Article: The Gentling Collection: Establishing a Treatment Protocol for Multilayered Works on Transparent Paper
Author: Diane E. Knauf and Jodie Utter
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The Gentling Collection: Establishing a Treatment Protocol for Multilayered Works on Transparent Paper

INTRODUCTION

Stuart and Scott Gentling were local Fort Worth artists and authors, known for their realistic, dry-brush watercolor, figurative paintings, and portraitures. Although the twin brothers were both respected artists in their own right, they were best known for their collaborations. These collaborations included the murals in the Bass Performance Hall in Fort Worth and *Of Birds and Texas*, an elephant folio of 50 high-quality reproductions of the Gentlings' Texas birds and landscape paintings that are accompanied by essays and commentaries that were printed in hand-set type (Doss, 2021). The folio was dedicated to John James Audubon who greatly influenced the Gentlings' work (Barker, 2021).

The collection of Gentling works acquired by the Amon Carter Museum of American Art form the basis for the museum's new Gentling Study Center. The collection consisted of more than 700 works on paper, sketch books, manuscripts, and a large number of objects, including costumes, model ships, and plaster casts. The works on paper included watercolor paintings, a large number of sketches, preparatory works for the Bass Hall Performance Hall murals and *Of Birds and Texas*, and plans for the Gentlings' studio, which was designed by the brothers. Many of the preparatory works for *Of Birds and Texas* demonstrated the Gentlings' artistic process.

The Gentlings had an intensive process for creating their paintings, which can be seen in figure 1. They would begin by creating an original drawing. The drawing would then be traced. The tracing would be used to transfer a line drawing onto the watercolor paper. The Gentlings would then add gray modeling to the line drawing to give it form prior to painting. The image would then be painted using a thick, opaque application of watercolor. Often, this finished painting was not the end of the Gentlings' process. They would commonly make prints of their paintings and continue to rework the image by painting over the print. Within the collection of works at the Amon Carter, there are examples from all stages of the Gentlings' process.

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MULTILAYERED WORKS

Description

Included in the collection of preparatory works were complex, multilayered pieces comprised of numerous drawings attached to a support with a variety of tapes (fig. 2). These works consisted of individual line drawings of birds on tracing paper that were arranged and taped to the paper support with pressure-sensitive tape in the desired layout. The paper support that the Gentlings used was often the verso of prints of their other works on a heavily filled paper. After the arrangement was decided, the background was drawn. The final composition was then traced as a whole and transferred to the watercolor paper prior to painting. Many of these multilayered works were the preliminary pieces for the watercolors from the *Of Birds and Texas* book.

Condition

Prior to the museum's acquisition, the collection was stored in the Gentlings' vacant studio for years after the brothers' deaths. The multilayered works ranged from approximately 12 × 8 in. to almost 5 × 5 ft. The condition tended to vary, but the works were often in fair to poor condition due to the brittleness of the tracing papers, the large number of oxidized tapes present, and the previous storage conditions. There was a heavy layer of surface dirt, planer distortions, staining, and tears throughout the pieces.

Multiple varieties of tracing paper were used on the layered works. However, most of the tracing papers used by the Gentlings appeared to be either overbeaten or acid-treated tracing papers. All of the tracing papers showed a high reactivity to moisture and fluctuations in the environment. The tracing papers ranged from brittle, yellow, and almost brown to showing very little deterioration.

The Gentlings appeared to favor two types of pressure-sensitive tape: white artist tape and masking tape. However,

Fig. 1. A group of sketches showing the stages of the artistic process: original drawing (a), tracing of original drawing (b), transfer of line drawing to watercolor paper (c), addition of grey modeling to the line drawing (d), painted image (e), and print of original painting (f); Stuart and Scott Gentling, *The Artists' Process*, ca. 1981–1985, graphite, watercolor, and printing ink on paper, 76.4 × 93.6 cm, Amon Carter Museum of American Art, Fort Worth, Texas, gift of the Fort Worth Museum of Science and History, 2018.43.

other tape varieties, like blue painter's tape, were occasionally seen. Like the tracing papers, the tapes were in a range of degradation states. The majority of the tapes were either tacky or brittle. The adhesive of the masking tapes had often penetrated the paper, leaving localized staining in the tape area. The artist tapes, however, rarely showed signs of staining.

Conservation and Protocol Needs

Once the condition of the works was known and documented, the conservation needs were considered and a treatment protocol was developed. The treatment needed to maintain the appearance of the multilayered works while preventing further deterioration. The artists' intentions and the fact that these were archive pieces needed to be considered. These pieces were never meant to be the finished works but were an integral part of the Gentlings' process.

The materials used in the multilayered works added to the complexity of the treatment. Considering that transparent paper can be highly reactive to moisture, can lose transparency with solvents (van der Reyden, Hofmann, and Baker 1993), and repairs show through from the verso, treatment with traditional conservation methods and materials can be challenging and at times inappropriate.

With tape being such an integral part of the Gentlings' process, careful attention also needed to be paid to how the tape would be treated. Generally, the tapes would be removed to prevent further deterioration of the work. However, with these multilayered works, removing the tape would change both the artist intent and the structure of the works. Beyond that, some works had drawings on the tape's carrier. This presented further complications when considering how to approach the treatments.

Treatment of the collection needed to include an overall approach, considering the collection as a whole, while remaining adaptable enough to incorporate the needs of the multilayered works on tracing paper. The time constraints of the project meant that the treatments needed to avoid time-consuming processes while maintaining the artists' intent and stabilizing the objects and materials present. Treatments also needed to be low moisture and minimize any changes to the transparency of the tracing papers within the collection. Due to these needs and the complex nature of the multilayered works, multiple treatment options were explored prior to the development of the treatment protocol.

TESTING PRIOR TO TREATMENT

The difficulties involved with treating tracing paper and the complex nature of the multilayered works made it imperative

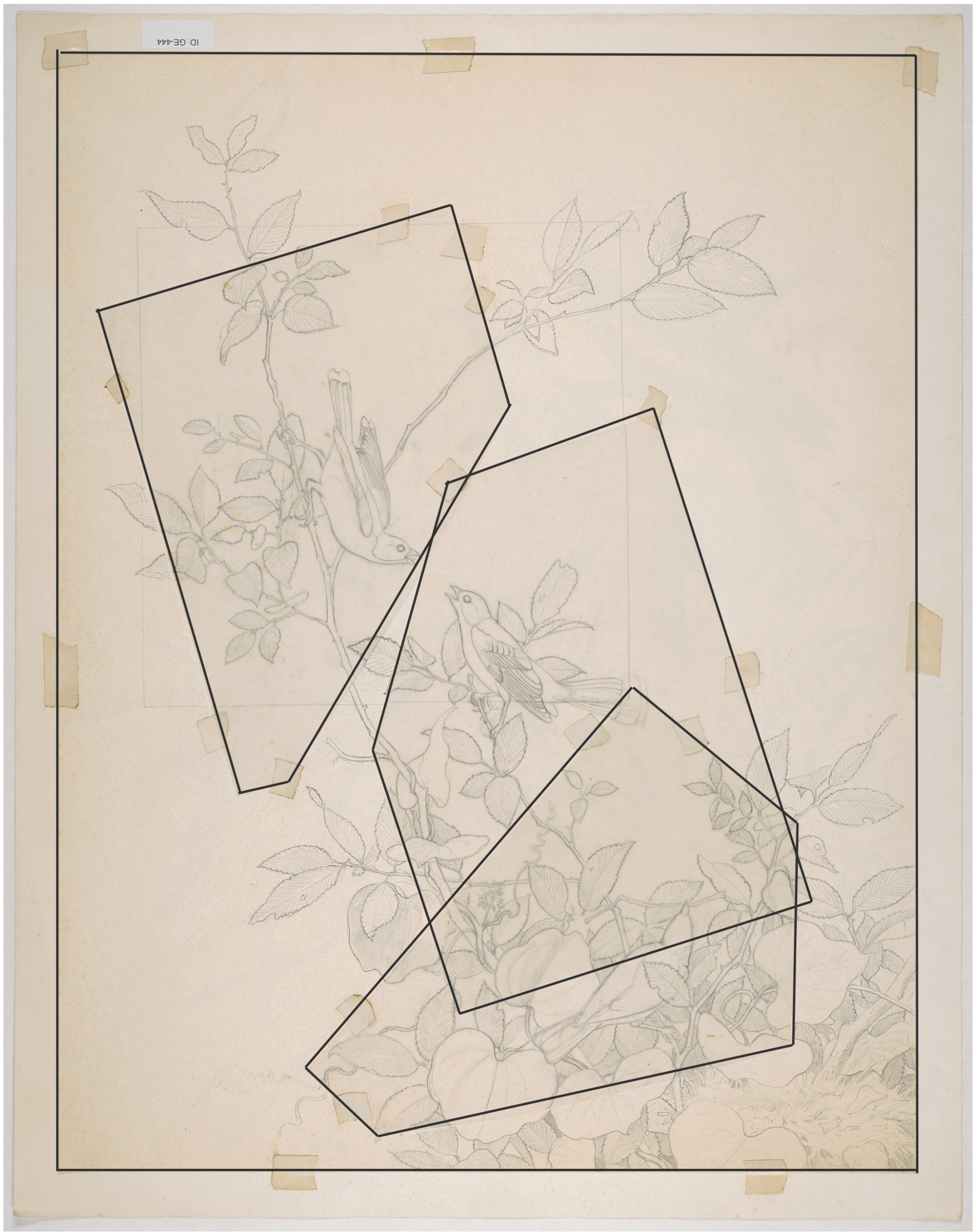

Fig. 2. Multilayered work with each individual sheet of paper outlined in black; Stuart and Scott Gentling, *Untitled*, graphite on paper, 66 × 50.8 cm, Amon Carter Museum of American Art, Fort Worth, Texas, gift of the Gentling Family, A2016.019.10.0085.

that the treatment options were first tested on tracing papers similar to those used by the Gentlings. Nanocellulose films and heat-set and solvent-set tissues were tested as repair materials. Gels were evaluated as a method of delivering moisture or solvents for any adhesive or tape removal within the collection. Methods of replicating and preserving the tape present were also explored. The goal of the testing was to determine the most appropriate route of treatment for the Gentling collection while accounting for the time allotted for treatment of the collection. Therefore, speed and ease of use were considered, along with the need to preserve the artists' intent and documentation of the Gentlings' working process.

Nanocellulose

In recent years, nanocellulose films have been introduced as a transparent material for tear repairs, infills, and as a coating to strengthen paper (Dreyfuss-Deseigne 2017a, 2017b, 2017c; Völkel et al. 2017; Williams 2018; Douglas and Coulthard 2019). The benefits of nanocellulose include the fact that it is pure cellulose, suggesting a high level of stability, and the strength of the films despite their thin and transparent appearance (Dreyfuss-Deseigne 2017b). This led to nanocellulose being tested as repair material for transparent papers and other transparent materials (Dreyfuss-Deseigne 2017c).

Nanocellulose is available in pre-formed sheets and as a gel or paste that can be used to make the films in the lab (Nanopaper-Art Films 2020; Weidmann Fiber Technology 2020). With the large number of transparent papers in the Gentling collection, and the fact that works are archive items, the preformed sheets were determined to be cost prohibitive for this project. Subsequently, a process to create nanocellulose films in the laboratory was developed using the 3% Celova for Art Conservation, a microfibrillated cellulose gel from Weidmann Fiber Technology (2020). Microfibrillated cellulose is created by mechanically fibrillating the fibers under a high shearing force until a three-dimensional network of long nanosized cellulose fibrils are formed (Dufresne 2013). To create the nanocellulose films in the laboratory, the 3% Celova for Art Conservation was mixed with deionized water to create a 0.2% solution that was then poured into a silicone tray with a flat bottom and allowed to dry (Knauf 2019).

Multiple studies have compared nanocellulose to Tengucho tissue, commonly finding that both have a high level of transparency compared to other repair tissues, with nanocellulose being slightly more transparent (Dreyfuss-Deseigne 2017c; Williams 2018). However, since the nanocellulose films used were created in the laboratory, their transparency likely varied from the nanocellulose films tested in the studies. Therefore, a comparison of the nanocellulose films produced in the laboratory and 6 g/m^2 Tengucho tissue was undertaken (fig. 3). The tests included repairing tears on sample transparent papers and measuring the opacity of both the Tengucho tissue and the nanocellulose films when applied to similar tracing papers that were used by the Gentlings. Although Klucel G was the advised adhesive for use with nanocellulose films (Dreyfuss-Deseigne 2017a), other adhesives were also tested, including wheat starch paste, methyl cellulose, Aquazol 200 in isopropanol, Aquazol 500 in isopropanol, and Klucel G in isopropanol. All adhesives were tested at a 5% w/v concentration.

The nanocellulose films were found to be highly reactive and difficult to work with when used with wheat starch paste and methyl cellulose. Aquazol 200, Aquazol 500, and Klucel G were easier to apply and performed better with the nanocellulose films than the water-based adhesives. All adhesives worked well with the Tengucho tissue. After application, the nanocellulose films seemed more prone to detaching from the sample tracing papers when exposed to fluctuating environmental conditions than the Tengucho tissue.

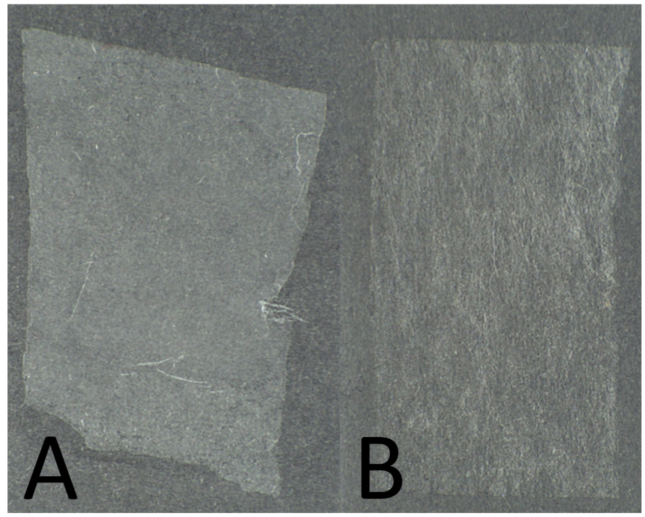

Fig. 3. (a) Nanocellulose film made in the laboratory and adhered to sample tracing paper with Klucel G in isopropanol. (b) Tengucho tissue adhered to sample tracing paper as a solvent-set tissue made with Aquazol 200 and reactivated with isopropanol.

The opacity of the nanocellulose films and the Tengucho tissue were then measured using the VSC 8000 (see appendix 1). As can be seen in figure 4, it was found that the Tengucho tissue was more transparent than the nanocellulose films. Although the Tengucho tissue was more transparent, its fibers were visible, leading the eye to be drawn to the repair. It was also found that although creating the nanocellulose films in the laboratory was more cost effective, it was more time consuming, but being able to adjust the nanocellulose films to the needs of each object was seen as beneficial. Yet due to the cost of premade nanocellulose sheets, the time it took to make the more cost-effective nanocellulose sheets in the laboratory, the occasional detachment of the nanocellulose films from the support, and the higher transparency of the Tengucho tissue, it was determined that nanocellulose films would not be a practical repair material for this collection.

	SAMPLE TRACING PAPER	SAMPLE TRACING PAPER WITH NANOCELLULOSE FILM	SAMPLE TRACING PAPER WITH TENGUCHO TISSUE
OPACITY	29%	37.5%	34%

Fig. 4. Calculated opacity for the sample tracing paper, the nanocellulose, and the Tengucho tissue.

Heat-Set and Solvent-Set Tissues

Heat-set and solvent-set tissues are often used for their ease and speed of application. They are commonly applied to moisture-sensitive papers and media because they require little to no moisture to adhere to the substrate and can be adjusted for each paper's needs. The tissues can be made with a range of adhesives, including methyl cellulose, wheat starch paste, Klucel G (hydroxypropyl cellulose), and resin- or acrylic-based adhesives (Anderson and Reidell 2009; Beenk, Kaye, and Miller 2009; Varga, Herrmann, and Ludwig 2015). Aquazol, a synthetic poly(2-ethyl-2-oxazoline) resin, has also gained popularity as a successful adhesive for heat-set and solvent-set tissues since it can also be reactivated with water, with a large range of organic solvents, and with heat (Pataki 2009; Lechuga 2011).

The adhesives tested for application on the Gentling collection included methyl cellulose, wheat starch paste, Klucel G in isopropanol, Aquazol 200 in water, and Aquazol 500 in water. All of the adhesives were applied in 5% w/v. Aquazol 200 and Aquazol 500 differ by their molecular weight and their viscosity, with Aquazol 500 being more viscous (Arslanoglu 2004). In addition, 6 g/m^2 of Tengucho tissue was tested for tear repairs, whereas kozo hinge tissue was tested for use as the hinge material. To create the repair tissues, the tissues were laid on a piece of Mylar. A fiberglass screen was placed over the tissue, and the adhesive was brushed through the screen. The screen prevented the distortion of the fibers and was particularly necessary for the thin Tengucho tissue.

Methyl cellulose and wheat starch paste were both reactivated with a small amount of water. However, even the minimal amount of water needed was enough moisture to cause localized distortions in the highly reactive transparent papers that were in the Gentling collection. Although Klucel G was successful when reactivated with isopropanol, it was determined that the adhesive did not produce a strong enough bond to properly stabilize the works, and any handling of pieces at the Gentling Study Center could cause the repairs to fail.

The Aquazol 200 and Aquazol 500 were tested as both a heat-set and solvent-set tissue. Due to the high reactivity to heat of some of the tracing papers used by the Gentlings, it was decided that a solvent-set application would perform better than a heat-set tissue for these works. During the tests, both molecular weights of Aquazol appeared to dissolve easier in water and produce a better adhesion when reactivated with water than when reactivated with isopropanol or acetone. Although both molecular weights had similar results, it was found that having the flexibility of using the stronger Aquazol 500 was beneficial, as Aquazol 200 did not adhere well to all paper supports in the collection.

Over the years, concerns over Aquazol's yellowing (Arslanoglu 2004) and failure in high relative humidity (Pataki 2009; Lechuga 2011) have been raised. However, aging tests had shown Aquazol to have a color change that is barely perceivable to the human eye (Wolbers, McGinn, and Duerbeck 1998; Herrmann et al. 2019). Because these works were archive items and would be stored in a controlled environment, the possible color change and failure with high humidity were of less concern for this collection. Since the tracing papers can lose their transparency with solvents, the large range of solvents that can reactivate Aquazol allowed for more flexibility in the solvent choice depending on the reaction of the tracing papers to the solvents. Therefore, Aquazol was selected as the adhesive for the solvent-set tissues for both the repair and hinging of works on transparent paper within the Gentling collection.

Gels

Since there was potential that moisture or solvents may need to be applied to the tracing papers during treatment, especially during tape removal, gels were tested to determine their usability on the transparent papers within the collection. Gels, particularly gellan gum and agarose, have become relatively popular in paper conservation for treatment of sensitive objects. Gellan gum and agarose are both polysaccharides that, when formed into a gel, restrict the flow of water into the object. The gels can also be adjusted by adding solvents, enzymes, chelators, and other solutions to meet the treatment needs (Maheux 2015; Hughes and Sullivan 2016; Magee 2019).

Gellan gum can be used as both a high acyl gellan gum and a low acyl gellan gum. The difference in the number of acyl groups, a double-bonded oxygen to carbons on the gellan gum substituent, impacts how the gel looks, its stiffness, and the retention of water in the gel (Maheux 2015; Magee 2019). Gels are commonly used between 1% and 10%, with the higher the percentages providing more control of the water transferred to the paper while increasing the capillary action of the gel (Iannuccelli and Sotgiu 2010; Hughes and Sullivan 2016). Due to the reactivity of the tracing papers, it was decided to work on the higher end of the percentages in most cases. High acyl gellan gum was the exception because, even at low percentages, its water retention is high, and producing well-made high acyl gellan gum gels can be difficult due to the tendency for it to form clumps.

The first round of gel test was used to gauge what gel showed the most potential. A 2% and a 3% high acyl gellan gum, a 6% and an 8% low acyl gellan gum, and an 8% and a 10% agarose were all tested. All of the gels, except for the high acyl gellan gum, were cast to approximately 5 mm thick. Due to the quick cooling and difficulty of pouring a thin cast, the high acyl gellan gum was heated in a glass tray with a flat bottom, allowing the gel to form a relatively thin gel as it cooled in the tray. When applied to the sample tracing paper, the most success was seen with the 3% high acyl gellan gum. However, this gel still produced a significant amount of expansion in the tracing paper sample.

Thus, a 6% high acyl gellan gum was tested. The 6% high acyl gellan gum was more difficult to make due to the clumping that is common when mixing, but sieving the mixture prior to heating helped reduce the lumps in the high acyl gellan gum. At this percentage, the transparent paper expanded less, allowing for the paper to be dried under weight with little to no signs of the localized treatment. However, it was still found that the gels worked best on the tracing paper samples when applied for no more than a minute or two per application.

Replicating vs. Preserving Pressure-Sensitive Tapes

The final method compared replicating the existing tapes vs. preserving the tape carriers. Replicating the tapes was attempted by layering multiple toned kozo tissues to produce a similar color to the oxidized tapes present throughout the Gentling collection. The method used to preserve the tape began with removal of the adhesive from the tape's carrier. The carrier was then lined on to a thick kozo tissue using 5% methyl cellulose.

Considering that there were concerns about the time constraints of the project and the amount of time that it would take to preserve the large number of tapes present, it was decided that there would be multiple approaches to the tapes within the collection. The multilayered pieces would have their tape removed, the tape carrier lined, and then re-adhered to the works. This decision was made because of the integral role the tape played in the works format and the fact that many of the pieces of tape had been drawn on, making them an invaluable part of the process.

However, due to the time constraints and the large number of works with tape in the collection, this decision was not applied to all of the works. It was decided that if the tape did not play an integral role in the work, the tape would be documented and removed. A sample of the tapes from a large number of works within the collection was then saved in an objects file, allowing for future research of the tapes used by the Gentlings without further deterioration of the objects.

TREATMENT PROTOCOL

After the treatment options were explored, the treatment protocol for the multilayered works were developed. The protocol took into consideration that these objects were archive items whose structure and appearance needed to be preserved while resolving issues that would cause further deterioration. Therefore, a multistep process was developed that would allow for removal of the pressure-sensitive tape adhesives, repairs to be made to all components of the work, and for the tapes to be preserved while preventing further deterioration to the objects.

To fully treat the works, it was known that they would need to be taken apart, each piece treated, and then put back together. Thus, ensuring that each component was placed in the correct location when put back together was a major concern. Ironically, to solve this issue, tracing paper was utilized for the first step of the treatment of these works. Prior to deconstructing the work, a sheet of tracing paper was aligned along two edges of the support. The alignment was notated on the tracing paper to ensure that the tracing paper would be placed in the same location when putting the work back together. The pieces of the multilayered works were then outlined, as was each piece of tape, essentially mapping the location of each component of the work. Each piece of tape was assigned a number that was notated on the piece of tape and on the tracing paper "map." An example of the tracing paper map can be seen in figure 5.

The works were then taken apart. As each sheet of tracing paper was removed from the primary support, full photography and documentation of the individual components took place. Then the tapes were removed from the tracing paper. Due to the degradation state of the tapes present, the tapes were able to be removed mechanically with localized heat and the application of solvent gels was not required. Because of the reactivity of the tracing paper, the heat was applied as minimally as possible with a heated spatula that was used to locally warm the adhesive while slowly removing the tape carrier. Any remaining adhesive was then removed mechanically, often with a crepe eraser. After removal, each piece of tape had the corresponding number from the tracing paper map written lightly in graphite on the carriers that did not have a drawing present. This allowed for easy identification and placement of each tape back in the correct location when the works were reassembled.

Then any general repairs to the tracing papers and the supports were made. Because these were archive pieces, staining from the tapes were not treated as part of the general repairs made. However, fold and crease reduction and tear repairs were commonly completed on the works. The Tengucho solvent-set tissue made with Aquazol 200 was used for the tear repairs on the tracing paper. Acetone was generally the solvent chosen for reactivation of the Aquazol. The high rate of evaporation and the lack of expansion to the tracing paper made acetone the ideal solvent choice, especially for the most reactive tracing papers in the collection.

Once the tracing paper was stabilized, the pieces of tape were treated. The adhesive on the tape's carrier was removed. Occasionally, acetone was used to soften the adhesive. However, in most cases, this was not necessary, as the adhesive layer could be removed mechanically with a crepe eraser. With the removal of the adhesive layer from the tape carriers, the tape was often thinner than it was originally. In some cases, the difference in thickness was very apparent. The tape carriers were lined onto a thick kozo tissue with 5% methyl cellulose, as seen in figure 6. The use of the thick kozo tissue for lining allowed for the lined tapes to have a

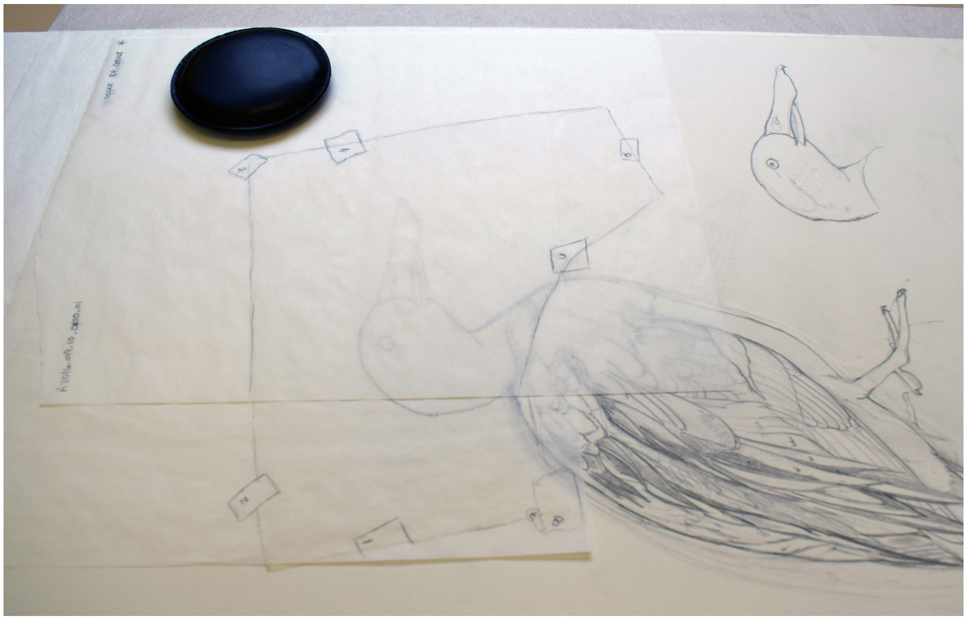

Fig. 5. Tracing paper "map" being made; Stuart and Scott Gentling, *Untitled*, graphite on paper, 61 × 48.4 cm, Amon Carter Museum of American Art, Fort Worth, Texas, gift of the Gentling Family, A2016.019.10.0100.

thicker appearance that was closer to the original thickness of the tape. The thicker kozo tissue also allowed for more of a buffer between the masking tape's acidic carriers and the work.

The tracing paper map made at the beginning of the treatment process was then used to place each component in the correct location, ensuring the layout of the works did not shift post treatment. The tracing paper was aligned according to the annotation on the tracing paper map. Weights were used to hold the tracing paper map in place, allowing areas of the map to be lifted and the components of the work to be aligned in the correct location.

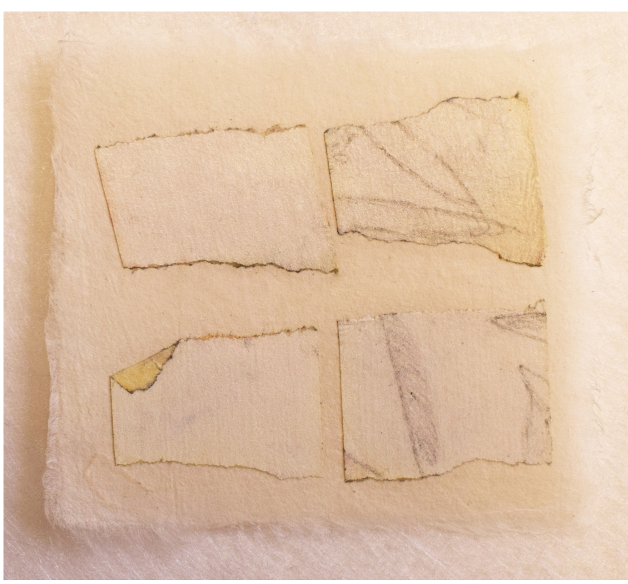

Fig. 6. Tape carrier lined on thick kozo tissue with methyl cellulose.

After the tracing paper pieces were put in the correct place, the tracing papers were hinged, using V-hinges made from kozo hinge tissue prepared as an Aquazol solvent-set tissue. Although the kozo hinge tissue was more visible, its thickness allowed for a more stable hinge than the Tengucho tissue would have produced. Aquazol 200 was the original adhesive used. and acetone was used for reactivation. However, this combination of Aquazol 200 and acetone had issues adhering to the heavily filled paper that was used as a support for many of the drawings. Therefore, the adhesive was changed to the slightly stronger Aquazol 500, and the solvent used to reactivate the adhesive was switched to a 70% isopropanol. The 30% water helped remoisten the adhesive, allowing for a stronger bond with the support.

The location of the hinges was carefully selected to prevent the hinges from being as visible and distracting from the work. This often meant the hinges were placed under the areas that would be covered by the lined tape carriers, as can be seen in figure 7, or in areas with heavy media application. The hinges were folded over a small strip of Hollytex. Both sides of the V-hinge were reactivated with the 70% isopropanol, and the hinge was placed between the tracing paper and the support. Weights were put in place, and the hinge was left to dry. After drying, the Hollytex was pulled out from the middle of the hinge.

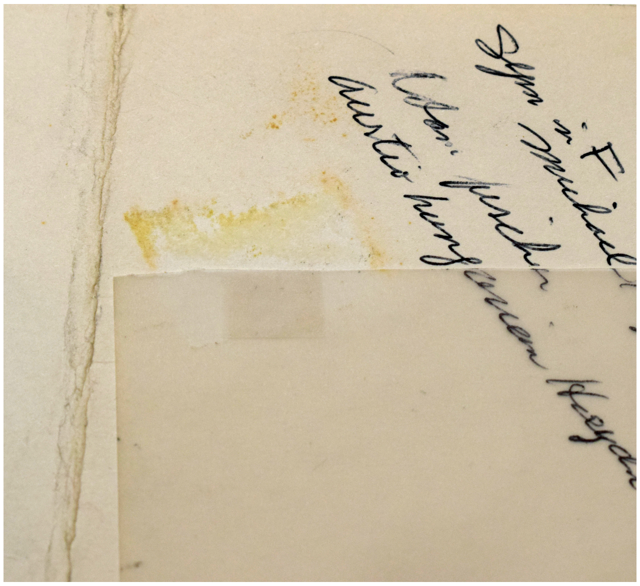

Fig. 7. Tracing paper's V-hinge placed under an area that would be covered by the lined tape carrier.

The lined tape carriers were then hinged into place using a similar method as the hinging of the tracing papers (fig. 8). The number that had been lightly written on the tape carrier was used to correctly place the lined carrier in the corresponding position labeled on the tracing paper map. After placement, this number was erased from the tape carrier. Two V-hinges, one on each side, were used on each lined tape carrier to secure the lined tape carrier in place.

Fig. 8. Lined tape carrier hinged in place.

The multilayered works were then photographed and prepared for storage. Each item was interleaved with acid-free paper. Blue board was used as a support between the pieces to support the works. The works that were small enough to be stored in archival boxes were placed in the boxes with the blue board support between each work. The larger works were placed in map cases.

CONCLUSION

The Gentling collection presented a variety of challenges due to the inherent qualities of the materials that made up the multilayered composition of the pieces treated. Preserving the evidence of the artists' process while stabilizing the deteriorating works was of the utmost importance. Because of the presence of the highly reactive tracing papers, treatment methods were carried out on sample tracing papers similar to those used by the Gentlings. This helped determine the most appropriate treatment materials and methods, allowing for the development of a treatment protocol for the multilayered works. The protocol developed allowed for each treatment to be approached with an understanding of what treatment needed to be completed and how those treatments could be executed in a manner that allowed for preservation of both the artist's intent and the structure of the work.

Although the repairs and hinges are not completely invisible, the before and after images in figure 9 show that the choice of materials and the hinge placement allowed for the majority of the treatment to be barely noticeable to the viewer. And although it was not practical for all tapes in the collection to be lined and re-adhered to the works, the multilayered pieces, which demonstrated the Gentlings' intricate artistic process, were deemed important enough to undertake this time-consuming process. Understanding the range of treatments and materials that could be successfully used allowed for adjustments to the adhesives and solvents to be easily made during treatment. This helped make the standardized treatment protocol flexible enough that the protocol could be applied to the full range of works in the collection.

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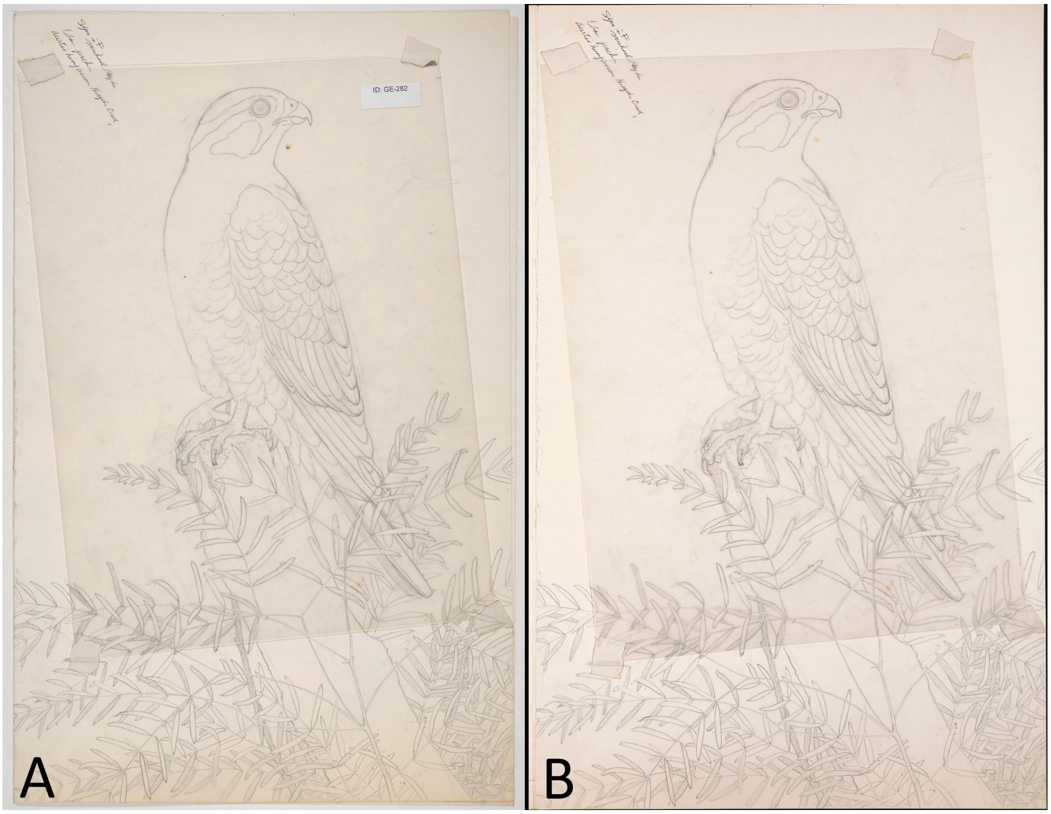

Fig. 9. Before treatment (a) and after treatment (b) images of a multilayered work within the Gentling collection; Stuart and Scott Gentling, *Untitled*, ink and graphite on paper, 71.2 × 56 cm, Amon Carter Museum of American Art, Fort Worth, Texas, gift of the Gentling Family, A2016.019.10.0038.

APPENDIX 1

Measurements were taken in two consecutive readings as described by Roger Williams (2018). The samples were placed on white backing for the first reading. The second reading was taken with the sample placed over a black background. The following formula was then used to calculate the opacity.

$$Opacity\ (y) = \frac{Y\ (black)}{Y\ (black)} \times 100$$

APPENDIX 2

High acyl gellan gum recipe

100 mL deionized water
0.4 g calcium acetate
2–6 g high acyl gellan gum (2 g for 2%; 3 g for 3%; 6 g for 6%)

Mix calcium acetate into the deionized water. Add high acyl gellan gum and stir until all clumps are gone (6% was sieved at the point to help remove clumps). Place mixture in a microwavable glass tray with a flat bottom. Cover the tray with a lid and heat in the microwave until bubbling. Let cool in the tray.

APPENDIX 3

Low acyl gellan gum recipe

50 mL deionized water
0.2 g calcium acetate
3–4 g low acyl gellan gum (3 g for 6%; 4 g for 8%)

Cut two pieces of Mylar and label. Add calcium acetate to the deionized water in a microwave-safe container. Add the low acyl gellan gum and stir until all clumps are gone. Cover with a lid and heat in the microwave until bubbling. Remove from the microwave. Quickly pour mixture onto one sheet of Mylar and cover with the second sheet of Mylar. Use a flat surface to apply pressure on top of the Mylar to spread the mixture out into a thin sheet. Let cool.

APPENDIX 4

Agarose recipe

50 mL deionized water
4–5 g agarose (4 g for 8%; 5 g for 10%)

Cut two pieces of Mylar and label. Add agarose to the deionized water in a microwave-safe container. Stir until all clumps are gone. Place the mixture in the microwave, cover with a lid, and heat until bubbling. Remove from the microwave. Quickly pour mixture onto one sheet of Mylar and cover with the second sheet of Mylar. Use a flat surface to apply pressure on top of the Mylar to spread the mixture out into a thin sheet. Let cool.

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SOURCES OF MATERIALS

Agarose
Stellar Scientific
2833 Smith Ave., Box #256
Baltimore, MD 21209

Aquazol 200 and Aquazol 500
TALAS
330 Morgan Ave.
Brooklyn, NY 11211

Celova for Art Conservation
Weidmann Fiber Technology
Neue Jonastrasse 60
8640 Rapperswil SG
Switzerland

Gellan Gum (High and Low Acyl)
Modernist Pantry
25 Harold Dow Hwy.
Eliot, ME 03903

Hinging Paper
Hiromi Paper Inc.
9469 Jefferson Blvd., Suite 117
Culver City, CA 90232

Nanocellulose Films
Nanopaper
1650 Summit Lake Dr., Suite 103
Tallahassee, FL 32317

DIANE E. KNAUF
Assistant Conservator of Work on Paper
Amon Carter Museum of American Art
Fort Worth, TX
diane.knauf@gmail.com

JODIE UTTER
Senior Conservator of Works on Paper
Amon Carter Museum of American Art
Fort Worth, TX
jodieu@cartermuseum.org