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A STICKY BUSINESS: THE REMOVAL OF HIDE GLUE FROM SILK

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This paper focuses on the removal of hide glue from silk, a problem faced during the remounting of a group of eleven prints on a silk substrate¹ (silk prints), in the collection of Mills Mansion State Historic Site. The prints, known as boudoir prints or *sujets grivois*, represent various scenes of intimate domestic life. Considered to be reproductions of eighteenth-century works of art, they are printed in dark brown ink and hand colored.² The silk is a tight plain weave fabric of a neutral color. The collection was framed with fancy French mattes and mounted behind glass. Vivid colors can still be seen in small areas at the perimeters, where the prints have been protected by the window mattes. These small areas give us a clue as to the original appearance of the prints.

The goals of the treatment were threefold: to replace the old acidic mounting and framing materials with safer ones; to provide more supportive mounts; and, to provide better protection from light through the use of ultraviolet filtering Plexiglas. An important consideration in choosing a treatment was to identify a method which could be applied to the entire collection. For the purposes of this paper, the treatment development for one print, *La Toilette* ("The Dressing Table") will be described.

When the frame was removed, it was discovered that the print had been attached to the back of the French matte with a generous application of glue around the entire perimeter. The matte was removed mechanically, leaving an uneven glue layer with a thin layer of paper fibers on the face of the print. The glue created a thick and stiff edge on all four sides of the print. Because they had become brittle, there was a risk that the glue might crack and cause splits across the silk. As is typical of much nineteenth-century silk, the print had become fragile and somewhat friable. The margins, which had been protected from light, were stronger than the more exposed center. The silk at the margins was still white in color,

1. Mills Mansion Historic Site, located in Staatsburg, NY, is the 1895 Beaux-Arts mansion of Ogden and Ruth Livingston Mills, designed by Stanford White. A New York State Historic Site since 1938, Mills Manion retains its original furnishings and is an excellent example of the great estates built by America's financial and industrial leaders in the late nineteenth century.

2. Engravings for several of the silk prints have been located, and have been attributed to Nicholas Ponce and Jean Massard, after Pierre Antoine Baudonin.

while the image area had become yellow, almost brown. On the reverse side of the print were areas of soot deposit, associated with the unsealed frame. The major conservation challenge was to remove or reduce the adhesive layer without damaging the silk.

Several treatments were considered. An attempt was made to remove the adhesive mechanically. However, the fragile nature of the silk eliminated this as a possibility. Matte burn deterioration was visible, thus these areas were susceptible to enlarging. Wet cleaning was not an option as it would dramatically alter the characteristics of the silk print.

Adding moisture to soften the glue was next considered. In adding moisture to an artifact there are several conservation options for which the variables include: speed and amount of liquid, control of the water, as well as the introduction of other materials. In order to try these options, a test sample was created to represent the artifact. A plain weave silk was located to which rows of hide glue were applied by brush. Lignin-containing paper was placed on top and pulled away when the glue had dried. The test sample was designed to achieve a better understanding of the materials; artificial aging was not carried out. Three options were considered and tried on test samples: Gore-tex, Solomons Steam Generator and Laponite gel.

Gore-tex, a polyester felt laminate, has been used successfully in conservation to remove glue and release backings. Adding moisture with Gore-tex was felt to be the least invasive option. The Gore-tex was laid smooth side down on the test sample, with wetted blotters. The whole package was covered with mylar to slow evaporation. After approximately four hours the adhesive had swollen only a small amount. In analyzing this technique, it was determined that water alone might not be sufficient to release the glue. This method was very slow, and resulted in insufficient swelling to be practical.

The Solomons Steam Generator produces a fine, adjustable, warm mist. It was hypothesized that the addition of moisture with controlled heat would soften the glue. Actually, the heat and moisture combination caused the adhesive to become gummy and sink into the silk. Cockling was observed.

Laponite is a gelling agent which has been used in Great Britain to remove glues from paintings and corrosion from bronzes. The material is a synthetic inorganic colloid that forms a thixotropic gel when dispersed in a liquid. The Laponite gel was placed on the glue areas. It was found to be quite controllable, enabling the user to apply the material only in the areas where it was needed, with adjacent areas being affected only minimally. Mylar was used to cover the Laponite to maintain its moisture. Heat was applied using a small tipped spatula. After approximately five seconds, it was possible to lift the adhesive right off of the silk, and onto the mylar.

The trials using Laponite were found to be sufficiently successful on the test samples to try this method on the actual piece. In fact, the glue on the Mills Mansion print was found to release even more easily than it had on the test sample. (The test sample glue was

very thick and strong.) On several occasions after the mylar was lifted, subsequent to the application of heat, the thick glue layer came up. This technique appeared quite successful as extensive amounts of glue were removed and the silk appeared to be free of glue. Once the entire edge was done, it was left overnight to dry under slight weight. Upon drying, however, the edge was found to be stiffer than the untreated glue edge. Some tide lines in areas with heavy soot also developed.

Each of the methods tested exhibited disadvantages: slowness; further embedment of the glue into the fibers; cockling of the margins; and tide lines. None of these methods was able to remove the complete glue layer. In only diminishing the layer, they left what glue remained even stiffer and shinier, than it was prior to treatment. These treatment possibilities were determined to be unsuccessful.

Following these unsatisfactory attempts, the next alternative considered was the use of enzymes. Deciding upon this treatment was difficult since the long-term effects of enzymes are uncertain. Can they truly be washed out or denatured? Is the silk really safe from an enzyme? Though these questions have not been answered sufficiently, it should be noted that enzymes have been used successfully to remove glue in paper conservation.

Could a specialized enzyme be identified that would break down the glue but not harm the silk? In searching for an appropriate enzyme, it was first necessary to determine the differences between the two protein materials: the silk and, the hide glue. Both silk and hide glue are proteins, composed of many of the same amino acids. Silk, however is a more specialized protein, composed of a higher concentration of four amino acids, as opposed to hide glue in which the concentrations are distributed more evenly among many amino acids. Amino acids lysine and arginine are important components found in hide glue, but are insignificant in silk.

An enzyme specific for these two amino acids is Trypsin. Trypsin will only attack the protein that contains lysine and arginine, cleaving bonds and leading to shorter chains that are water soluble.

Trypsin, a pancreatic protease isolated from a number of animals, is available from chemical companies and is relatively inexpensive. It is a fine white crystalline powder, clear when dissolved in water. It is stable for years as a powder when kept frozen, as long as it is kept dry and tightly sealed. While the enzymes are in a crystalline state, they are particularly sensitive to moisture. The smallest amount of moisture encourages the enzyme to break down sooner.

In using an enzyme, care to one's personal safety should be observed, especially when the enzyme is still in powder form. The use of gloves and goggles is recommended while measuring.

Trypsin works in a range of pH's from slightly acidic to slightly alkaline. As the pH has a direct bearing on the enzyme's effect, a buffer is added. A recommended buffer is Trizma Pre-set. This buffer maintains the solution at pH 7. Calcium chloride is also added, which

acts to stabilize the enzyme, preventing it from attacking itself. The enzyme solution was described by Catherine Baker.³

Enzymes have a narrow working temperature range, typically near body temperature. At times it can be difficult to maintain the temperature at the optimum (the rate of activity increases with increase in temperature) but still below 40°C (104°F), beyond which Trypsin will denature. The temperature was kept constant, around 38°C, with the aid of an insulated cup filled with hot water; sealed with a custom-made ethafoam ring lid, which also suspended the enzyme containing flask. Though the optimum working time for the enzyme is one hour, the enzyme solutions remained active for three hours before any delay or reduction in activity was noticed.

The enzyme was denatured with ethanol. Note that enzymes cease being active once conditions become unfavorable; any change in temperature, polarity, and moisture could cause this to happen. Ethanol is a common method for denaturing. It works by being slightly more polar than water.

In treating the silk prints with Trypsin, the initial plan was to use the enzymes in a poultice, which would limit the amount of moisture present yet still keep the enzyme in a moist enough environment to remain active.⁴ However, it was found that the extra bulk of the poultice in combination with the glue was difficult to control. On a test area there was spill-over onto the unglued areas of silk.

The final and successful technique employed was direct application of the enzyme solution to the print on a suction table. The suction table minimized the risk of the solution spreading.

Prior to applying the enzyme, the soot needed to be removed. The darkening of the silk by the soot was remedied by pre-dampening with blotters at the sooty areas. The soot transferred to the blotters, reducing the darkening and presence of tide lines on the silk.

The treatment on the suction table was carried out as follows: The suction table was masked out, except for a rectangular area, approximately 2" x 14". This isolated and increased the suction to a working area the size of the length of margin, by its width. Since there was splitting caused by the matte burn at the junction of the margin and the image area, the opening also kept the degraded area from moving. The silk print was laid face up on thin polyester batting with polyester reemay as a separator. It was covered with wet strength tissue and PVC plastic sheeting, creating a sealed package. Only the working area was kept open.

3. Baker, "Enzymes: Description and Use in Paper Conservation." Mimeograph Class Handout. Art Conservation Dept., Buffalo State College, Oct. 1991.

4. Methylcellulose in a 4% solution was chosen for its long-term stability.

The enzyme solution was applied by brush, only to those areas where there was glue. Areas approximately 1/2" wide were treated at one time. Upon completion of an area treatment would proceed to the next. Several applications for each 1/2" section were required, as the glue layer was quite thick. In the beginning, the glue layer prevented any suction through the silk. After one to two minutes, the glue swelled and began to break down enough to be removed. A small Teflon spatula was then used to lift up the glue from the silk. This procedure was repeated in the same area, after which only the smallest amounts of glue remained. Slightly warmed water was applied, drawn through with suction, to further dissolve the glue. This flushing had a two-fold purpose: to remove remaining degraded products such as broken down adhesive, and to remove as much of the enzyme as possible. Between applications of water, the silk was allowed to dry somewhat in order to prevent moisture wicking beyond the margin. Once an entire edge was completed, the area was denatured with ethanol.

Several factors allowed this treatment option to be successful. First, the glue was located along the margin and not in the image areas so that treatment did not also have to address the reaction of the enzyme solution with the ink and pigments. Second, the glue was adhered to areas where the silk was stronger, which allowed for more manipulation. And finally, the glue was present on the same side of the silk as the image, allowing the print to be right-side up during the treatment.

Because of a number of unknowns, using enzymes is often a last resort. Although other methods for these nineteenth-century prints were tried in hopes that a partial removal would be satisfactory, the remaining glue layer became more problematic. In using enzymes, all of the glue was removed, leaving the silk flexible and ready for mounting and reinstallation at Mills Mansion State Historic Site. This alternative treatment method, used so successfully in this project, should be carefully considered as a viable option for other artifacts with protein glues.

Acknowledgments:

I want to thank Deborah Trupin for her invaluable help and guidance throughout this treatment, as well as Heidi Miksch, Bill Stevenson and everyone at Peebles Island who have been so encouraging.

Materials and Suppliers:

Gore-tex - W.L. Gore and Associates, Inc.
PO Box 1550,
Elkton, MD 21921-1550

CR Solomons Steam Generator - Type 882
Manufactured by: Elsec (Oxford, UK)
Conservation Resources International
8000 H- Forbes Place
Springfield, Virginia, 22151

Laponite 2101 - Pfizer, Minerals, Pigments & Metals Division,
640 N. 133th St.
Easton, Pa. 18043

Trypsin Type III - from Bovine pancreas, T8253.
Sigma Chemical Company
PO Box 14508
St. Louis, MO 63178

Trizma Pre-Set pH Crystals - #T3878. Sigma Chemical Co.

Calcium Chloride - #C-4901. Sigma Chemical Co.

Enhanced Cold Suction Table - Museum Services Corporation
4226 Howard Ave
Kensington, MD 20895

Reemay - Talas
213 W. 35th Street
New York, NY 10001-1996

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