Lifted Cellulose Nitrate: Conserving an Early Robert Mapplethorpe Object

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In February 2011 the Getty and the Los Angeles County Museum of Art (LACMA) announced a joint acquisition of archival materials and works by, or associated with, Robert Mapplethorpe. Although Mapplethorpe's fame derived from photography, he did not consider himself a photographer, but an artist: during his studies at the Pratt Institute in Brooklyn in the 1960s, he only took classes in painting and sculpture, and majored in graphic art. It was not until 1971 that he found his interest in photography, after he had borrowed a Polaroid camera to advance his works with collages, which he had previously made from magazine clippings.[1]

A goal of the Getty Research Institute (GRI) is to collect the work of individual artists in depth and to show the development in an artist's oeuvre. For that reason, the GRI is very interested in Mapplethorpe's early and therefore formative years, between 1968 and 1972, when he created many 3D-objects and jewelry designs.[2]

Description of the Object

One of these acquired Mapplethorpe pieces was an untitled object from 1971, a lidded box that houses an altered snow globe (Figure 1:).

Both the box and the lid are made from wood covered with decorative papers and cellulose nitrate (CN) plastic sheets on top. The CN material (Figure 2:) is plasticized with camphor (Figure 3:). The front and top have floral papers, whereas the sides are a dark brown. The left and right edges of the floral-decorated sides are profiled through a convex expansion of the paper/CN layer, and the hollow area between the paper and the wood is filled with papier-mâché (Figure 4 and Figure 5). A metal clasp locks the front, and metal hinges connect the lid and the box at the rear.

The inside of the box is lined with a fine textile, and a hollow cylinder is mounted to the middle of the box to hold the altered globe in place. This snow globe has additional pieces, a rabbit's foot and a small red painted piece, incased in a nylon stocking and held in position by ribbons wound around the outside of the stocking. The globe further has a fringe trim attached to its bottom (Figure 1:).

[1] GETTY PRESS
[2] GETTY PRESS

Figure 1: *Untitled*, 1971, Robert Mapplethorpe. Wood, paper, papier-mâché, glass, cellulose nitrate (with camphor), nylon, metal, rabbit's foot, liquid, and other plastics, 6 x 6 1/2 x 6 1/2 in. Gift of The Robert Mapplethorpe Foundation to the J. Paul Getty Trust and the Los Angeles County Museum of Art. © Robert Mapplethorpe Foundation. Held at the Getty Research Institute, 2011.M.20.45

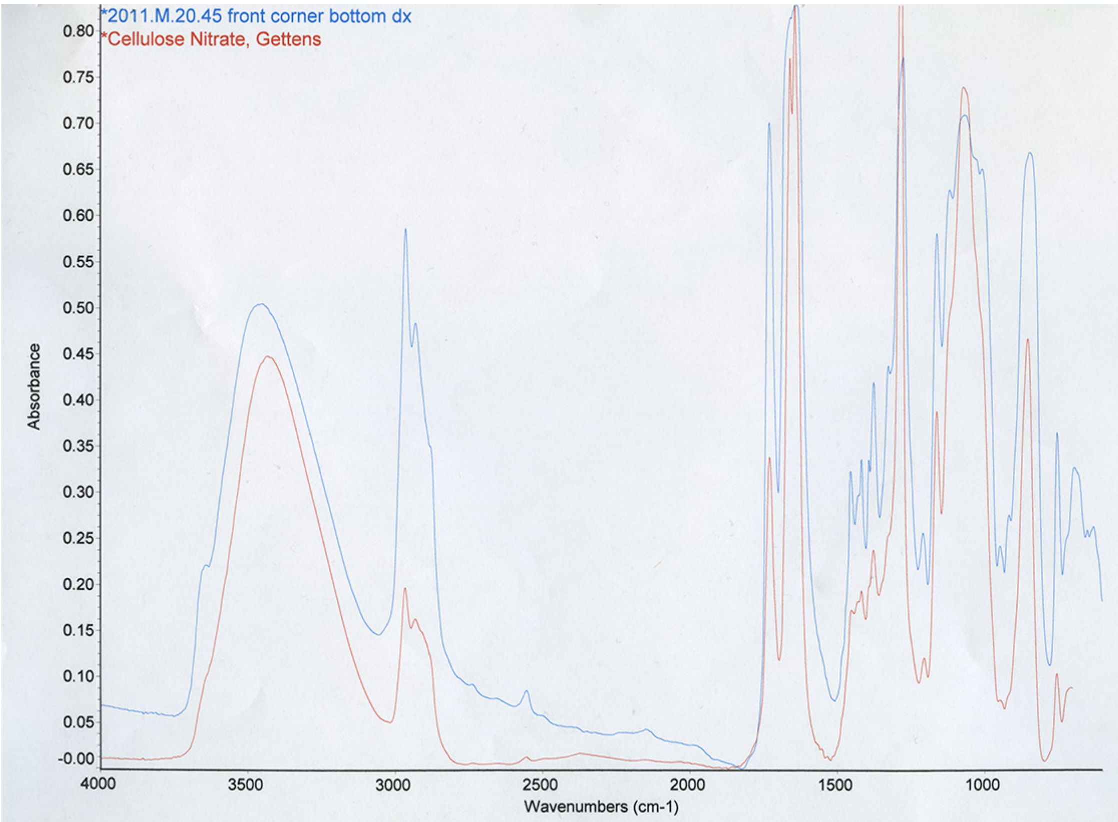

Figure 2: FTIR analyses: Cellulose nitrate in plastic sheet

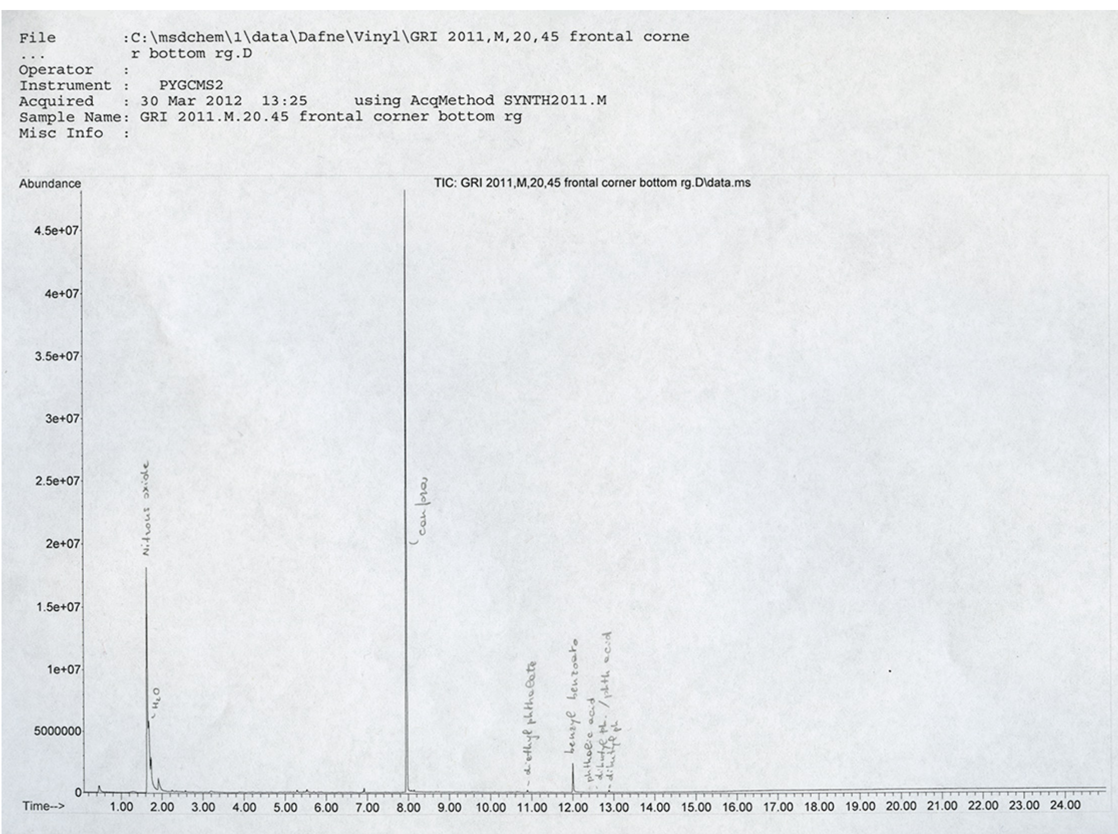

Figure 3: Py-GC/MS: Camphor in plastic sheet

The Object's Condition

The first step in any conservation project is to examine the condition of the piece in detail to determine debris, alterations, damage, or missing elements.

On this object, the CN plastic sheets of the box had lifted and delaminated from the papier-mâché surface, likely due to natural shrinkage of the wood. The floral paper, however, was still adhered to the now-domed CN sheet. At the proper left front corner, the lifted plastic/paper layer was torn, causing it to lift further. The exposed papier-mâché had become brittle over time and was partly detached from the wooden surface (Figure 4 and Figure 5).

Figure 4: Damage to left front of box

Figure 5: Detail of damage

Our Approach

We decided to reattach the torn and lifted CN plastic sheet to prevent future damage. Therefore, the brittle papier-mâché underneath had to be consolidated first.

Usually conservators use aqueous adhesives such as hide glue, wheat paste, or (optionally) acrylic dispersions to work on wood, paper, or papier-mâché parts. But water and water vapors should not be introduced to CN materials, since they undergo hydrolytic deterioration reactions: cellulose nitrate ($C_6H_7O_{11}N_3$) plastics are synthesized by esterification of cellulose ($C_{12}H_{22}O_{11}$) with sulfuric (H_2SO_4) and nitric acid (HNO_3). During this process some of the hydroxyl groups (–OH) are substituted with nitrate groups (–NO_2). The N–O bonds are the weakest in the molecule and, therefore, because they are thermal-initiated and weakened, are easily attacked by oxygen (O_2) to form nitrous oxides (NO_2) that then react with moisture (H_2O) to form nitric acid (HNO_3). Nitric acid attacks organic materials causing the autocatalytic breakdown of the polymer, as described by scientist Yvonne Shashoua in a paper from 2006.[3]

In order to avoid interference between the evaporating adhesive solvent in direct contact with the CN plastic sheet, we chose an adhesive that remains sticky after it dries to a clear film.

[3] SHASHOUA 2006, pp. 68, 69

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The dried film of the aqueous acrylate dispersion Lascaux® 360 HV has this sticky property, as it is visco-plastic with good tensile strength. Unfortunately, it only possesses medium adhesion strength and, therefore, might not prevent the energized CN sheet from lifting again. Once dried and thus made water-insoluble, the Lascaux® film can be permanently activated using acetone, alcohols, toluene, or xylene.[4]

To ensure that the adhesive would work properly with the materials in the Mapplethorpe box, we made test samples of its dried film and tested its adhesion property. We also checked three substances for consolidating the papier-mâché, both for their ability to fully stabilize the material and for the solvents they contained. The results would then help us devise a treatment proposal for the object.

Testing the Materials to Develop a Treatment Plan

On Mapplethorpe's box, delamination had mainly occurred between the papier-mâché and the paper layer, so we made test dummies[5] by gluing a soft blotting paper, imitating the papier-mâché, to a stiff cardboard piece, imitating the wood layer, and adhering a piece of colored paper to a hard and domed 0.010-inch-thick Mylar® plastic sheet (Figure 6) using an acid-free polyvinyl acetate resin emulsion (PVAC). By using the strong PVAC, a predetermined breaking point would not be within these layers, but within the to-be-tested weaker Lascaux® 360 HV adhesive film area.

Figure 6: Dummy: Cardboard, blotting paper, colored paper, and domed Mylar®

We made an even adhesive film using a mold that allowed a steady adhesive application onto a carrier. The mold was fabricated from Mylar® strips that we cut on a board shear and adhered to a silicone-coated plastic carrier with double-sided pressure-sensitive tape. The space between the strips was narrower than the plastic spatula used to apply the adhesive onto the mold, so that the strips functioned as a guide rail (Figure 7 and Figure 8).

[4] www.kremer-pigmente.com
[5] Amount of dummies according to statistics in DIN 50011 part 11, DIN 50010 part 1 and 2, DIN 50035 part 1 and 2.

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A carrier was essential, because the dried and now-sticky Lascaux® 360 HV was difficult to handle, and the film would crumple when removed from its carrier. Silicone-coated polyester sheets appeared to be the best carrier choice, since uncoated foils made it harder to release the dried film onto an object. The film could additionally be softened with a fast-evaporating, and therefore less harmful, solvent such as acetone to ease its lifting. We learned that the film should be manufactured in the size needed; any later cutting was difficult due to the stickiness of the film, including stickiness to cutting tools. Slicing through an additional piece of silicone-coated plastic placed on top, therefore, was helpful.

We tested adhesive films in two thicknesses: one 0.005 inches thick, and another 0.010 inches thick. The thicker one ensured an even film with sufficient adhesion, but we also tested the thinner one to minimize the thickness of the adhesion layer, though we assumed it might not have adequate adhesion strength, especially given that the Lascaux® adhesive might form adhesive "islands" when applied too thinly onto the silicone-coated foil. During testing the 0.005-inch film did not form this island phenomenon and, therefore, we included it in further testing.

Figure 7: Mold: Mylar® strip adhered on silicone-coated carrier using double-sided pressure-sensitive tape

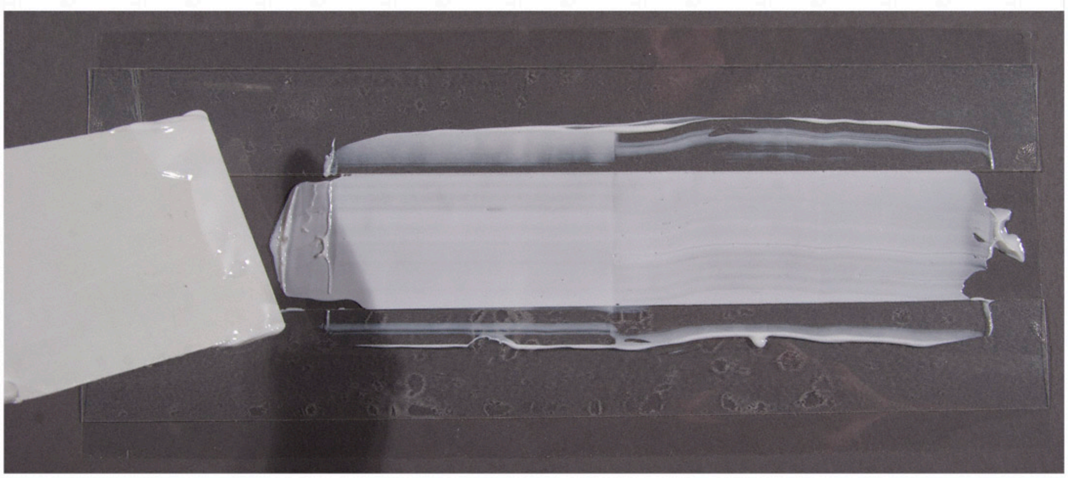

Figure 8: Adhesive application onto the mold to create the adhesive film

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It was important to check the behavior of the Lascaux® film on fragile papier-mâché surfaces. Therefore, we consolidated part of the blotting paper test dummies and left the rest unconsolidated. We then pressed the Lascaux® film, still on the silicone-coated plastic sheet, onto the blotting papers and lifted it up to gauge the film's application and adhesion characteristics as well as the bonding quality between the adhesive and the papers.

The test revealed that the bonding between the dried adhesive film and the *unconsolidated* blotting paper was not very steady and that the layers could easily separate with loose fibers and particles being ripped off (Figure 9). We did not see this separation effect as strongly with the *consolidated* blotting paper, however. Here, the adhesion of the film was satisfying and stable (Figure 10). We observed no difference between the thicker and the thinner adhesion film, and therefore determined to use the thinner one for re-adhering the detached layers.

Figure 9: Adhesive on carrier on non-consolidated blotting paper

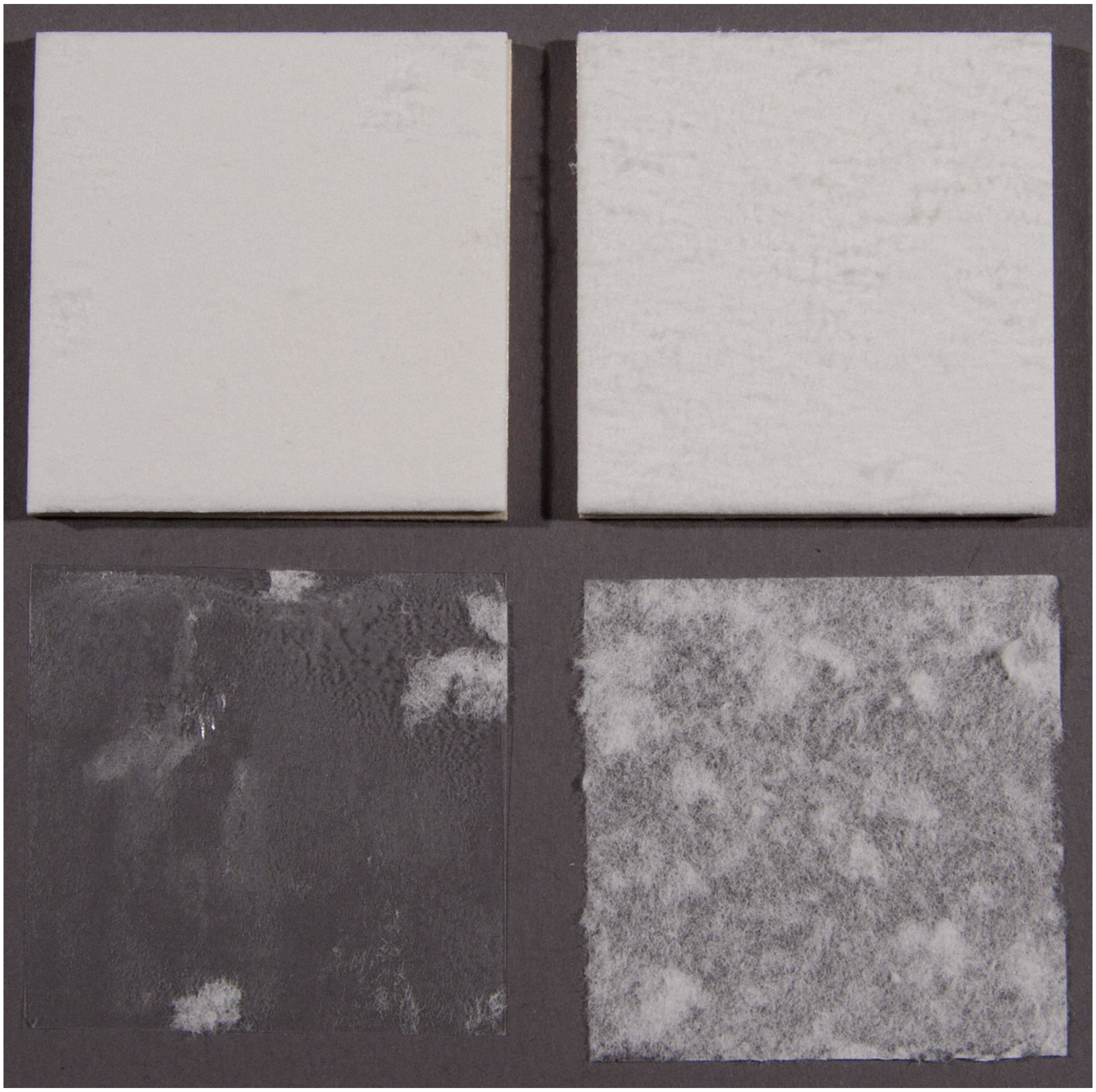

Figure 10: Comparing consolidated blotting paper (left) with non-consolidated blotting paper (right)

To determine an appropriate consolidation medium for the papier-mâché, we tested three materials on blotting paper: a very low-viscosity wheat paste; Paraloid B-72; and the Lascaux® Medium for Consolidation. Wheat paste is commonly used for consolidating paper materials, Paraloid B-72 has proven to be a good consolidation medium for wooden pieces, and the Lascaux® Medium for Consolidation is specifically designed for consolidation purposes. Both wheat paste and the Lascaux® Medium, an aqueous dispersion of an acrylic copolymer,[6] are water-based media. Only Paraloid B-72, a thermoplastic acrylic resin,[7] can be dissolved in non-aqueous solvents like acetone, toluene, or xylene. We decided to compare all three media on their penetration depth and the possibility of applying them locally. For better visibility during testing, we dyed the media black using a multi-purpose tinting paste by MIXOL®.

Whereas wheat paste and Paraloid B-72 remained mostly at the surface of the blotting paper, while only colored solvent sank and spread into the soft blotting paper, the specially designed Lascaux® Medium for Consolidation penetrated deeply and locally to the bottom of the blotting paper (Figure 11, Figure 12, and Figure 13).

[6] www.kremerpigments.com/shopus/index.php?cat=0207&lang=ENG&product=81012
[7] Paraloid B-72: Cameo
http://cameo.mfa.org/materials/record.asp?key=2170&subkey=6848&Search=Search&MaterialName=paraloid+b+72

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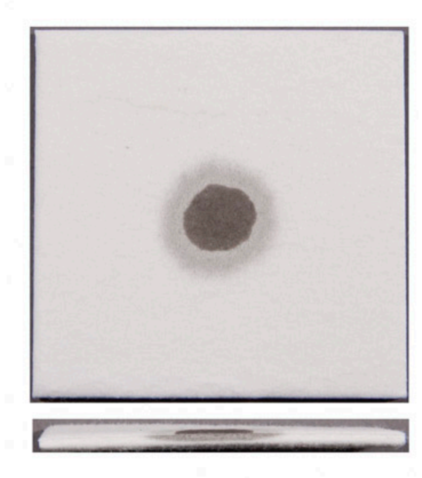

Figure 11: Wheat paste on blotting paper, dyed black

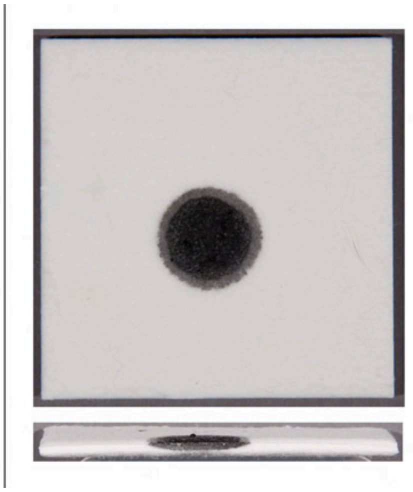

Figure 12: Paraloid B-72 on blotting paper, dyed black

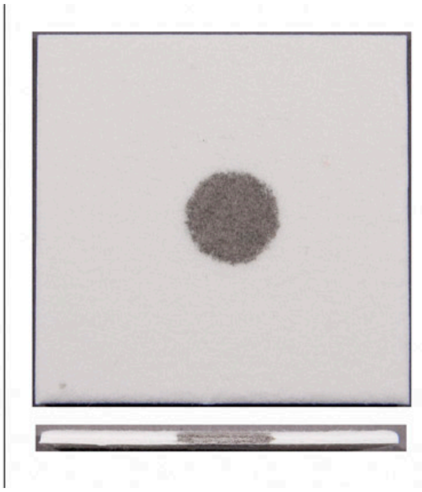

Figure 13: Lascaux® Medium for Consolidation on blotting paper, dyed black

The penetration depth and the stickiness after drying were important because the consolidation medium would additionally function as an adhesive between the papier-mâché and the wood. This aspect needed to be considered since there was no other way of introducing an adhesive between these two layers. Moreover, all layers could only be pressed together once the papier-mâché was consolidated and the adhesive film was positioned.

To check the adhesive properties of the dried consolidation medium, we put a sample of each between a test piece of cardboard and blotting paper with only a light weight on top. As a result, the Medium for Consolidation did not show the same stickiness as the other Lascaux® products, but it had adequate adhesion.

These tests discussed above revealed that the papier-mâché needed to be consolidated, preferably with a non-aqueous medium like Paraloid B-72, prior to re-adhering the CN sheet. Unfortunately, Paraloid B-72 did not have the same consolidation quality as the Lascaux® Medium for Consolidation, which is water-based and thus might harm the CN material. During application we, therefore, reduce the direct water vapor impact by positioning a Mylar® sheet right below the lifted CN/paper layer.

The adhesive Lascaux® 360 HV had sufficient strength in both tested thicknesses — 0.005 inches and 0.010 inches — to keep an energized stiff plastic sheet in place, as long as it rested entirely on an adhesive film. Even after three months the formerly domed plastic sheet was still well adhered and could not be lifted easily (Figure 14 and Figure 15).

It was simple to create an adhesive film by using a mold, but handling the film was a bit difficult since it stuck to anything, including its carrier and the cutting tools. Therefore, we produced extra film material, in case some of it might be lost during the work.

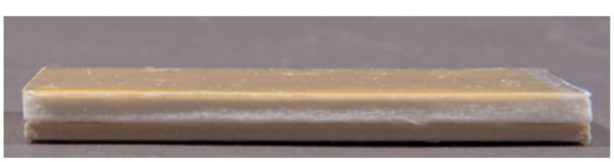

Figure 14: Adhered cardboard/blotting paper and adhered colored paper/ Mylar® (domed)

Figure 15: Adhered dummy after 3 months

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Treatment

Our technique for applying the adhesive film was successful during testing, but we had to re-evaluate it during treatment, since the space between the papier-mâché and the CN plastic sheet above turned out to be too narrow. This limited access caused two problems: First, due to the flat work angle, the release of the adhesive film onto the now-consolidated, but still weak, papier-mâché resulted in damage to the papier-mâché when the carrier was lifted; and second, this limited access reduced the size of the application area for the adhesive film, which needed to be as large as possible to ensure the energized CN sheet would not lift again.

Therefore, we changed our approach and applied the adhesive directly onto the consolidated papier-mâché, just as we did with the aqueous consolidation medium. This was considered a compromise solution, in favor of ensuring a good consolidation result as well as reducing the mechanical impact and direct harm to the object via possible water vapor introduction to the CN sheet, which, as discussed earlier, was intentionally reduced by positioning a Mylar® barrier directly below the paper/CN layer, as there was no direct contact between the consolidation medium or the adhesive and the CN plastic.

After installing the Mylar® barrier, we consolidated the papier-mâché with the Lascaux® Medium for Consolidation and let it dry overnight before we applied the Lascaux® 360 HV adhesive evenly using small-scale Mylar® spatulas and brushes (Figure 16). We did not apply the adhesive in areas where the paper/CN sheet layer showed losses, since these gaps would not be filled, and the uncovered adhesive would remain glossy and attract dust. We then let the adhesive dry overnight before removing the Mylar® barrier. Finally, we carefully pressed down the paper/CN layer using light weights, which remained in place for a week. Even after a month the CN sheet did not lift — and so we considered the treatment a success (Figure 17 and Figure 18).

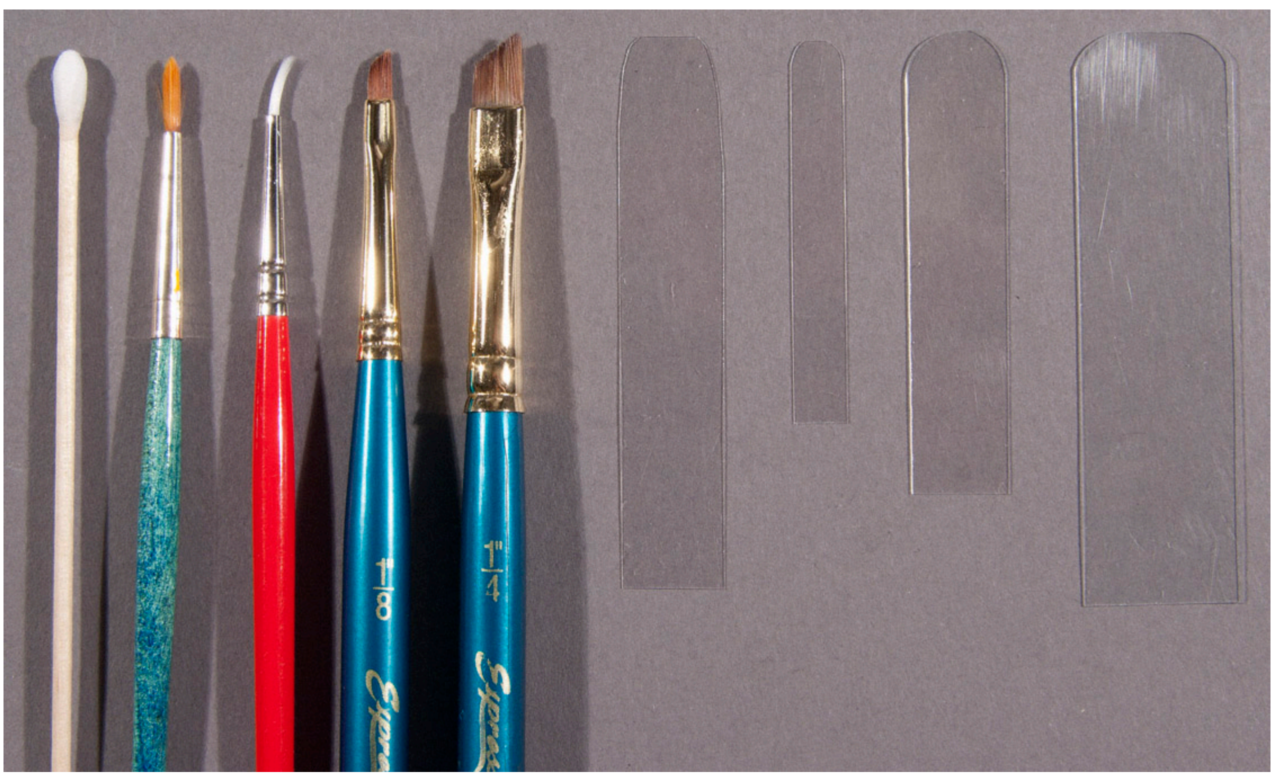

Figure 16: Tools, including a homemade spatula

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Figure 17: Box after treatment

Figure 18: Detail

Conclusion

On an early piece by Robert Mapplethorpe, a cellulose nitrate (CN) plastic sheet had separated from its papier-mâché/wood layer and showed a tendency to lift. To re-adhere the CN sheet we chose an adhesive that remained permanently sticky in order to avoid direct contact between the solvent of the adhesive and the CN sheet. In tests, Lascaux® 360 HV adhesive proved to have good film handling properties.

During treatment, though, we slightly changed our approach, as the restricted access to the damaged area could have resulted in harm to the object. We found an alternative way to apply the adhesive and successfully carried out the treatment.

The downside of the adhesive we chose is its medium adhesion strength, which means that we will need to check the efficacy of the treatment over time, especially since the CN sheet tends to lift. Therefore, we may have to review the treatment periodically. In absence of material tension this technique seems to be quite reliable.

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List of Materials

Blotting Paper	Conservation Resources	www.conservationresources.com
Cardboard, acid-free	University Products	www.universityproducts.com
Lascaux® Acrylic Glue 360 HV	Kremer Pigments Inc.	www.kremerpigments.com
Lascaux® Medium for Consolidation	Kremer Pigments Inc.	www.kremerpigments.com
MIXOL®	MIXOL®	www.mixol.de
Mylar®	Mylar® Plastic Sheets	www.polyester-sheets.com
Paraloid B-72	Kremer Pigments Inc.	www.kremerpigments.com
PVAC, acid-free (834-403N JADE®)	AABBITT Adhesives, Inc.	www.aabbitt.com
Double sided tape	University Products	www.universityproducts.com
Silicone Coated Polyester Sheet	TALAS	www.talasonline.com
Wheat Paste (Jin Shafu)	Hiromi Paper Inc.	www.hiromipaper.com

Literature

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SHASHOUA 2006: Yvonne Shashoua, "Inhibiting the Inevitable; Current Approaches to Slowing the Deterioration of Plastics" in *Macromolecules in Cultural Heritage, Conference in Catania (Italy), November 9-11, 2005*, 2006, pp. 68-71

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