, produced more questions than answers. More research is needed, and the successful treatment protocols need to be refined and tested further.

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Notice to the Reader: Talbot's *The Pencil of Nature* in Canada

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Abstract

As the first commercially published book illustrated with photographs, *The Pencil of Nature* generates considerable historical interest, much of which is centred on the photographs rather than the book. The importance of the photos places *The Pencil* at an intersection in terms of how it is perceived: it is somewhere between a published book and a photograph album. This paper outlines the custodial history and conservation treatment of Library and Archives Canada's copy of *The Pencil of Nature*, examining the mixture of archival, library, and conservation practices at play in the stewardship of such an important and complex document.

Notice to the Reader.

> The plates of the present work are impressed by the agency of Light alone, without any aid whatever from the artist's pencil. They are sun-pictures themselves, and not, as some persons have imagined, engravings in imitation.

–Henry Fox Talbot, The Pencil of Nature, 1844, 5-line "Notice"

Introduction

The historical interest around the photographs in *The Pencil of Nature* places it at an intersection in terms of how it is perceived: it is somewhere between a published book and a photograph album. Today, fewer than thirty-nine complete copies are known to exist; about the same number are found in museums as in libraries, reflecting the fact that the presence of the early Talbotype plates turns *The Pencil* into something more than the typical book of its era. Library and Archives Canada (LAC) has the complete first fascicle of *The Pencil of Nature* as well as eight extra plates. This paper will discuss the provenance of LAC's copy and present a detailed summary of LAC's custodial treatment of it, looking at the decisions which have been made regarding intellectual and physical control, with a focus on conservation and rehousing.

Historical Sketch

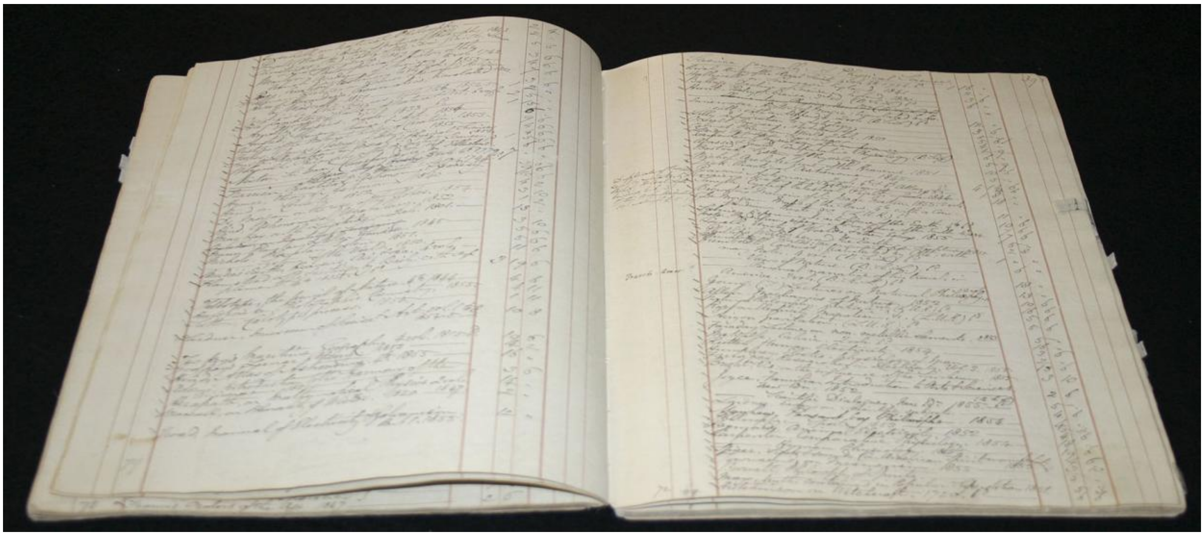
The Pencil of Nature was the first commercially published book illustrated with photographs. Five years prior to its publication, Henry Fox Talbot had invented the negative-positive process. The salted paper positive process was used to create the photographs in these books. Beginning in 1844, this publication was released in parts over a span of two years, during which time one could purchase the six different fascicles individually. Although the technique it presented was revolutionary, *The Pencil of Nature* was not a commercial success at the time.

The Pencil presents a challenge in some ways to conventional ideas of what makes a book. It was not uncommon in the 19th century for books to be printed in parts (Charles Dickens was publishing the last instalments of *Martin Chuzzlewit* when Talbot issued fascicle 1 of *The Pencil of Nature*), but the fact that so many surviving copies of *The Pencil* are fragmentary is perhaps unusual. In his article "Henry Fox Talbot's The Pencil of Nature: A Revised Census of Original Copies," Schaaf finds that almost every copy is different, and notes the difficulty of finding a single "standard" copy: "[p]ast assessments of this seminal publication were often generalized from the attributes of a single copy; in many cases that copy was demonstrated to have been exceptional." This heightened variation among copies may stem from the fact that, unlike many books, *The Pencil* lacks a narrative: as long as each photo is associated with the correct accompanying text, changing the order of the photos does not create confusion for the reader the same way taking two instalments of a serialized novel out of sequence would. As Schaaf notes, "[t]he fact that *The Pencil* was issued as a part book encourages owners to restructure theirs. This is readily understandable and probably does little harm" (Schaaf 1993, 388).

Purchase and Custodial History

In April 1849, an angry mob burned down the building housing the parliamentary library of the province of Canada in Montreal. Over the next few years the library's collection was partially reconstructed, but tragically a significant portion was destroyed in another fire in February 1854. The following year, faced with the task of rebuilding the library collection yet again, Parliament's Joint Library Committee appointed Alpheus Todd, assistant librarian, to undertake a book-buying mission in England and France. Todd was in Europe for eight months and obtained by purchase and donation a large number of books; he estimated that once all orders had been filled, "the number will probably exceed 20,000" (Canada 1856, 19).

Among the items Todd acquired was a complete copy of fascicle 1 of *The Pencil of Nature*. He noted it in the ledger in which he kept track of all his purchases as "Talbotype, the [p]encil of Nature, 4to 1844," and recorded the price paid as four shillings and sixpence (Todd 1856, 38) (figs. 1, 2). This price represented a substantial discount over fascicle 1's original price of 12 shillings, especially considering that the copy Todd purchased included eight extra plates. The exact date of purchase is not recorded, nor is the name of the seller. However, Todd's "A Report of the Librarian of the Legislative Assembly on the State of the Joint Library of Parliament" mentions the London-based publisher and bookseller Henry G. Bohn as providing "the choicest portion of our *English* books" (Canada 1856, 15). The presence of labels on two of the extra plates – *Martyr's Monument, Oxford* and *Gate at Christ Church* – which read "On Sale at Messrs. BROOKS (Brothers)" may be evidence of another source.



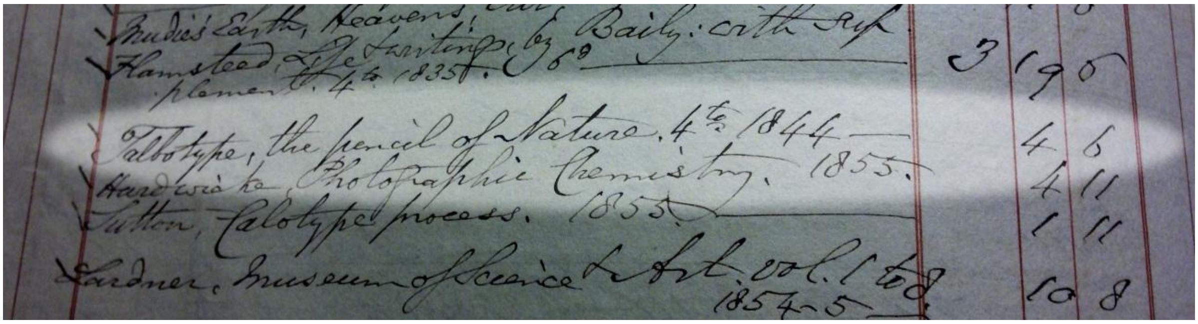


Fig. 1. Alpheus Todd's Ledger: List of Works Purchased in England and France in the year 1855. Ledger open to pg. 38-39 *(top).*
Fig. 2. Detail of the entry "Talbotype, the pencil of Nature, 4^{to}, 1844 4/6" pg. 38 *(bottom).*
Reproduced with permission of the Library of Parliament.

The book remained in the custody of the Library of Parliament for over 100 years until it was transferred to the National Library of Canada (NL). The precise date of *The Pencil of Nature*'s arrival at the NL is unknown; however, a large number of rare books were transferred from the Library of Parliament to the NL in the 1960s and it is possible that *The Pencil* was among them. At NL it was stored in the Rare Book Collection at the shelf location TR144 T2 1844 fol., where "fol." (abbreviated from "folio") is a size classification indicating that the item is over 9.7 in. (250 mm) tall.

In 1967, in celebration of the 100^{th} anniversary of Canadian Confederation, a number of new government buildings were inaugurated in Ottawa, Ontario. One was a joint repository for the Public Archives and National Library, known as the PANL building, which featured shared facilities and conservation services. After 30 years, both institutions had outgrown the building which no longer met the current environmental standards for archival or library collections. The two institutions physically separated. NL remained in PANL while the collections and preservation staff from the National Archives, previously known as the Public Archives, moved in 1997 to the Preservation Centre, a custom built, state of the art storage facility with conservation laboratories located in Gatineau, Quebec.

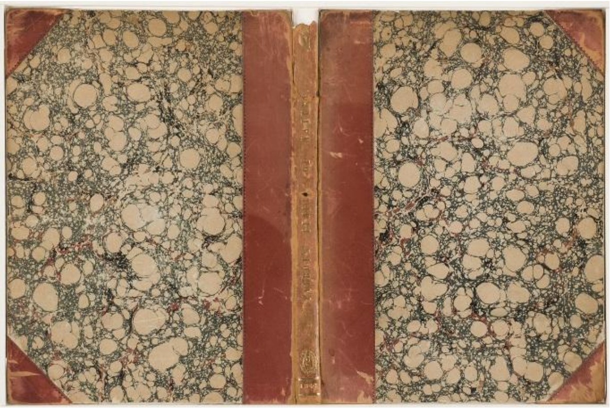
Pre-Conservation History

In 2002, despite being in a fragile condition, the NL's copy of *The Pencil* was exhibited in a show entitled *The Photographically Illustrated Book in Nineteenth-Century Canada* (Schwartz 2013). The attention generated provided an opportunity to coordinate the first concerted conservation effort between photograph and book specialists.

Conservation treatment would address the fragility and improve access; however, due to changing priorities and pressures, the treatment would not be complete for another seven years. One of the first challenges encountered had to do with the inadequate storage environment at PANL and whether *The Pencil* should return to permanent storage in that location after being exhibited. During discussions *The Pencil* remained in a secure, controlled environment in the conservation laboratory at the Preservation Centre. The 2004 merger of the National Archives and National Library which created Library and Archives Canada (LAC) figured prominently in additional delays as staff of both institutions were reassigned and negotiations for special collections storage space were finalised. However, this merger ultimately provided a solution to the previous storage issues as *The Pencil* was granted a permanent home at the Preservation Centre. In 2006, with a mostly new team in place, the conservation file was re-opened.

Description and Condition of Binding

Fascicle 1 with eight extra plates was bound in a ½ leather binding without the original notice or wrapper, measuring 12.12 x 9.25 x 0.68 in. (306 x 233 x 17 mm). The text block sewing supports were laced through the boards, which were covered in red vegetable-tanned calf skin and marbled paper. The leather covers were decorated with a blind-roll design around the edges. The leather spine was gilt with various tools and stamps, the first being a beaver, an ownership symbol for The Library of Parliament, followed by the title [TALBOT'S PENCIL OF NATURE.], then [LIBRARY OF PARLIAMENT CANADA.] and ending with the publication year [1844] (figs. 3-6).



Figures 3-6. left: Full cover view of binding in ½ leather and marbled paper; right: Details of title and tooling on the spine.

SHEET	SIGNATURE , TEXT AND PLATES	
		Flyleaf
1		*Title Page*
2	B	*Introductory Remarks*
3		(Cont'd)
4	C	*Brief Historical Sketch*
5		(Cont'd)
6	D	(Cont'd)
7		(Cont'd)
8	E	(Cont'd)
9		(Cont'd)
10	F	(Cont'd)
11		(Cont'd)
12	G	(Cont'd)
13		(Cont'd)
14	H	(Cont'd)
15		(Text, Plate I)
16		*Plate I. Part of Queen's College, Oxford.*
17	I	(Text, Plate II)
18		*Plate II. View of the Boulevards at Paris.*
19		(Text, Plate III)
20		*Plate III. Articles of China.*
21	K	(Text, Plate IV)
22		*Plate IV. Articles of Glass.*
23		(Text, Plate V)
24		*Plate V. Bust of Patroclus.*
25		*Extra Plate 1. The Martyr's Monument. (5:XXI)*
26		*Extra Plate 2. Magdalen College, Oxford.*
27		*Extra Plate 3. Queen's College, Oxford. (1:I)*
28		*Extra Plate 4. Cloisters of Lacock Abbey. (4:XVI)*
29		*Extra Plate 5. The Tower of Lacock Abbey.(5:XIX-B)*
30		*Extra Plate 6. Botanic Gardens, Oxford.*
31		*Extra Plate 7. Gate of Christchurch. (4:XVIII)*
32		*Extra Plate 8. High Street, Oxford.*
		Flyleaf

Fig. 7. Collation diagram.

The text block edges were coloured red. The blue endbands were a stuck-on style. The double folio flyleaves were made of plain wove paper. The spine was backed and heavily rounded with a plain paper lining. The text block consisted of nineteen printed sheets and thirteen plates. The pages were not numbered. Every second printed sheet was identified with a signature letter from B to K, no A or J. The thirty-two sheets were gathered into ten signatures, each made up of three to four single sheets. They were stitched together using the over-cast sewing technique, in which a thread spirals over the spine edge from back to front and top to bottom, piercing through each signature and perforating the sheets (figs. 7-9). The signatures were then sewn onto three recessed cord supports. Although the book was clearly identified as being in the Library of Parliament of Canada, it is not clear where or when the original wrapper was removed and the subsequent leather binding added.

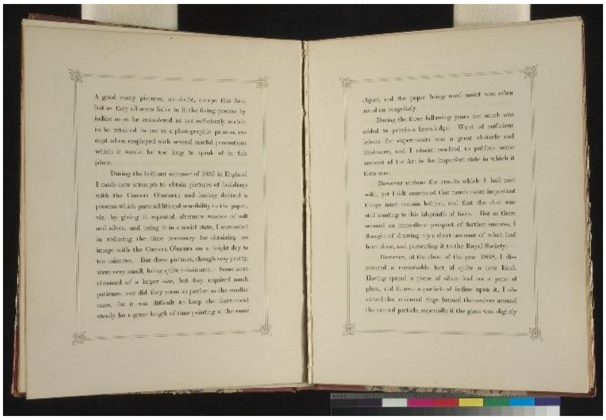


Fig. 8. Over-cast sewing before conservation *(left)*.
Fig. 9. Dismantling of text block, detail of the 32 sheets gathered into 10 over-cast sewn signatures *(right)*.

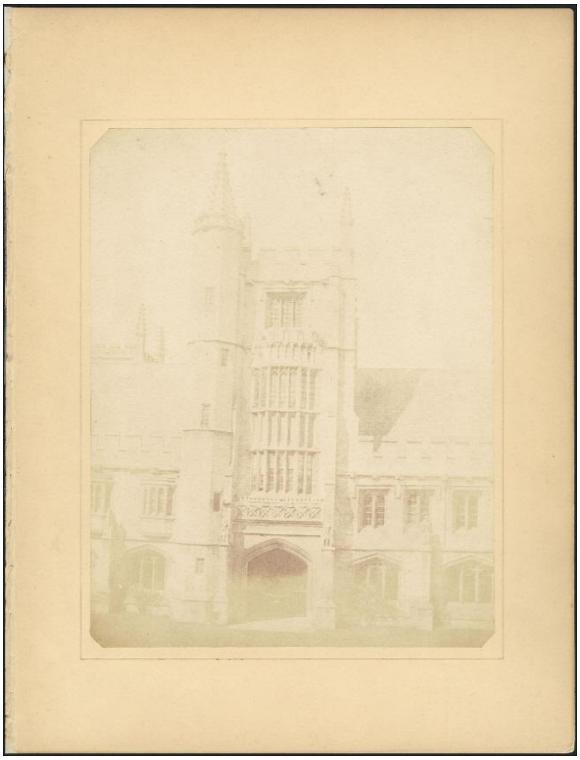
While it does not specifically mention *The Pencil of Nature,* Todd's report describes expenditures for bindings carried out in Europe on numerous items before they were transported to Canada. (Canada 1856, 10). Identification of the leather, marbled paper and binding features suggest a typical late 19th century binding with no indication of the bookbinder. It would be speculation to say which scenario is more likely: that the book was bound as we find it now when Todd made his purchase in 1855, that he had it bound in Europe and the Library of Parliament stamps were subsequently applied, or, lastly, that the book arrived in Canada in an unknown binding state and was bound at the Library of Parliament.

Prior to conservation treatment the binding was in poor condition, with the front board having detached completely and the leather being split at the back joint and missing completely at the top end-cap. In addition, the sewing had broken in many places throughout the text block and the front flyleaf had broken away at the perforation line. It was evident that the pages were under tension during handling due to the over-cast sewing. This, combined with the perforations from the sewing, put the pages at risk of tearing or detaching.

Description and Condition of Photographs

The five plates in fascicle 1 are typical in sequence and image quality in comparison to other fascicle 1 copies. Bound with LAC's fascicle were eight extra plates, five originating from other fascicles while three were never part of *The Pencil.* The five plates from other fascicles are as follows: *Martyr's Monument, Oxford* (fascicle 5, plate XXI); *Queen's College* (fascicle 1, plate I); *Cloister of Lacock Abbey* (fascicle 4, plate XVI); *The Tower of Lacock Abbey* (fascicle 5, plate XIX-B); and *Gate at Christ Church* (fascicle 4, plate XVIII). In his article, Schaaf indicates that plates which were sold separately would have had, "PATENT TALBOTYPE OR SUN PICTURES" labeled or stamped in blue on the verso (Schaaf 1993, 389). The five extra plates just mentioned do carry this label on the verso. However, two of these, *Martyr's Monument, Oxford* and *Gate at Christ Church,* have the complete label with a majuscule "OR" and include the address of the bookseller. Two others, *Cloister of Lacock Abbey* and *The Tower of Lacock Abbey,* both have the label with a majuscule "OR", but do not carry the address. Finally, the verso label found on *Queen's College* features a miniscule "or", but with the bottom section cut off; therefore, no address can be seen, if it was indeed originally present. Out of the five, only one, the *Queen's College* plate, has the typical ruled line around the image. This plate also lacks a plate number and on the verso features a handwritten title as well as other text, both of which have been cut off. Thus, it can be assumed that this page was larger than the fascicle at one time. Two of the five plates, *Martyr's Monument, Oxford* and *Queen's College,* have been mounted by their edges to the support, and the other three, *Gate at Christ Church*, *The Tower of Lacock Abbey*, and *Cloister of Lacock Abbey,* have been mounted overall to the secondary support. Only *Martyr's Monument, Oxford* has a printed label adhered to the support centred below the photograph reading: "The Martyr's Monument, Oxford. *From Nature*."

In addition to the five plates described above there are three extra plates that were not originally part of any fascicle (figs. 10-12). They are titled: *Magdalen College, Oxford; Botanic Gardens, Oxford*; and *High Street, Oxford.* All three plates have the typical blue stamp on the verso that indicates that they are "PATENT TALBOTYPE OR SUN PICTURES". The blue stamp on *High Street, Oxford* is slightly smaller than the stamps on the other two pages. All three plates are mounted overall onto secondary supports ruled in pale brown ink. This type of mounting is unusual, as all other known fascicle images are mounted by the edges alone, with the ruling in pale brown ink. Only *Magdalen College, Oxford* has the image corners cut at a 45° angle. On the verso of all three, hand written in pencil or in ink, are the titles and numbers; however, some have been cut off, which would indicate that the pages were larger at one time and were likely trimmed during the binding process.



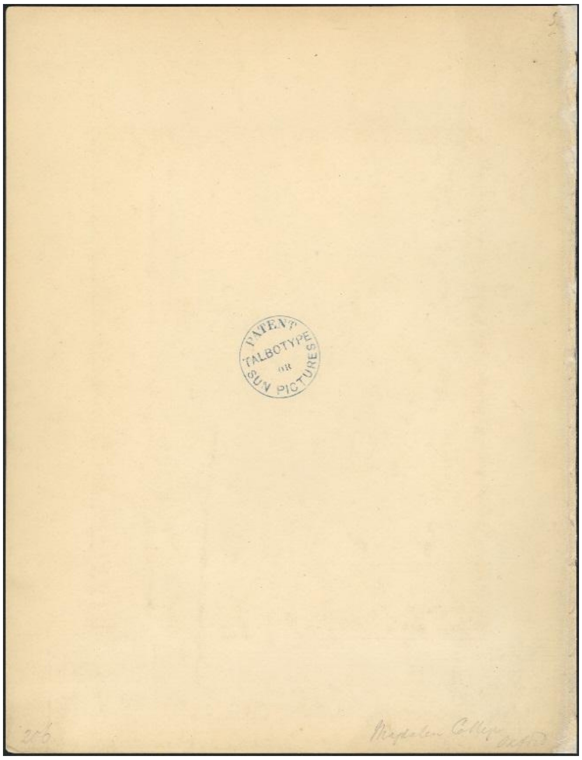


Fig. 10. Extra Plate 2, *Magdalen College, Oxford*. Left is recto, right is verso
Measurements: Secondary Support 11 x 9.1 in. (298 x 232 mm); Image: 8.2 x 6.5 in. (208 x 165 mm); Stamp: 1.3 in. (33 mm).

Fig. 11. Extra Plate 6, *Botanic Gardens, Oxford*. Left is recto, right is verso
Measurements: Secondary Support 11 x 9.1in. (298 x 232 mm); Image: 7.6 x 6.4 in. (193 x 164 mm); Stamp: 1.3 in. (33 mm).

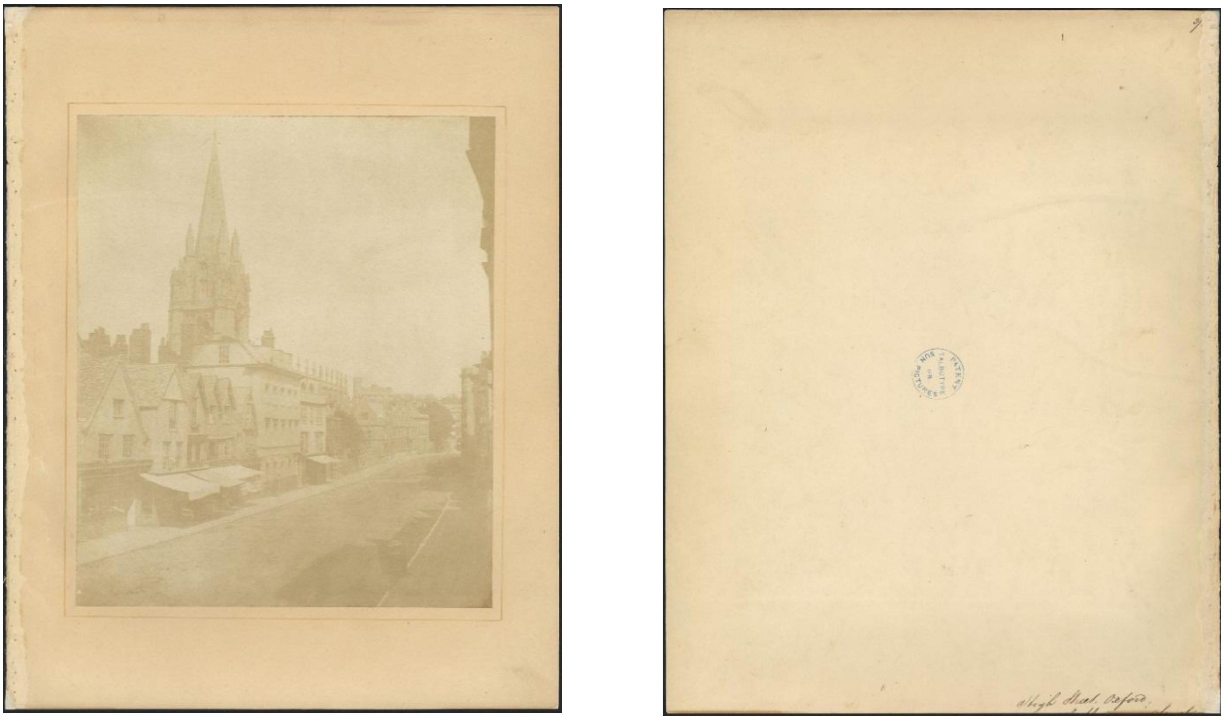


Fig. 12. Extra Plate 8, *High Street, Oxford*. Left is recto, right is verso
Measurements: Secondary Support 11.7 x 9.1 in. (299 x 231 mm); Image: 8.2 x 6.8 in. (209 x 174 mm); Stamp: 0.8 in. (21 mm).

The photographs in the fascicle and the eight extra plates are in fair condition, as some photographs have faded to the typical yellow/green colouration and others have only faded along the edges, leaving a rather characteristic reddish colouration in the centre of the image. There is one photograph within the fascicle, *Articles of China*, Plate III, which has a transfer of text from the adjacent page onto the centre red high-density area of the photograph.

Conservation Options and Decision Rationale

Due to the overall condition of the photographs, support pages and binding, an investigation was begun to determine an appropriate conservation solution. Schaaf's census was reviewed to locate other copies for comparison (Schaaf 1993). A consultation opportunity was then arranged for LAC conservation staff to view complete contemporary wrapper binding structures of *The Pencil* fascicles at both the New York Public Library and the Metropolitan Museum of Art. The knowledge gained by consulting other original copies was influential in the development of the following conservation options.

Option 1: Fixed leaf format

1.1 *Maintain the current binding through conservation.* This was not considered an option due the fragility and conditions mentioned above.

1.2 *Reconstruct the original structure as produced by the publisher.* This was not considered a satisfactory structure for LAC's *The Pencil* as it would necessitate the use of adhesives and would pose other associated risks to the book. The Perfect Binding of the original issues relied on adhesive and leather applied directly to the spine edge of the fascicles' single sheets to secure the pages together with the printed paper wrapper. The Perfect Binding has proven time and again to be an unreliable binding technique as the adhesive dries and crumbles and pages begin to separate and detach.

1.3 *Reconstruct a binding in the style of the current 19th binding.* This was not considered an option due to the damage already caused by the over-cast sewing.

Option 2: Flexible format

2.1 Provide an alternative binding structure and incorporate existing components as permitted. This was not considered an option due to the historical significance of the fascicle format. Techniques such as adding repair tissue and adhesive to join sheets in pairs for the creation of signatures to sew through the fold were seen as too intrusive as the format would be completely altered.

Option 3: Accessible format

3.1 Disbind the structure into single sheets and maintain the binding components separately. This was considered the most appropriate option in relation to Talbot's publication objective, which was to present the text and accompanying plates in a wrapper. The extra plates were to be individually matted.

Conservation

LAC's conservation staff chose to pursue option 3 with the additional conservation objective of minimizing risk during handling and viewing. The treatment itself began with dismantling the text block by removing the over-cast sewing threads. The text pages and secondary supports of the plates were then surface cleaned with an Absorene dirt eraser and residual adhesive was mechanically removed. Localized humidification and repair along spine edges was necessary on the text pages and secondary supports of the plates. A wrapper was constructed for the fascicle's loose sheets using an acid free paper, and the plates were interleaved with Usumino Kozo tissue. No conservation treatment was carried out on the photographs. To facilitate public access and record current condition, high resolution digital images were taken of *The Pencil* including the binding, the recto and verso of each page, and the extra plates.

Housing

Fig. 13. Fascicle 1 in a four-flap.

A standard acid free storage container measuring 21.2 x 17.3 x 4.3 in. (540 x 440 x 110 mm) was selected to house the binding, the fascicle, and the matted extra plates. The size of the matted plates measures 20 x 16 in. (509 x 460 mm) and required thin spacers to be placed as fillers in two sides of the container. A PAT approved acid free mat board was selected for the housing. The binding was laid open to allow full view under a sheet of Mylar® and secured with archival mounting corners into a sink mat with a protective cover. Fascicle 1, complete with its five plates in a four-flap made of acid free paper, was also housed in a sink mat with protective cover (fig. 13). Each extra plate was individually matted in a sink mat as follows (figs. 14, 15):

Fig. 14. (1) Bottom layer (mat board 1); (2) Secondary window mat (mat board 2) was cut just larger than the overall secondary support; (2b) a sheet of Mylar® was attached with double sided tape to the recto of (2), and Filmoplast® P90 was taped along the recto exterior; the photograph was attached to the Mylar® with four archival mounting corners. (3) Primary window mat (mat board 3) was cut, permitting the view of the image only for presentation; (4) cover (mat board 4).

Fig. 15. Cover (mat board 4) / primary window mat (mat board 3) *(top)*; Primary window mat (mat board 3) / secondary window mat (mat board 2) and Mylar® and Plate *(centre)*; Plate with Mylar® and secondary window mat (mat board 2) / bottom layer (mat board 1) *(bottom)*.

Current Intellectual Control

Despite the fact that it has been disbound and thus no longer resembles the popular image of a book, LAC continues to treat its copy of *The Pencil of Nature* as a published monograph rather than an object in the photograph collection. *The Pencil*, in its custom housing, resides in the Rare Book Collection at LAC's Preservation Centre in a vault at 18°C and 40% RH, which are the same environmental conditions used in the vaults housing the general photograph collections. Due to its rehousing in a large archival box, *The Pencil* is no longer shelved upright. Instead, the box is kept in flat storage with other oversized material such as atlases and large plate books; to reflect this change in location, the size designation "fol." has been changed to "xx.fol.," the code LAC uses to indicate books which are over 20 in. (500 mm) tall and must be shelved flat.

The intellectual treatment of *The Pencil of Nature* as a book is consistent with the original circumstances of its publication; it was, after all, first published as a fairly conventional book – with the notable distinction of being the first published book to feature photographs – and it seems logical to continue treating it that way. It should also be remembered that copies of *The Pencil* were issued as fascicles: the bindings would have been added after purchase, if desired, as was fairly standard at the time. Therefore, it does not appear that the presence or the lack of a binding should enter into whether or not an item is considered a book.

Conclusion

Library and Archives Canada's treatment of it copy of *The Pencil of Nature* reflects the item's complex history. The historical significance of the fascicle format influenced the conservation methodology, resulting in the disbinding of the book and the creation of custom housing for the binding, the fascicle, and the extra plates. Despite the change in its physical circumstances, *The Pencil* nonetheless remains a book, and its intellectual treatment reflects that.

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Photographic Activity Tests of Various Adhesives Suggested for Use on Water-Sensitive Photographs

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Abstract

Photographic Activity Tests (PATs) were run on various adhesives of interest to conservators for conserving silver-image water-sensitive photographs where aqueous adhesives might cause planar distortions. The results suggest that the ever popular Lascaux 360 HV and Lascaux 498 HV adhesives should not be used. Other products that were tested passed the PAT and are possible substitutes.

Keywords: photographic activity test, PAT, adhesive, Lascaux 360 HV, Lascaux 498 HV, Lascaux 303 HV, Paraloid B-72, BEVA 371, Plextol B500

Introduction

For more than 25 years, conservators have been using various acrylic adhesives (e.g. Lascaux 360 HV and Lascaux 498 HV) either in a pressure-sensitive, heat-set or solvent reactivation application for conserving silver-image photographs especially for water-sensitive photographs where aqueous wheat starch paste or methylcellulose solutions might cause planar distortions. Some of these acrylic adhesives were tested as part of a project on tapes and heat-set tissues carried out at the Canadian Conservation Institute (CCI) (Down et al., 2011) and were found to fail the Photographic Activity Test (PAT). This threw these adhesives into question so it was decided to look at them in more detail to see what could be recommended for silver-image photographic materials and to see if possible alternatives could be found.

Photographic Activity Test

The PAT (ISO 18916 2007) is a test used to detect possible chemical interactions between a material-in-question (e.g. paper, adhesive, etc.) and the photographic image (such as in silver-gelatin prints).

The test consists of constructing two different types of sandwich stacks consisting of the material to be evaluated and one of two detectors. The first sandwich is used to measure the propensity of the material being tested to stain gelatin and makes use of a Stain Detector. This detector is a piece of conventional fibre-based black-and-white photographic paper unexposed and processed so that the end product is a clear piece of gelatin on a white background. The second sandwich utilizes a detector that is unprocessed colloidal silver in gelatin on a polyester plastic base and is called the Image Interaction Detector. Colloidal silver is sensitive to oxidative or reductive processes initiated by the paper, adhesive, etc. The material being evaluated is not in direct contact with the detectors, but instead, Whatman #1 filter paper is used as a separator in order to prevent any physical interaction (such as adhesion) between the detectors and the material.

The whole assembly of detector, sample material, and filter paper is placed between two pieces of glass and under a small amount of weight to ensure the sandwich remains flat. The sandwiches are then placed in a temperature and humidity controlled chamber for 15 days at a temperature of 70°C and relative humidity of 86%. Corresponding controls are also incubated alongside the test samples. For the controls, Whatman #1 filter paper is substituted for the adhesive samples.

The samples are evaluated using densitometry and via a visual test. Densitometry measures the yellowing of the Stain Detector by comparing the density readings before and after incubation. For the Image Interaction Detector, densitometry measures the fading or darkening of the colloidal silver film by once again comparing before and after readings. The Image Interaction detector is evaluated visually after incubation for what is called "mottling" or in other words patchy fading, darkening, or spotting which may not be picked up by the densitometry readings. Any mottling that is easily recognizable and any density changes in the detectors beyond a certain amount, when compared to controls, determines whether a material passes or fails the PAT. If the material-in-question fails any one of the three tests (i.e. image interaction, staining, or mottling) then it fails the PAT test.

Depending on the situation, the adhesive test samples placed in the sandwich were prepare by either heat-setting them to Whatman #1 filter paper, solvent reactivating them to the filter paper or simply placing them next to the filter paper without using either of the above processes.

PAT Results from the Tapes and Heat-set Tissues Project (2009)

The tapes and heat-set tissues project was initiated at CCI to help understand the nature and stability of different tapes and heat-set tissues and their impact on paper (Down et al., 2011). Besides running a PAT on the adhesive side and carrier side of all 42 tapes and heat-set tissues included in the project, the following tests were also performed: extracted pH, colour change of the carrier side of the product and of the paper substrates to which they were attached (reverse side), and mechanical and solvent removal of the products from 1870s commercial printing paper and resin-coated photographic paper before and after aging in the dark (some aging tests were done in ovens).

For the PATs, the tapes and heat-set tissues were adhered to Whatman #1 filter paper as they would have been applied in normal conservation practice. For the heat-set tissues, the products were heat-set onto Whatman #1 filter paper at temperatures recommended by the manufacturer using a dry mount press held at the recommended temperatures for 3 minutes. For the pressure-sensitive products, they were lightly tacked at either end of the strip onto the test papers and then pressed using a Roll Down Machine that delivered the same pressure to each strip. Water-activated and solvent reactivated products were also applied to the filter paper and then pressed using the Roll Down Machine to ensure that the same pressure was used for every sample.

The results of the PATs for the tapes and heat-set tissues can be seen in Table 1 (see Appendix) which is organized according to adhesive chemistry of the products. Only 43% of the products passed the PAT. Of particular interest to photographic conservation will be the following results:

- homemade wheat starch paste passed the PAT
- Library of Congress Heat-set Tissue (containing Plextol B500 and Rhoplex AC-73) passed the PAT
- Lascaux 360 HV, Lascaux 498 HV and the mixture of 360 and 498 (all heat-set) failed the PAT

- Seal Fusion 4000 Film and Colormount Tissue for dry mounting (both heat-set) both passed the PAT
- BEVA 371 Film which was heat-set passed the PAT.

The results obtained from the Lascaux products were particularly disturbing as these products have been used frequently in conservation as heat-set or solvent-reactivated adhesives for silver-image photographic materials when aqueous applications (e.g. wheat starch paste and methylcellulose solutions) cannot be used because they would cause planar distortions.

Additional PAT Results (2013)

Because the Lascaux products failed the PAT in 2009, it was decided to retest these products, look at them in more detail and test a few alternative ones that have been suggested for possible use in photographic conservation in hopes of finding a heat-set or solvent-reactivated type that might pass the PAT and be recommended for use on silver-image water-sensitive photographic materials. Thus, the following adhesives were tested without being heat-set onto the Whatman #1 filter paper as they were done in 2009. Instead, these adhesives were painted onto Whatman #1 filter paper full strength, dried for 72 hours and then sandwiched with another piece of Whatman #1 filter paper for the PAT.

- Rhoplex N-580
- Lascaux 360 HV (2009 and 2012 batches)
- Lascaux 498 HV (2009 and 2012-1 batches)
- Lascaux 303 HV
- Plextol B500
- Paraloid B-72 (in toluene)
- BEVA 371 Original Formula solution
- BEVA 371b solution (the new substitute for BEVA 371).

Also PATs were run at the Image Permanence Institute (IPI) on the following samples: Lascaux 498 HV and Plextol B500 both prepared on Hollytex as a backing[1]. A PAT of the Lascaux 498 HV on Hollytex was also run at CCI to see if the same results would be obtained as that from IPI.

The results of these PATs are given in Table 2 (see Appendix). It can be seen that the Rhoplex N-580, Lascaux 498 HV (samples done at CCI) and the Plextol B500 (samples done at CCI) all failed the PAT. On the other hand, the IPI samples for Lascaux 498 HV and Plextol B500 on Hollytex both passed the PAT which contradicts the CCI results for these samples. There are three possible reasons why the CCI and IPI results might differ for the Lascaux 498 HV on Hollytex. First, it should be noted that the same sample batch was tested at both locations. Table 2 shows that the reason for the Lascaux 498 HV on Hollytex failing the PAT at CCI was due to the mottling test. The mottling evaluation is subjective and it is possible that what was considered mottling in the CCI PAT Image Interaction Detector was not considered mottling at IPI. The second reason is inherent laboratory to laboratory variations. Even though the PAT is a standardized test and variations between laboratories, for the most part, are taken into consideration in the PAT results evaluation, borderline samples may still either fail or pass depending on where the test was performed. The third possible reason for a difference is that the testing at CCI was performed one year later than at IPI. Sample storage, handling or aging might have caused these differences.

As for the Plextol B500 sample, the test samples were not exactly the same. The IPI sample was on Hollytex and the CCI sample had no backing. It is not suspected that this would be the cause for the different results. The more likely cause would be the subjective evaluation of the mottling test and variations between the laboratories causing the sample to narrowly fail the stain portion of the PAT.

It is also concerning that the new BEVA 371b did not pass the PAT while the old BEVA, which is no longer available, did pass. This is likely due to the formula change (Chludzinski 2010) in the new product which now is causing it to fail the PAT.

The results for the Lascaux 360 HV were somewhat confusing. The samples that were heat-set onto the Whatman #1 filter paper in 2009 failed the PAT while the samples run in 2013 (i.e. same batch used in 2009 and new batch from 2012) both passed the PAT. One difference between the samples was that no heat-setting was used for the samples run in 2013. Another difference was that the 2009 heat-set sample was treated as a label or tape and therefore the filter paper backing also acted as the separator between the adhesive and the detector. For the non-heat-set samples that were run in 2013 there was no backing and therefore a filter paper separator was required between the adhesive sample and the detector. This could be the reason why the samples in 2013 passed the PAT. It is likely that the heat-setting used in 2009 pushed the adhesive into the filter paper with the result that it was physically closer to the detector compared to the 2013 samples which were separated from the detector by the full thickness of filter paper (see Figure 1). Ultimately, the adhesive in 2009 was closer to the detector and more likely to cause a detrimental effect when compared to the non-heat set samples. It is suggested that the 2013 samples are the more accurate PAT results for this adhesive product.

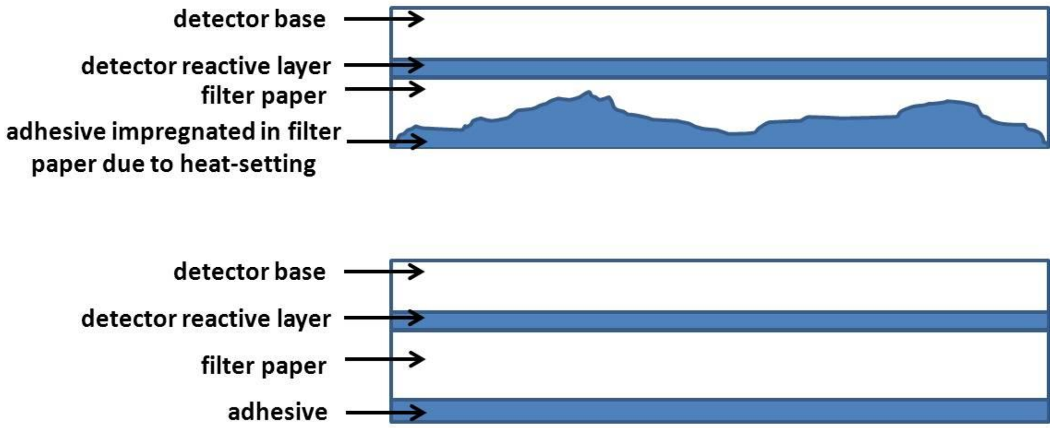

Figure 1. The top image shows the possible migration of adhesive into the filter paper caused by the heat-setting procedure. The bottom image shows the adhesive with no heat-setting and a filter paper barrier between it and the detector reactive layer. It is clearly evident that with heat-setting and no additional filter paper separator being used, the adhesive is much closer to the reactive layer of the detector.

The Lascaux 498 HV samples all failed the PAT except for the IPI sample as explained above. Because of the widespread use of this product with photographic materials, a further examination was required to see if a concentration of the adhesive could be found that would pass the PAT. PATs were performed at four different concentrations with and without heat-setting. The results are summarized in Table 3 (see Appendix). In either case, heat set or not, the trend is clear. As the concentration is lowered, the PAT result progresses closer to passing grade. Eventually, at a concentration of 25 percent for no heat-setting and 50 percent for the heat-set sample, the adhesive passed the PAT. However, at these low concentrations they are not very effective adhesives and do not adhere well making them essentially useless as for use in conjunction with photographic materials.

Since Lascaux 360 HV is no longer available and the Lascaux 303 HV is its substitute, PATs were performed on the Lascaux 303 HV. The adhesive was applied to the Whatman #1 filter paper using solvent reactivation, heat-setting, and without either one of these processes. The results are also given in Table 3 (see Appendix). Fortunately, it passed the PAT and it appears that there is no significant difference in the results, regardless of the method of application. Aging data on this adhesive is not available at this time. Analysis showed that it is 2-ethylhexyl acrylate/ethyl acrylate copolymer which is definitely different than the Lascaux 360 HV (Williams 2013).

Recommendations

Recommendations for adhesives for silver-image water-sensitive photographs might encompass the following products since Lascaux 360 HV, which has been used in the past, has been discontinued. If more aging and handling data on the Lascaux 303 HV becomes available in the future and shows it to be a stable useful product, it could be considered for use as it passed the PAT. Paraloid B-72 and the old BEVA 371 (film and solution) also passed the PAT and if they have the correct handling properties, they also could be considered. On the other hand, the mixed PAT results obtained from CCI and IPI for Lascaux 498 HV and Plextol B500 suggest that they should not be used on such photographs.

Notes

1. These samples were made and sent to IPI by Christophe Vischi, Assistant Conservator of Photographs, National Gallery of Canada.

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Table 1: Results of the PAT from the Tapes and Heat-set Tissues Project, Arranged According to Adhesive Type

Tape or Heat-set Tissue	WA PS HS	Adhesive Component Chemistry	Image (%) (pass is -20 to +20 %)	Stain (depending on run, pass is <19-22)	Mottling	Adhesive Overall PAT Rating
PROTEIN Containing Products						
Gummed Paper Hinging Tape	WA	Protein	pass 1.79	pass 0.10	fail	**FAIL**
Repa Tex G5	WA	Protein + MC	pass -4.02	pass 0.11	pass	**PASS**
Gummed Linen Hinging Tape	WA	Protein + Starch (>8:1)	pass -8.93	pass 0.10	fail	**FAIL**
Hinged Cambric Cloth Tape	WA	Protein + Starch (>8:1)	fail -40.18	pass 0.10	fail	**FAIL**
Perforated White Linen Tape	WA	Protein + Starch (>8:1)	fail -49.86	pass 0.09	fail	**FAIL**
STARCH Containing Products						
Homemade WSP (w Kurotani tissue)	WA	Starch	pass -2.59	pass 0.12	pass	**PASS**
Gummed Linen Tape	WA	Modified Starch	pass 12.71	pass 0.14	fail	**FAIL**
ACRYLIC - PnBA Containing Products						
filmoplast P	PS	PnBA + $CaCO_3$ + UN	pass -4.14	pass 0.12	pass	**PASS**
Frame Sealing Tape FST 1000	PS	PnBA	pass 0.75	pass 0.13	pass	**PASS**
Self-adhesive Linen Hinging Tape	PS	PnBA	fail 21.80	pass 0.11	fail	**FAIL**
Framer's Tape II #S2000	PS	PnBA	pass 19.08	pass 0.11	fail	**FAIL**
ACRYLIC - PnDA Containing Products						
Scotch Magic Tape #810	PS	PnDA	pass 6.24	pass 0.14	pass	**PASS**
Scotch Magic Removable Tape #811	PS	PnDA	pass 6.09	pass 0.15	pass	**PASS**
Photo & Document Repair Tape #001	PS	PnDA + PIB ++	pass -3.79	pass 0.12	fail	**FAIL**
Acid-Free Db-Stick Adhesive Pen #007	PS	PnDA + PIB ++	pass -6.67	pass 0.14	fail	**FAIL**
Scotch Adhesive Transfer Taper #924	PS	PnDA + small PAA	fail 30.68	pass 0.12	fail	**FAIL**
Double-coated Film Tape #415	PS	PnDA (+PAA)	fail 21.96	pass 0.12	fail	**FAIL**
ACRYLIC - PEHA Containing Products						
filmoplast P90	PS	PEHA + $CaCO_3$	pass -5.32	pass 0.12	pass	**PASS**
gudy 871	PS	PEHA + PVAC + soap	pass -1.78	pass 0.10	pass	**PASS**
gudy 831	PS	PEHA + PVAC + soap	pass -8.61	pass 0.12	fail	**FAIL**
filmoplast T Tape (black)	PS	PEHA + PVAC + talc/mica	pass 5.94	pass 0.12	fail	**FAIL**
filmolux 609	PS	PEHA + PVAC + PH	pass 14.81	pass 0.12	fail	**FAIL**
filmoplast SH	PS	PEHA + PVAC	pass 2.81	pass 0.18	fail	**FAIL**
filmomatt libre	PS	PEHA + PVAC	pass 8.40	pass 0.11	fail	**FAIL**
PH7-70 Conservation ATG Tape Perm	PS	PEHA + UN	pass 15.25	pass 0.12	fail	**FAIL**
Self-adhesive Frame Sealing Tape	PS	PEHA	pass -3.44	pass 0.15	fail	**FAIL**
ACRYLIC – PODA Containing Product						
filmoplast R	HS	PODA + UN	pass -1.85	pass 0.11	pass	**PASS**
ACRYLIC – PEA/PMMA Containing Product						
Library of Congress Heat-set Tissue	HS	PEA/PMMA	pass -5.11	pass 0.13	pass	**PASS**
ACRYLIC - PBA/PMMA Containing Products						
Lascaux 498 HV	HS	PBA/PMMA	fail -51.99	pass 0.12	pass	**FAIL**
Lascaux 360 HV	HS*	PBA/PMMA	fail -41.34	pass 0.12	pass	**FAIL**
Lascaux 498 HV/360 HV	HS	PBA/PMMA	fail -33.81	pass 0.11	pass	**FAIL**
ACRYLIC - PMA/PEMA Containing Products						
Unsupported Archibond	HS	PMA/PEMA	pass -1.85	pass 0.12	pass	**PASS**
Crompton Tissue	HS	PMA/PEMA	pass 5.97	pass 0.12	fail	**FAIL**
PVAC or VAE Containing Products						
Hayaku Gummed Japanese	WA	PVOH/PVAC	pass -1.38	pass 0.12	pass	**PASS**
Document Repair Tape	PS	PVAC-vinyl maleate	pass -1.68	pass 0.13	pass	**PASS**
Vinamul 3252	HS	VAE + VAL/VAC + NaCMC	fail -73.30	pass 0.16	fail	**FAIL**
EVA Containing Products						
Seal Fusion 4000 Dry Mounting Film	HS	EVA	pass -4.83	pass 0.13	pass	**PASS**
Seal Colormount Dry Mounting Tissue	HS	EVA + UN	pass -1.70	pass 0.13	pass	**PASS**
BEVA 371 Film	HS	EVA + KRN ++	pass 2.70	pass 0.13	pass	**PASS**
Rubber Containing Products						
Duck General Purpose Masking Tape	PS	Rubber + tackifier	pass -4.22	pass 0.13	pass	**PASS**
Scotch 893	PS	Rubber + PP	pass 0.84	pass 0.10	pass	**PASS**
SBR Containing Product						
Spray Adhesive Super 77	PS	SBR + rosin?	pass 5.96	pass 0.14	fail	**FAIL**

Abbreviations: $CaCO_3$ = calcium carbonate; EVA = ethylene/vinyl acetate copolymer; HS = heat-set product; KRN = ketone resin N; MC = methylcellulose; NaCMC = sodium carboxymethylcellulose; PAA = poly(acrylic acid); PEA = poly(ethyl acrylate); PEHA = poly(ethylhexyl acrylate); PEMA = poly(ethyl methacrylate); PH = phthalate; PIB = polyisobutylene; PMA = poly(methyl acrylate); PMMA = poly(methyl methacrylate); PnBA = poly(butyl acrylate); PnDA = poly(decyl acrylate); PODA = poly(octadecyl acrylate); PP = polypropylene; PS = pressure-sensitive product; PVAC = poly(vinyl acetate); PVOH = poly(vinyl alcohol); SBR = styrene butadiene; UN = unknown; VAC = vinyl acetate; VAE = vinyl acetate/ethylene copolymer; VAL = vinyl alcohol; WA = water-activated products; WSP = wheat starch paste.
* Is also used wet, as a PS product or solvent-reactivated.

Table 2: Comparison of Results of the PATs for Various Adhesives

Adhesive					Results of the PAT			
Batch	**Heat-set**	**Backing**	**Run Date**	**Polymer Chemistry**	**Image (%) (pass is -20 to +20)**	**Stain (pass is <0.20; Control 0.11)**	**Mottling**	**Overall**
Rhoplex N-580								
2012	no	none	2013	BA	fail -25.96	pass 0.13	fail	**FAIL**
Lascaux 360 HV								
2009	51.5°C	tissue	2009	>>50% BA/MMA	fail -41.34	pass 0.12	pass	**FAIL**
2009	no	none	2013		pass -14.94	pass 0.11	pass	**PASS**
2012	no	none	2013		pass -4.43	pass 0.13	pass	**PASS**
Lascaux 498 HV								
2009	75.5°C	tissue	2009	56% BA/MMA	fail -51.99	pass 0.12	pass	**FAIL**
2009	no	none	2013		fail -23.76	pass 0.11	pass	**FAIL**
2012-1	no	none	2013		fail -26.74	pass 0.11	pass	**FAIL**
2012-2	no	Hollytex	2013		pass 9.83	pass 0.13	fail	**FAIL**
2012-2	no	Hollytex	2012 IPI		pass -1.26	pass 0.13	pass	**PASS**
Lascaux 303 HV								
2013	no	none	2013	EHA/EA	pass -7.68	pass 0.12	pass	**PASS**
Plextol B500								
2012-1	no	none	2013	66% EA/34% MMA	pass 14.63	fail 0.20	fail	**FAIL**
2012-2	no	Hollytex	2012 IPI		pass -1.31	pass 0.12	pass	**PASS**
LOC HST	88.4°C	tissue	2009	56% EA/44% MMA	pass -5.11	pass 0.13	pass	**PASS**
Paraloid B-72								
in toluene	no	none	2013	70% EMA/30% MA	pass 2.31	pass 0.12	pass	**PASS**
BEVA								
371Film	60-62°C	tissue	2009	EVA + KRN ++	pass 2.70	pass 0.13	pass	**PASS**
371Solution	no	none	2013		pass 5.42	pass 0.19	pass	**PASS**
371b Solution	no	none	2013	EVA + AKR ++	fail 23.31	fail 0.20	fail	**FAIL**

Abbreviations and Notes: AKR = aldehyde ketone resin; BA = butyl acrylate; EA = ethyl acrylate; EHA = 2-ethylhexyl acrylate; EMA = ethyl methacrylate; EVA = ethylene vinyl acetate copolymer; HS = heat-set; KRN = ketone resin N; LOC HST = Library of Congress Heat-set Tissue which contains Plextol B500 and Rhoplex AC-73; MA = methyl acrylate; MMA = methyl methacrylate; ++ means there are more components present. All samples were run at CCI except those labeled IPI which were run at the Image Performance Institute.

Table 3: Results of the PATs for Lascaux 498 HV Prepared at Different Concentrations With and Without Heat-setting and the Results of Lascaux 303 HV With and Without Heat-setting and Acetone Reactivating

Adhesive			Results of PAT			
Batch	**Concentration of Adhesive (%)**	**Heat-set or Solvent Reactivated**	**Image (%) (pass is -20 to +20 %)**	**Stain (pass is <0.23; Control is 0.14)**	**Mottling**	**Overall**
Lascaux 498 HV						
2012-1	100	no	fail -29.13%	pass 0.13	pass	**FAIL**
	75		fail -25.71%	pass 0.12	pass	**FAIL**
	50		fail -23.26%	pass 0.13	pass	**FAIL**
	25		pass -14.10%	pass 0.12	pass	**PASS**
	100	75°C	fail -27.42%	pass 0.12	fail	**FAIL**
	75		fail -24.61%	pass 0.13	pass	**FAIL**
	50		pass -19.84%	pass 0.12	pass	**PASS**
	25		pass -13.73%	pass 0.12	pass	**PASS**
Lascaux 303 HV						
2013	100	no	pass -7.38%	pass 0.14	pass	**PASS**
		50°C	pass -14.10%	pass 0.14	pass	**PASS**
		acetone activated	pass -13.00%	pass 0.13	pass	**PASS**