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Observations on the Penetration of Two Consolidants Applied to Insecure Gouache on Paper

ABSTRACT

Weakly-attached gouache is a familiar problem for the paper conservator. Consolidation generally relies on the expectation that an adhesive can be delivered to the paint/paper interface. The degree of consolidant penetration can be influenced by the careful selection of adhesive, diluent, and application technique. In this preliminary study, a fluorescent dye was added to solutions of gelatin and methyl cellulose. The labeled adhesives were applied to surrogate objects of flaking gouache paint on papers of different absorbencies. The following application techniques were compared: addition of alcohol as a diluent in the adhesive solution, application of the consolidant with the object on the suction disc, and humidification of the surrogate object prior to consolidation. After applying the consolidants, thin sections of each surrogate object were cut with a microtome and viewed under magnification using ultraviolet light. Photomicrographs illustrate the level of adhesive penetration for each treatment variation.

INTRODUCTION

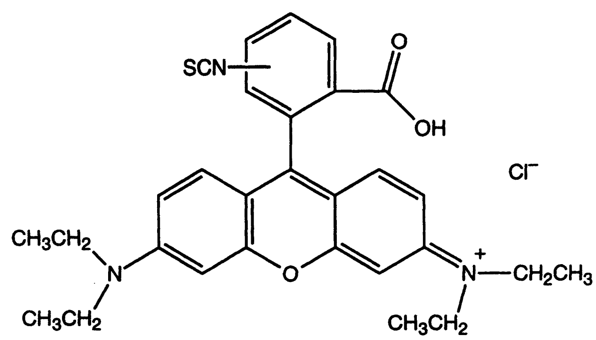
Paintings in gouache on paper supports often pose consolidation problems. Various techniques have been proposed for enhancing treatment results, but few studies have been designed to examine them. Consolidation treatment is generally considered to have been effective if flakes of paint are secure when gently probed. Experience, along with the opportunity to observe a consolidated object over time, have shown conservators which treatments have been the most successful.

The Paper Conservation Catalog (Book & Paper Group, 1984 to present) provides practical information in the outline titled *Consolidation/Fixing/Facing* (Rodgers ed., 1988). It is suggested there that alcohol or other solvents "applied to an area after consolidating can disperse adhesive, or create a capillary pull to deposit more adhesive into the paint film and reduce slight surface deposit or shine." (p.14). With particular reference to methyl cellulose, it is stated that "dilution of the methyl cellulose solution with alcohol improves penetration of the consolidant . . ."(p.8). Under the heading of *Improving penetration of consolidants* (p.17), suggestions include the overall humidification of the object and the use of a suction table or disc.

The goal of the present study was to demonstrate to what extent the penetration of a consolidant could be affected by varying the adhesive, the diluent, the paper absorbency, and the application technique. It was modeled after two unpublished student research projects which studied adhesives for watercolor consolidation according to several criteria.[1] Those previous studies characterized adhesive penetration using direct fluorescence tracing and fluorescence microscopy. The same techniques were employed in this investigation to obtain visual confirmation, in the form of photomicrographs, of the degree of adhesive penetration.

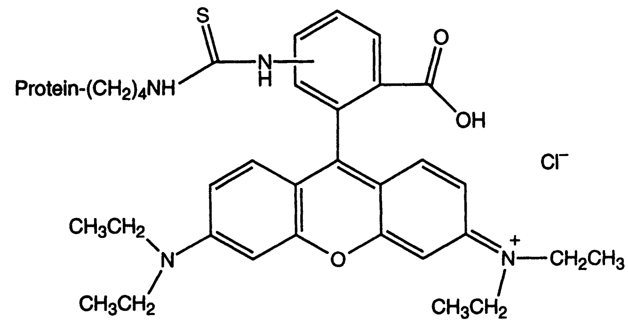
TECHNIQUE FOR DIRECT FLUORESCENCE TRAINING

Direct fluorescent tracing is well-documented in biological applications. It typically involves chemically attaching a fluorescent dye to a protein, injecting it into an animal, and observing the distribution by subsequent microscopy of tissue sections. The process of reacting a protein with the dye is known as *conjugation*, and the combined material is called the *conjugate*. Early research indicated that, apart from the change in absorption and fluorescence emission, the physical properties of the conjugate, including molecular size, shape, and viscosity, did not differ appreciably from the starting protein (Schiller 1954). One of the fluorochromes which has proven useful in direct fluorescent tracing is Rhodamine B. An isothiocyanate reactive group can be attached to the Rhodamine B to form a reactive probe. When this molecule,



Rhodamine B Isothiocyanate or RITC

Fig. 1.



RITC conjugate with amino group in a protein

Fig. 2.

Rhodamine B Isothiocyanate or RITC (fig. 1) is combined with a protein, the isothiocyanate can react with an amino group on the protein to form a stable thiourea (fig. 2).

A small number of these reactive fluorescent molecules can attach to the protein molecule.[2] The unreacted fluorescent material can be removed by dialysis or filtration.

PREPARATION OF THE ADHESIVE

The adhesives chosen for this investigation are commonly-used aqueous adhesives, photographic gelatin and methyl cellulose. Each adhesive was initially prepared as a concentrated stock solution of 4.0% weight/volume, as described below.

Gelatin: Placed 2.0 grams granular gelatin in a small glass jar and added distilled water to 50 ml. Allowed gelatin granules to soak overnight. Warmed glass jar in a double boiler on a hot-plate at about 60°C for 45 minutes (until well dissolved). Stored jar in refrigerator until ready for use, when it was warmed and diluted to 1.0% w/v solution.

Methyl Cellulose: Placed 2.0 grams of powder in a glass jar and added distilled water to 50 ml. Allowed powder to dissolve overnight. The solution was later diluted to 0.5% w/v solution for testing.

PREPARATION OF THE DYE/CONSOLIDANT CONJUGATES

Four 10 ml glass vials were filled with the diluted consolidant solutions to be tested: 1.0% gelatin in H_20, 1.0% gelatin in 50/50 H_2O/EtOH, 0.5% methyl cellulose in H_2O, and 0.5% Methyl cellulose in 50/50 H_2O/EtOH. In a separate vial Rhodamine B Isothiocyanate or RITC, supplied as a bright pink powder, was dissolved in ethanol. Using a syringe, a small amount of the RITC solution was delivered to each consolidant vial. Each RITC/adhesive mixture was then dialyzed.[3] If any "free dye" remained in the adhesive mixtures, it could travel into the paint and paper layers of the surrogate objects with the diluent rather than with the conjugated adhesive—thus skewing penetration studies. To insure that this did not occur, dialysis was performed using cellulose dialysis tubing. This semi-permeable membrane allows the small "free dye" molecules to pass through and into a rinse solution, while retaining the large protein, cellulose ether, or conjugated molecules within the tubing. In order to determine the success of the dialysis procedure, samples were taken from the beakers at successive rinse changes and analyzed using ultraviolet-visible spectrophotometry.[4]

PREPARATION OF THE SURROGATE OBJECTS

The surrogate objects were prepared in imitation of the materials and techniques observed in a gouache painting on paper, executed in 1990, which was recently treated by the author. Correspondence with the artist revealed that the painting was made using Winsor & Newton Designers Gouache. Areas of black paint were especially susceptible to flaking in the model painting, so Lamp Black (#0605 337 <515> Winsor & Newton Designers Gouache) was chosen for the surrogates in this study.

The support materials used to create the surrogates were selected because they were 100% cotton fiber and of similar thickness, but represented three different rates of absorbency.

A. Lanaquarelle watercolor paper
   hot-pressed / 0.46 mm thick
   water droplet absorbed in about 1 minute

B. Unidentified Drawing Paper
   0.41 mm thick
   water droplet immediately absorbed

C. Strathmore 500 Series Bristol
   plate-surface / 3-ply / 0.37 mm thick
   water droplet not absorbed after 1 hour

A measured amount of the tube gouache paint was mixed with deionized water and applied to the paper samples in four separate coats with drying in between applications. The objects were thermally and mechanically damaged to induce paint cracking and flaking.[5]

APPLICATION OF THE CONSOLIDANTS

Six combinations of diluent and application technique, plus one control, were tested for each of the two adhesives and three paper types, making a total of forty-two treated surrogates. Using a 1.0 ml syringe, 0.3 ml of the RITC/adhesive conjugate was applied to each surrogate. One set (seven surrogate objects) of each paper type was consolidated with 1.0% w/v gelatin, and a second set with 0.5% w/v methyl cellulose. The adhesives were applied by the application techniques listed below:

1. Control, no consolidant applied
2. H_2O alone as diluent
3. H_2O/EtOH as diluent
4. H_2O alone as diluent with object on suction disc
5. H_2O/EtOH as diluent with object on suction disc
6. H_2O alone as diluent with humidified object on suction disc
7. H_2O/EtOH as diluent with humidified object on suction disc

PENETRATION STUDIES

Once the RITC/adhesive conjugate dried, the treated area was cut from the surrogate object and embedded in a pellet of *Bio-plastic Liquid casting plastic* as described by Wolbers (Wolbers et al. 1990). The pellet was cured and then sliced into 20-micron thin-sections on a microtome. Thin-sections were chosen over cross-sections for two simple reasons. First, the grinding and polishing action usually employed with cross-sections in Bioplastic would damage the soft paper and brittle paint layers. Second, cutting thin-sections allowed thirty or forty samples to be observed *for each treatment type,* and generalizations could be more easily made based upon these repeated observations.

The thin-sections were observed under a binocular microscope at 32X magnification using a green filter cube (N 2.1), which transmits green exciting radiation in the range of 515-560 nanometers. This is suitable for illuminating an RITC conjugate with an excitation maximum at 558 nanometers. When viewed in this green light, the Rhodamine B fluoresces a bright orange-red color. The autofluorescence of the paper in this light is a dark red color, and one can clearly see the location of the labeled consolidant within the paint and paper layers.

OBSERVATIONS AND PHOTOMICROGRAPHS

The effects of paper absorbency and application technique on adhesive penetration were found to be subtle but telling. Photomicrographs of the thin-sections illustrate the level of penetration clearly, with the brighter areas corresponding to the deposition of the adhesive. But there are other considerations by which consolidant performance is judged. Therefore, tables have been included which list the observations made on application of the adhesive to the surrogate object, on the surface of the surrogate object after drying of adhesive, and on viewing thin sections under the microscope. In each instance, a plus or minus sign was assigned to the observation to indicate a desirable or undesirable result. The surrogate/adhesive/application technique which received a plus sign for all three observations was considered the most successful. The experiment was strictly designed and executed for the purpose of making comparisons. Variations could be introduced in actual treatment which would be more likely to produce desirable results.

SUMMARY OF OBSERVATIONS

In general, this study has served to highlight a few persistent problems. In testing, it was often difficult to encourage adhesive deposition at the paint/paper interface without either leaving adhesive on the paint surface or causing it to penetrate too far into the paper support. Is concentration of the adhesive at the paint/paper interface a realistic goal? It may not be achievable given other working parameters.

The addition of ethanol often caused the adhesive to diffuse throughout the paper support. All of the cases where the paint remained insecure after treatment involved 50/50 water/ethanol solutions. This suggests that additional adhesive applications would be necessary to secure the paint layer. It is possible, however, that the advantages alcohols provide outweigh the need for repeated applications. It is known, for instance, that ethanol aids in reducing the risk of paint dissolution and clearing residual adhesive from the surface. Perhaps the effect of adhesive diffusion could be reduced by varying the application technique.[6]

To summarize the observations, a few statements can be made which largely provide evidence in support of common sense:

1. Although this research was not undertaken for the purpose of comparing the two adhesives, it is possible to comment on this subject. In general, the gelatin tended to penetrate more easily than the methyl cellulose. This may be partially attributed to the lower viscosity of the gelatin at the temperatures and concentrations employed.

2. For the slowly absorbent watercolor paper (surrogate A), some aid was helpful in enhancing penetration. Gelatin performed best when applied in water alone with the object on the suction disc (Table 1, A4) while methyl cellulose benefitted from the simple addition of ethanol as a diluent (Table 2, A3).

3. For the very absorbent drawing paper (surrogate B), penetration was more easily achieved. Gelatin gave the most desirable result when applied in water alone with the object on the suction disc (Table 3, B4). None of the seven treatments gave optimum results with methyl cellulose. The most acceptable result was produced by adding ethanol as a diluent (Table 4, B3). In this instance the adhesive was diffused and more applications would be required to secure the paint.

4. For the non-absorbent bristol paper (surrogate C), the additional aids were useful in combination to move the adhesive beyond the paint surface. Although none of the results for this paper type were thoroughly acceptable, both gelatin and methyl cellulose responded fairly well to the addition of ethanol (Table 5, C3 and Table 6, C3), and gelatin gave a similar result with ethanol, suction and humidity (Table 5, C7).

5. The addition of ethanol as a diluent caused diffusion of the adhesive in paper types A and B. The paint flakes were sometimes left insecure.

6. Humidification of the surrogate objects prior to consolidation treatment often resulted in slowed absorption and paint dissolution.

7. The suction disc proved ineffective with the non-absorbent paper because it was nearly incapable of drawing air through the support. The suction disc was most useful for the more absorbent papers when water alone was the diluent.

These results are, of course, specific to these particular adhesive conjugates and these surrogate objects. Still, it is hoped that the observations made here can be helpful in the decision-making process. Although precautions were taken to minimize any effect that RITC might have on the behavior of the adhesive molecules, one would ideally study the unadulterated adhesives. Techniques for observing penetration which could be adapted to this goal include Scanning Electron Microscopy and Infrared Mapping Microspectroscopy.

ACKNOWLEDGEMENTS

This research was completed during my postgraduate fellowship in paper conservation at the Philadelphia Museum of Art, made possible by the funding of both the National Endowment for the Arts and the Getty Foundation. I would like to thank the Head of Conservation, Marigene H. Butler, for allowing me to continue the work. Paper Conservators Faith Zieske and Nancy Ash provided practical advice and encouraging words, and Conservation Chemist Beth Price was generous with technical support. The research was begun while I was still a student at the Winterthur/University of Delaware Program in Art Conservation, and the guidance of John Krill and Betty Fiske were pivotal in its development. I extend my appreciation to Janice Carlson in the analytical laboratory at Winterthur for allowing my continued use of the museum's equipment, and to Richard Wolbers for his assistance in both refining the technique for the direct fluorescence tracing and in making the photomicrographs. I also thank Rick Sobel and the Chemistry Department at the Community College of Philadelphia for the use of their Ultraviolet-Visible Spectrophotometer.

NOTES

1. Strumfels compared the performance of several consolidants applied to layers of flaking paint (Strumfels, 1987). A portion of that project was repeated by the author (Dennin 1993). Both of the studies sought to compare different consolidants according to several criteria, including capillary action, adhesion of paint flakes, surface change, discoloration of adhesives after ageing, physical strength of the consolidant, and consolidant penetration into the paint layers.

2. The preparation of a methyl cellulose conjugate with RITC was dependent on the isothiocyanate group being attracted to secondary alcohols. This particular application has not been reported elsewhere, and the manufacturer could only suggest that RITC would have a greater affinity for primary alcohols. While the degree of conjugation achieved for the gelatin/dye conjugate was believed to be higher than for the methyl cellulose/dye conjugate, enough fluorescent dye was present in all of the adhesive solutions to render them highly visible using fluorescence microscopy.

3. Each RITC/adhesive mixture was delivered into a separate length of cellulose dialysis tubing. The filled tubes were placed into four separate beakers, each containing 2000 ml of the same diluent as the adhesive inside. A magnetic stirrer and stirring plate were used to keep some movement in the beakers. The water or water/ethanol in the beakers was changed once each day for four days, until the bright pink color of the fluorochrome could no longer be detected in the surrounding water. The rinse solutions were then analyzed using UV-Vis Spectrophotometry.

4. Dialysis was considered complete for an adhesive/dye mixture when the Rhodamine B, a strong absorbance peak at about 550 nanometers, could no longer be detected in the rinse solution. While gel filtration is considered the optimal method for removing unreacted RITC from the conjugated material, it is believed that this dialysis procedure was effective at indicating the point at which free dye was not moving with the diluent. Therefore, the source of fluorescence in a cross section can be attributed to the deposition of the labeled adhesive rather than to the path of the diluent.

5. Samples were exposed to five cycles of two hours each at 50°C followed by two hours at 0°C. Each rectangle was then placed in a glassine folder and rolled around a 1/2" diameter glass rod, once with the paint layer facing in and a second time with the paint layer facing out.

6. Other possibilities might include lowering the alcohol content of the adhesive solution or applying the alcohol to the paint surface before and/or after the adhesive, rather than mixing it into the solution as a diluent.

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MATERIALS AND EQUIPMENT

Winsor & Newton Designers Gouache and Surrogate Paper samples from local art supply store.

Photographic Gelatin, 250 Bloom-Surface, Rousselot Lot #51.714, Type 18097, from Jose Orraca Studio.

Methyl Cellulose Paste Powder, Process Materials Corp. (Now available from Archivart).

Ethyl Alcohol, denatured 95% from Fisher Scientific (King of Prussia, PA; Catalog #A-407) is given as 87% Ethanol, 5% Methanol, 1% Ethyl Acetate, 1% Methyl Isobutyl Ketone, 1% Aliphatic Hydrocarbons, and the balance water.

Deionized Water, Tap water from Philadelphia Museum of Art paper conservation laboratory with two resin deionizing columns and carbon filters from Ionpure Technologies Corporation, (North Wales, PA).

Rhodamine B Isothiocyanate, from Sigma Chemical Company (catalog #R-1755).

Cellulose Dialysis Tubing, from Sigma Chemical Company (catalog #D-9777).

The Ultraviolet-Visible Spectrophotometer in the Chemistry Lab at the Community College of Philadelphia is a Hewlett Packard B452A Diode Array Spectrophotometer which uses HP 89531A MS-DOS-UV-VIS Operating Software.

The suction disc in the paper lab at the Philadelphia Museum of Art is of the type described in the article by Timothy Vitale in The Paper Conservator (Volume 12, 1988). The vacuum was adjusted to draw 7"Hg with no object on the disc.

Bio-plastic Liquid casting plastic (catalog #35W1710 distributed by Ward's Natural Science).

The Microtome in the Analytical laboratory at Winterthur Museum is a Jung Biocut 2035.

The Microscope in the Microscopy Room at the Winterthur Museum is a Leitz Aristoplan, with a Leica Wild MPS 52 35mm Photoautomat for the making of photomicrographs.

Color transparencies were made using Kodak Ektachrome Daylight ASA 400 film.

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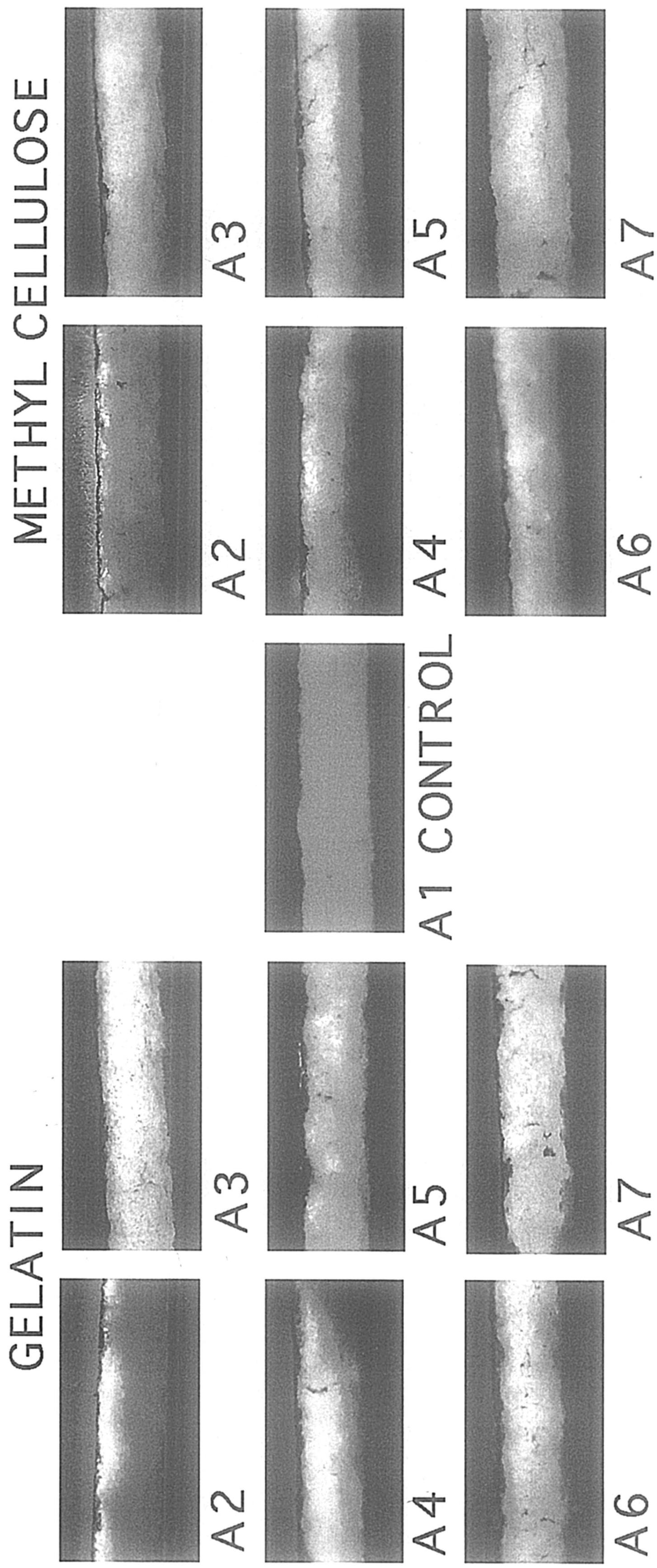
METHYL CELLULOSE
A2
A3
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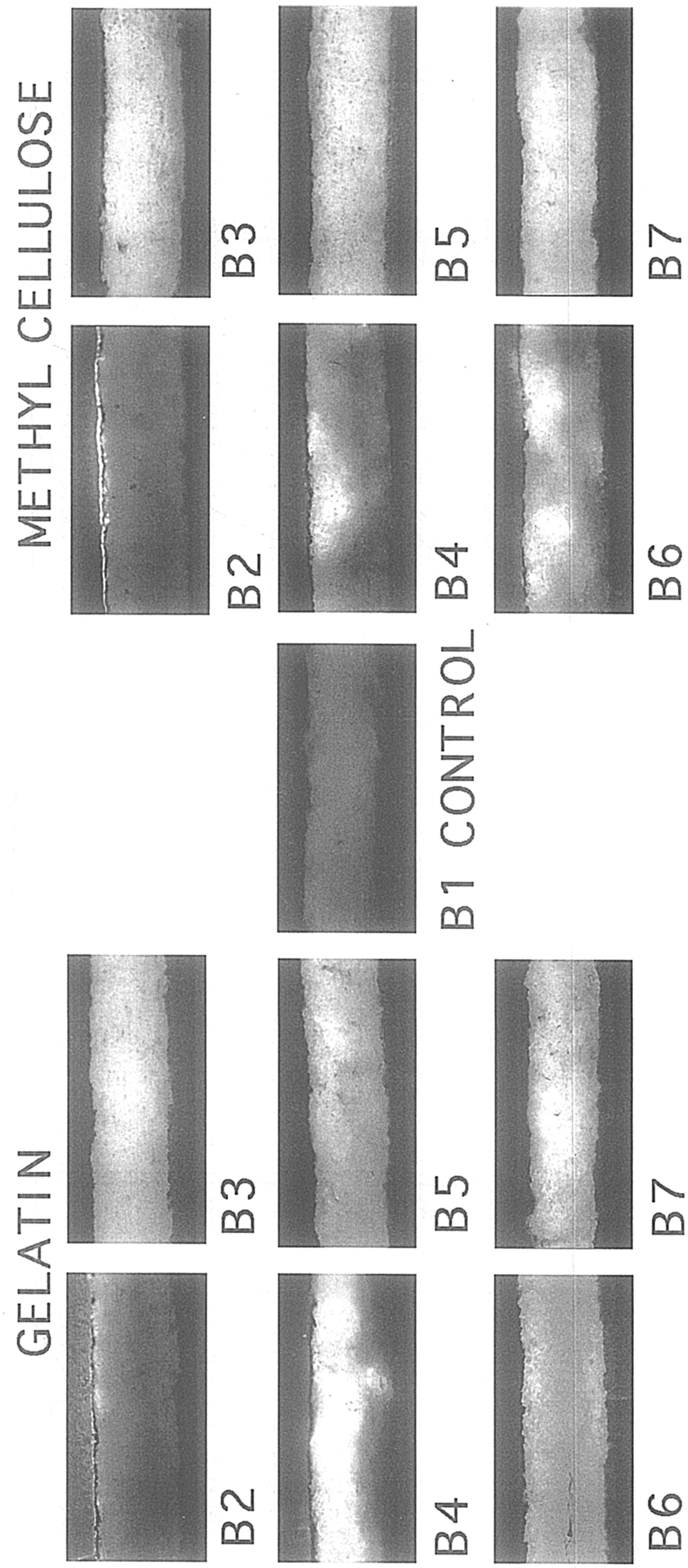
A6
A7
A1 CONTROL
GELATIN
A2
A3
A4
A5
A6
A7

Table 1.

Surrogate A (absorbs 1 min) **1.0% GELATIN**	**Observations on Application of Adhesive to Surrogate Object**	**Observations on Surface of Surrogate Object After Drying of Adhesive**	**Observations on Thin Section with UV Light Under Magnification**
A1 Control			
A2 H_2O	severe lateral spreading of adhesive; fully absorbed after 1 hour -	slight sheen on surface, some dissolved paint, flakes secure -	adhesive at paint/paper interface or just beyond +
A3 H_2O/EtOH	adhesive absorbed immediately +	no sheen, no dissolved paint, some insecure flakes -	adhesive distributed throughout paper with less at interface -
A4 H_2O suction disc	adhesive absorbed in a few seconds +	no sheen, no dissolved paint, flakes secure +	adhesive in upper 2/3 of paper +
A5 H_2O/EtOH suction disc	adhesive absorbed in a few seconds with some lateral spreading -	shiny surface, no dissolved paint, flakes secure -	some adhesive at paint surface; most distributed irregularly throughout paper -
A6 H_2O suction disc humidified	adhesive absorbed immediately with dye evident in filter paper -	no sheen, no dissolved paint, flakes secure +	most adhesive near center of paper layer, between paint and verso -
A7 H_2O/EtOH suction disc humidified	adhesive absorbed in a few seconds +	slight sheen, no dissolved paint, flakes secure -	adhesive distributed throughout paper not quite to verso -

Table 2.

Surrogate A (absorbs 1 min) 0.5% METHYL CELLULOSE	Observations on Application of Adhesive to Surrogate Object	Observations on Surface of Surrogate Object After Drying of Adhesive	Observations on Thin Section with UV Light Under Magnification
A1 Control			
A2 H_2O	adhesive spread laterally and required 2 hours to fully absorb -	shiny surface, some dissolved paint, flakes secure -	some adhesive at paint surface w/most at paint/paper interface -
A3 H_2O/EtOH	adhesive absorbed in a few seconds with slight lateral spreading +	no sheen, no dissolved paint, flakes secure +	adhesive in top 1/3 to 2/3 of paper layer +
A4 H_2O suction disc	adhesive did not spread but required 15 minutes on disc to fully absorb -	slight sheen on surface, some dissolved paint, flakes secure -	adhesive irregularly distributed in top 2/3 of paper layer -
A5 H_2O/EtOH suction disc	adhesive absorbed immediately +	slight sheen on surface, no dissolved paint, flakes secure -	adhesive distributed throughout top 1/3 to 2/3 of paper layer +
A6 H_2O suction disc humidified	adhesive required 20 seconds to break surface, minor spreading, then absorbed -	slight sheen on surface, some dissolved paint, flakes secure -	adhesive irregularly distributed in top 2/3 of paper layer -
A7 H_2O/EtOH suction disc humidified	adhesive required 15 seconds to fully absorb with minor spreading +	slight sheen on surface, some dissolved paint, flakes secure -	adhesive evenly distributed throughout paper layer -


METHYL CELLULOSE
B2
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B4
B5
B6
B7
B1 CONTROL
GELATIN
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B4
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B6
B7

Table 3.

Surrogate B (absorbs immed) **1.0% GELATIN**	**Observations on Application of Adhesive to Surrogate Object**	**Observations on Surface of Surrogate Object After Drying of Adhesive**	**Observations on Thin Section with UV Light Under Magnification**
B1 Control			
B2 H_2O	adhesive did not spread but required 3 hours to fully absorb -	very shiny surface, much dissolved paint, flakes secure -	adhesive on paint surface and at paint/paper interface -
B3 H_2O/EtOH	adhesive absorbed immediately +	no sheen, no dissolved paint, some insecure flakes -	adhesive evenly distributed throughout paper layer -
B4 H_2O suction disc	adhesive required a few seconds to break surface, then absorbed +	no sheen, no dissolved paint, flakes secure +	adhesive at paint/paper interface and in top 2/3 of paper layer +
B5 H_2O/EtOH suction disc	adhesive did not spread but required 6 minutes to fully absorb -	slight sheen on surface, no dissolved paint, flakes secure -	adhesive irregularly distributed throughout paper layer -
B6 H_2O suction disc humidified	adhesive absorbed immediately with dye evident in filter paper +	no sheen, no dissolved paint, flakes secure +	less adhesive visible overall with some at bottom 1/3 of paper layer -
B7 H_2O/EtOH suction disc humidified	adhesive absorbed immediately +	slight sheen on surface, some dissolved paint, some flakes insecure -	adhesive evenly distributed throughout paper layer -

Table 4.

Surrogate B (absorbs immed) **0.5% METHYL CELLULOSE**	**Observations on Application of Adhesive to Surrogate Object**	**Observations on Surface of Surrogate Object After Drying of Adhesive**	**Observations on Thin Section with UV Light Under Magnification**
B1 Control			
B2 H_2O	adhesive did not spread but required 3 hours to fully absorb -	very shiny surface, some dissolved paint, flakes secure -	adhesive nearly all on paint surface -
B3 H_2O/EtOH	adhesive absorbed immediately +	no sheen, no dissolved paint, some flakes insecure -	adhesive distributed throughout paper layer -
B4 H_2O suction disc	adhesive did not spread but required 6 minutes to fully absorb -	slight sheen on surface, some dissolved paint, flakes secure -	adhesive at paint/paper interface or just beyond +
B5 H_2O/EtOH suction disc	adhesive absorbed immediately +	slight sheen on surface, some dissolved paint, flakes secure -	adhesive evenly distributed throughout paper layer -
B6 H_2O suction disc humidified	adhesive required 20 seconds to break surface, minor spreading, then absorbed -	slight sheen on surface, some dissolved paint, flakes secure -	adhesive at interface and slightly diffused into paper layer +
B7 H_2O/EtOH suction disc humidified	adhesive absorbed in a few seconds +	slight sheen on surface, some dissolved paint, flakes secure -	adhesive evenly distributed throughout paper layer -

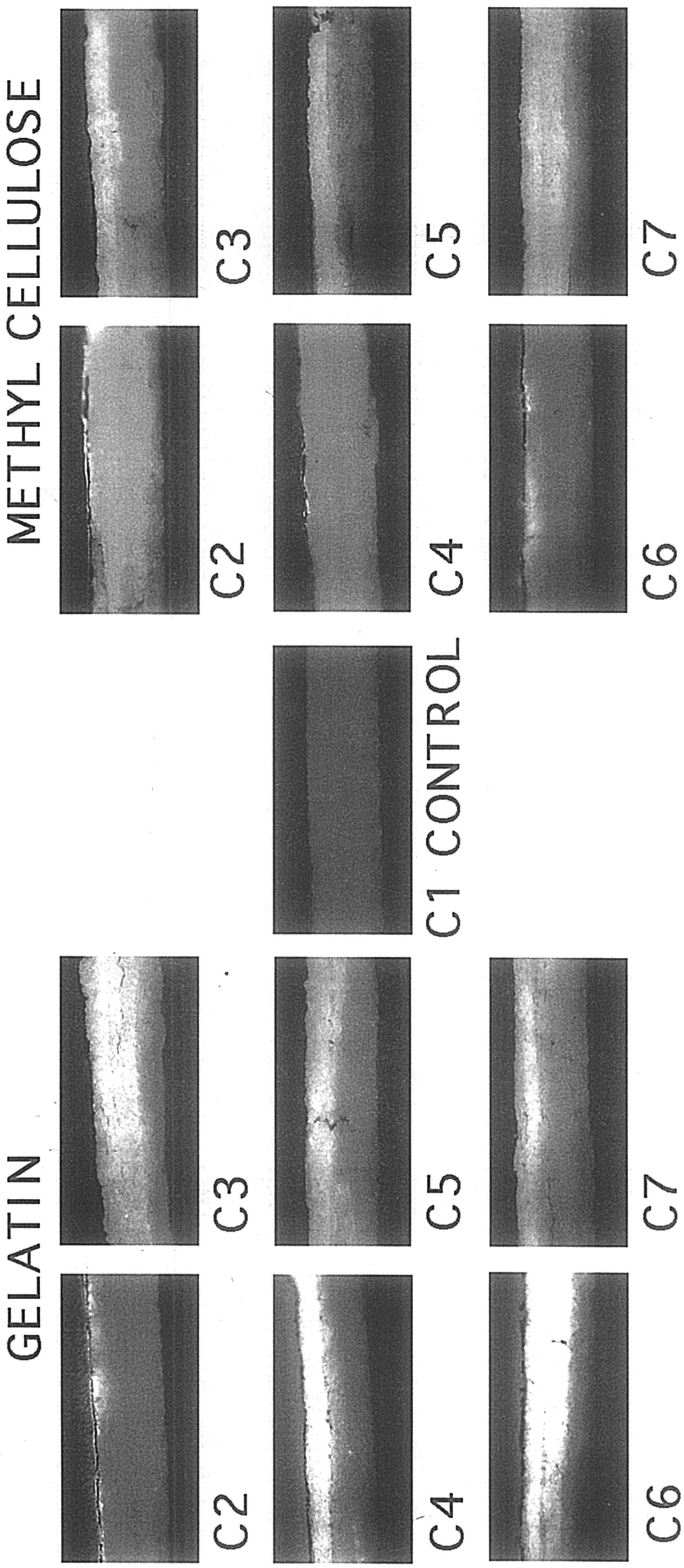
METHYL CELLULOSE
C2
C3
C4
C5
C6
C7
C1 CONTROL
GELATIN
C2
C3
C4
C5
C6
C7

Table 5.

Surrogate C (not absorbent) **1.0% GELATIN**	**Observations on Application of Adhesive to Surrogate Object**	**Observations on Surface of Surrogate Object After Drying of Adhesive**	**Observations on Thin Section with UV Light Under Magnification**
C1 Control			
C2 H_2O	adhesive spread laterally and required 1.5 hours to fully absorb -	very shiny surface, much dissolved paint, flakes secure -	most adhesive on paint surface and some at paint/paper interface -
C3 H_2O/EtOH	adhesive absorbed immediately with slight lateral spreading -	no sheen, no dissolved paint, flakes secure +	adhesive in top 2/3 of paper layer +
C4 H_2O suction disc	adhesive required one minute to break surface with some lateral spreading -	no sheen, no dissolved paint, flakes secure +	adhesive at paint/paper interface and top 1/3 of paper layer +
C5 H_2O/EtOH suction disc	adhesive absorbed in a few seconds with slight lateral spreading -	slight sheen on surface, some dissolved paint, flakes secure -	adhesive in top 1/3 to 2/3 of paper layer +
C6 H_2O suction disc humidified	severe lateral spreading of adhesive before absorbing after 1 minute -	no sheen, some dissolved paint, flakes secure -	adhesive in top 2/3 of paper layer +
C7 H_2O/EtOH suction disc humidified	adhesive spread slightly and absorbed after 10 seconds -	no sheen, no dissolved paint, flakes secure +	adhesive in top 1/3 to 2/3 of paper layer +

Table 6.

Surrogate C (not absorbent) **0.5% METHYL CELLULOSE**	Observations on Application of Adhesive to Surrogate Object	Observations on Surface of Surrogate Object After Drying of Adhesive	Observations on Thin Section with UV Light Under Magnification
C1 Control			
C2 H_2O	adhesive spread laterally and required 3 hours to fully absorb -	very shiny surface, much dissolved paint, flakes secure -	most adhesive on paint surface with some in top 1/3 of paper layer -
C3 H_2O/EtOH	adhesive absorbed in a few seconds with some lateral spreading -	no sheen, no dissolved paint, flakes secure +	adhesive in top 1/3 of paper layer +
C4 H_2O suction disc	paper not held on disc; some spreading; left on disc 1.5 hours to fully absorb -	very shiny surface, some dissolved paint, flakes secure -	most adhesive on paint surface with some in top 1/3 of paper layer -
C5 H_2O/EtOH suction disc	adhesive required several seconds to absorb; paper not held onto disc -	slight sheen on surface, some dissolved paint, flakes secure -	adhesive in top 1/3 of paper layer +
C6 H_2O suction disc humidified	paper held to disc; adhesive spread laterally; 10 minutes to fully absorb -	slight sheen on surface, some dissolved paint, flakes secure -	adhesive at paint/paper interface +
C7 H_2O/EtOH suction disc humidified	adhesive spread slightly; one minute to fully absorb -	slight sheen on surface, some dissolved paint, flakes secure -	adhesive diffused in top 1/3 to 2/3 of paper layer -