

Treatment of Water Sensitive and Friable Media Using Suction and Ultrasonic Mist.

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Introduction

At the 1964 Philadelphia meeting of the IIC-American Group I gave a talk that may have been the first professional talk related to the conservation treatment of art on paper. At that time I tried to make the point that "while the damage and deterioration more often occurs in the paper support it is the media on the surface of the paper that determines what can or cannot be done to treat the work of art"¹. This point is no where more obvious than in the treatment of the water sensitive and friable works of art I will be discussing today.

I have continued to work to develop methods and techniques to more safely treat problems I have faced in the preservation of these very difficult works of art on paper throughout my career. Toward this end I invented the suction table in 1972² and developed the moisture chamber/suction table/ultrasonic humidifier/air filter system during the 1980's. A U.S. Patent for this system was received in May 1993 and Museum Services Corp. will soon start production of the chamber³.

I first introduced this system at the AIC meeting in Washington, D.C. in 1985⁴ and in 1988 Shannon Zachary and I gave demonstrations and presented results of our research and development of techniques using the system at a symposium sponsored by the Canadian Conservation Institute in Ottawa. Unfortunately the Symposium '88 presentations have never been published⁵.

Lectures and demonstrations of the techniques that have been developed using The System were also given at suction table workshops at the Smithsonian's Conservation Analytical Lab in 1989 and 1990, at the Canadian Conservation Institute in 1991, and in 1993 at the Tokyo National University of Fine Art and Music and at the Japanese Mounters Annual Meeting in Japan.

Shannon Zachary and Holly Maxson showed my most recent video of these techniques at the IPC meeting in Manchester, England. This brief review of the development of the Moisture Chamber/Suction Table System was followed by slides showing the original moisture chamber built in 1984. This chamber had armports that did not easily allow the conservator to manipulate the object being treated. It had to be lifted off the suction table in order to place the object or blotters on the table. The mist entered the chamber at only one opening and

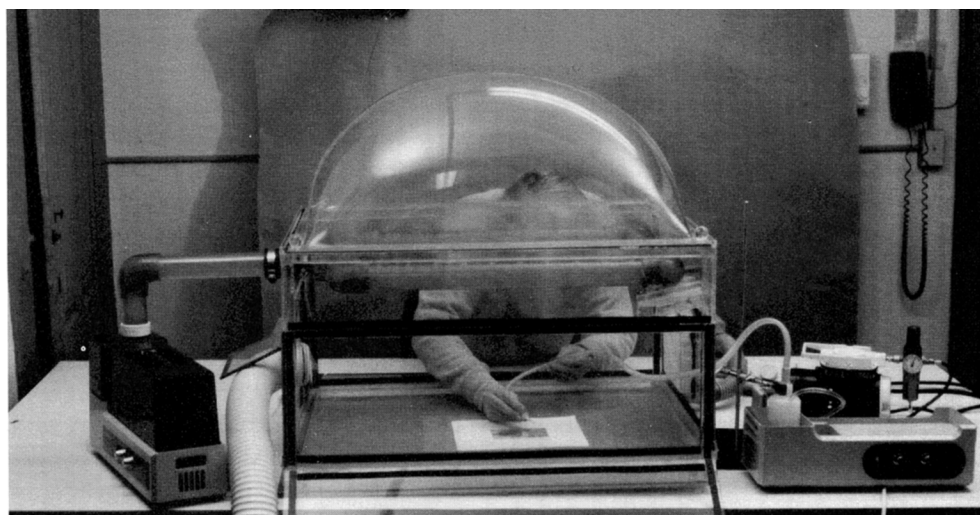


Fig. 1 Current Model of Weidner Moisture Chamber/Suction Table System.

tended to overly wet the object nearest this entry point. But despite its shortcomings it proved the system was workable and led to subsequent models that culminated in the model seen in Fig. 1.

Our latest model is for teaching purposes and is in seven sections so it can be dismantled and packed and shipped. It is not as air tight as my regular chambers but does contain the ultrasonic mist inside the chamber successfully during treatments. This "travelling model" has a flat top rather than the "bubble" top of earlier models. Large doors on all four sides of the chamber are also standard in the later chambers. The mist now enters the chamber more uniformly through perforated tubes running around the walls at the top of the chamber.

We packed this travelling chamber and used it along

with the Museum Services Corp. suction table from the Handa mounting studio in the Tokyo National Museum in Japan. Our audience during the lectures and demonstrations were conservators, collectors and curators in Tokyo but also about 340 Japanese mounters at their annual meeting in Kameyamada, in the mountains of Nagano Prefecture, northwest of Tokyo.

Some recent treatments using the Moisture/Chamber Suction Table System.

Slides of works of art that were either considered for treatment or actually treated using the moisture chamber/suction table system were discussed.

These examples included:

1. A pastel portrait that is applied directly to gesso on a yellow chalk ground on a thick, warped cardboard:

The pastel and gesso are lifting off the chalk ground and there is blind cleavage throughout. There is no paper layer.

This pristine pastel is still in my lab and I have come reluctantly to the conclusion that there may be no treatment possible without disturbing or darkening the pastel.

The moisture chamber/suction table system does not seem to be an appropriate treatment alternative because the desiccated gesso does not relax using moisture from the ultrasonic humidifier. Since the thick, warped cardboard support is not porous, the suction table would be of no help in flattening either the cardboard or the gesso without applying pressure to the obverse side. The pastel will probably transfer to any material applied to its surface. The moisture in any solution that might be found to soften the gesso may darken some of the pastel colors.

This treatment has been put on hold but, with the owner's approval, may be attempted as an experimental treatment, at a later date.

2. A pastel and chalk portrait--probably over a salted paper photographic image on a brittle, discolored, stained paper.

Because the pastel was badly rubbed and ingrained into the surface of the paper an aggressive treatment using the moisture chamber/suction table system was possible. The drawing was thoroughly wetted using the ultrasonic mist in the moisture chamber and considerable staining was successfully removed using the suction table. It was also lined with Japanese paper and wheat starch paste, using the suction table for adhesion and for the initial drying and flattening.

3. A large, Roswell Weidner pastel landscape.

The pastel was irregularly applied: in some areas built up with many layers of pastel separated with local appli-

cations of fixative to prevent the top layer of pastel from mixing with a lower layer; in other areas the pastel was very lightly applied or the paper support itself was part of the design. It is on a heavy weight, strong paper.

The paper support which expanded 1" in its 36" dimension when wetted was so badly cockled it was not exhibitable. Because I was working with the artist I could take a few more chances than I might otherwise, i.e. placing the pastel face-down on polyester web during the wetting-up with the ultrasonic mist. It was wetted on both the obverse and the reverse. When the paper support was thoroughly relaxed and expanded the pastel was turned face-up on polyester web and blotters, the vacuum was turned on and, once the paper support was flat, the edges were weighted. The vacuum was turned off and the pastel was left with the edges weighted for almost two weeks in the closed moisture chamber. When the relative humidity inside the chamber coincided with the RH outside the chamber for several days the weighted edges were released.

The paper has remained flat for several years now. There was no noticeable change in the pastel due to the treatment with the ultrasonic mist.

4. An unfixed pastel by Mary Cassatt.

However, in order to treat pastels, such as this unfixed pastel where nothing could be allowed to touch the pastel at any time during the treatment, a technique was shown that involved adhering Japanese paper strips with wheat starch paste to the reverse edges of the pastel paper support. Four strips of Japanese paper corresponding to the size of the object are water cut at one edge. These frayed edges are pasted out with rather strong paste and adhered to the reverse edges of the paper support. The outer edges of the Japanese paper strips are then caught in a hoop/frame device. This device is much like an embroidery hoop or the old "Dutch Method" paper frame used in painting conservation (Fig 2). Secured in this paper frame the pastel can be suspended face-down over the table surface or suction table and the paper support can be wetted from the reverse only with the ultrasonic mist.

After the paper support was relaxed this pastel was turned face-up on polyester web and blotters and the edges of the paper support were weighted with polyester web/blotter covered plexiglas tubes /filled with lead shot. The tubes are custom-made so that the weight is distributed evenly on all the edges. This pastel was allowed to "stretch dry" without using the suction table. The pastel was left in place with the edges weighted for an extended period as was done with the Weidner pastel.

Older pastels especially when they have been mounted on a wood strainer, have deteriorated, weak edges. The Japanese paper that remains adhered to the reverse edges of the paper support after using the hoop/strainer

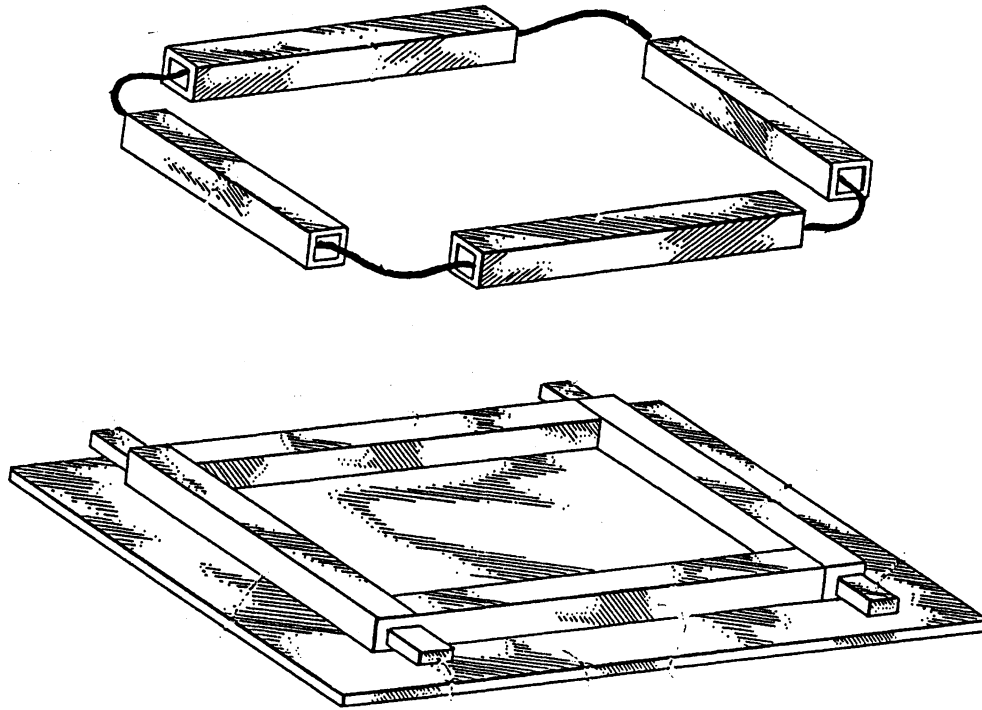


Fig. 2. Hoop/Strainer Device.

technique actually strengthens the edges.

The Mary Cassatt pastel was being treated because of tears and cockling at the corners. The paper support had been glued to a wood strainer and the strain that occurs during periods of changing temperature and humidity caused the cockling and tears.

In its Japanese paper hoop/frame the pastel was suspended face-down and the tears were mended on the reverse with Japanese paper and wheat starch paste. The pastel was immediately turned face-up on a spot suction plate and the mends were dried using the suction to hold the mend flat while the paste dried.

The pastel was then relaxed overall using ultrasonic mist on the reverse only. It was then dried and flattened without suction pressure using edge weights as explained above. Because the cockles (or draws) at the corners were so pronounced suction might have formed creases in the paper support. The possibility of color changes in unfixed pastels when wetted also dictated a very conservative approach.

5. A large 19th century school map.

The condition of the map was normal for 19th century school maps: shellac over printing ink and watercolor on a badly desiccated, brittle, abraded, torn, and creased paper support. The moisture chamber can also be used as a ventilation chamber. A flexible plastic hose connect-

ed to an explosion-proof fan vented to the out-of-doors is inserted through a hole in the side of the chamber. This hose can be used to vent off solvent fumes even as the work of art is being wetted with the ultrasonic mist.

The shellac was removed from this map by swabbing the surface with alcohol using the chamber as a ventilation chamber to remove the fumes from the surface. The surface was then flooded with the solvent and the suction table, when turned on, removed the residual shellac from the paper support into a blotter beneath the map. Water soluble stains in the paper support were also removed through the suction table using the ultrasonic mist.

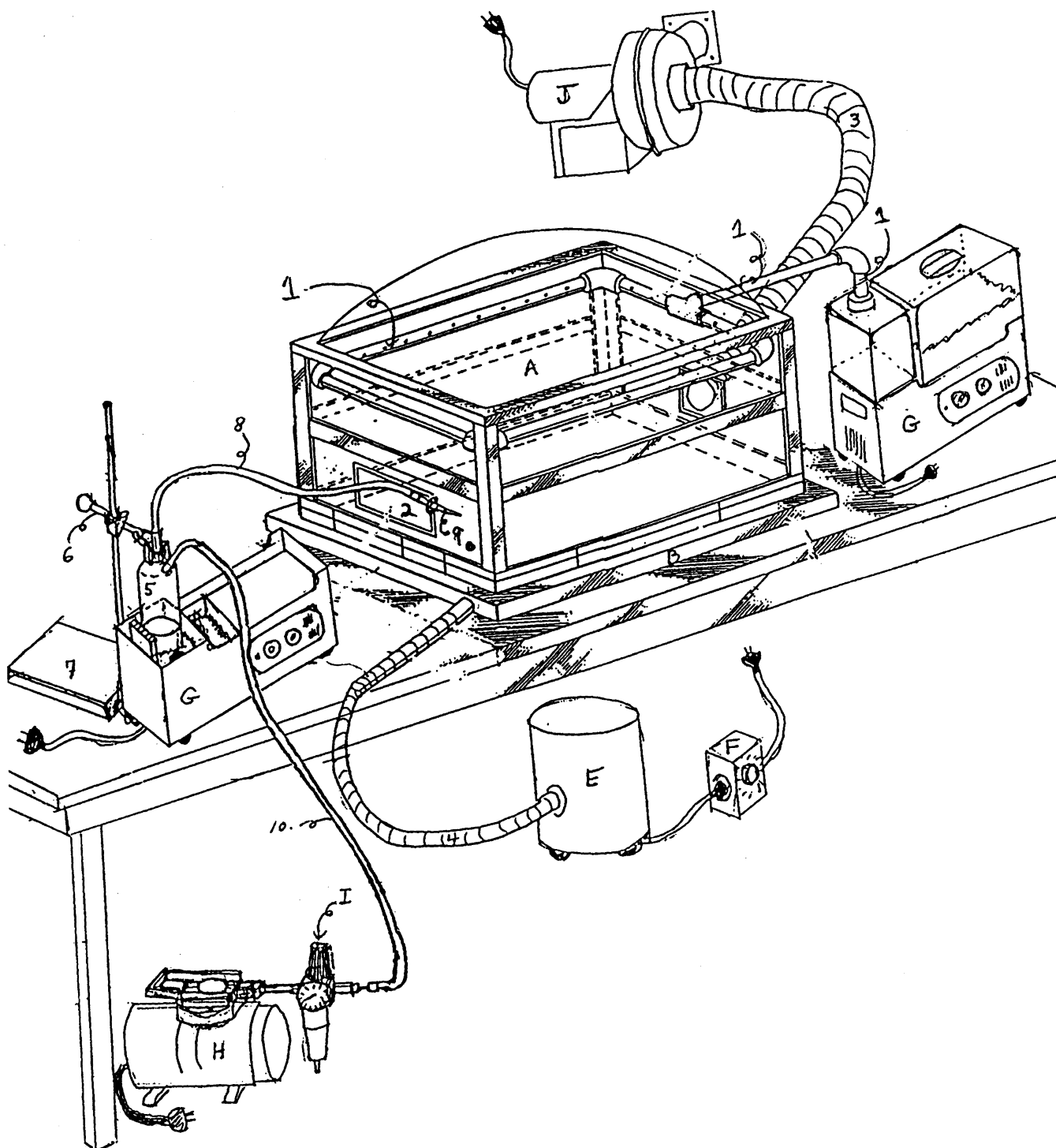
The Apparatus Used in Treatments of Pastels, Water Sensitive Paintings, and a Varnished Map.

The apparatus seen in the diagram in Fig. 3 includes both my normal Moisture Chamber/Suction Table System set-up and the Michalski set-up for using an ultrasonic mist/gelatin solution for local consolidation and stain removal.

The apparatus is flexible and each component can be used separately or all together, for instance:

- Using suction only - with the moisture chamber acting to filter the air passing through the object being treated on the suction table.
- Using the ultrasonic mist in the moisture chamber to wet-up the object and stretch drying with the four edges weighted without using the suction table.
- Using the ultrasonic mist to overall relax the object while applying the ultrasonic mist or ultrasonic mist/gelatin jet locally for paint consolidation or stain removal.
- Using the moisture chamber as a ventilation chamber when using solvents.
- Using ultrasonic mist simultaneously with solvents and the suction table.
- Using the moisture chamber either as a true humidity chamber by controlling the input of the ultrasonic mist, or (if given sufficient time) as a form of spray

Fig. 3
Weidner Apparatus for Conservation Treatments of Works of Art on Paper for
Water Sensitive or Friable Media - 1993.



wetting to thoroughly wet the paper.

Please note that I call this a **MOISTURE CHAMBER** not a **HUMIDITY CHAMBER** because it is seldom used to humidify an object. It is used to "wet-up" an object.

The chamber is constructed of plexiglas and can have either a bubble top or a flat surface. The ultrasonic mist enters the chamber through perforated tubes running around the top of the chamber walls. The mist is directed slightly upward to spread it throughout the chamber. The mist does not touch the top of the chamber where it might condense and drip.

Magnetic tape holds the doors tightly closed. Having doors on all four sides of the chamber is important, especially for larger objects when two or more conservators are working together, so that the object can easily be moved in and out of the chamber, blotters can be changed, and tools, solvents and other chemicals can be replaced without disturbing the object.

Air must pass through the system when the suction table is in use or else an implosion may occur. I have used an automobile carburetor filter in my chamber but it will only filter out gross dirt from the air. A clean room is still the best answer for clean air since the air is filtered even when the chamber doors are open. I have not been able to build a clean room in my new lab. But, I have installed a large environment air system that requires about 24 hours of operation in my closed work-room before the suction table treatment is begun. I have not tested its efficiency.

When using the chamber as a ventilation chamber I insert the flexible hose through a special opening in the chamber venting it out-of-doors through an explosion-proof fan. The hose must be covered with a screen to prevent objects from being drawn into the hose.

THE MICHALSKI SUCTION/MISTER SYSTEM

Many of us have used suction and ultrasonic mist applied locally through tubes to remove stains, to test for

color changes and to consolidate media. However, I believe the apparatus I'll now discuss allows greater control in the application of the ultrasonic mist and opens the way to the use of other chemicals and solvents in local treatment applications for both paint consolidation and local stain removal.

Stefan Michalski, Senior Conservation Scientist at the Canadian Conservation Institute, has invented a device

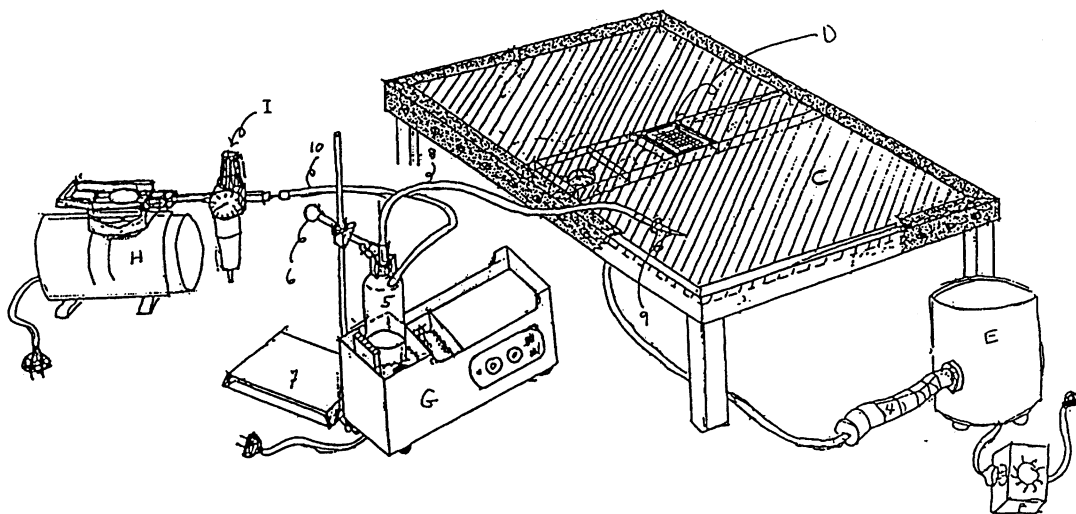


Fig. 4. Michalski Spot Suction Plate, Weidner Spot Suction Table and Apparatus for Local Applications of Ultrasonic Mist/Gelatin Solution for Setting Down Flaking Paint or Local Stain Removal --1993.

using suction and ultrasonic mist for the consolidation of desiccated paint on ethnographic objects⁶. The apparatus set-up in Fig.4 is based on Mr. Michalski's invention. Using a plastic bottle suspended over the mechanism of an ultrasonic humidifier is for me the most ingenious part of his system. That one could form a mist of the gelatin solution in a bottle and control the force of the ultrasonic mist with the air compressor pressure were also revelations. I was able to use a .5% solution of gelatin before the "cavitation" (bubbling) occurs that Niccolo Caldararo described in last Year's *Book and Paper Annual*⁷. Other chemicals that might be applied through this system have not been explored. But I found that acetone and alcohol added to the gelatin solution in the bottle actually seemed to activate the ultrasonic mist.

The Nalgene plastic bottle containing the water or water/gelatin solution is suspended over the ultrasonic mechanism of a humidifier. Air enters the bottle from an air compressor forcing the ultrasonic mist out through the tube to a plastic tip or pipette.

The spot suction table is fitted with openings for a small flat suction plate (Fig. 5) that Mr. Michalski has designed and the funnel beneath the plate is connected to the vacuum. A dimmer controls the actual vacuum pressure.

My chamber fits on this spot table (Fig. 6) so that the

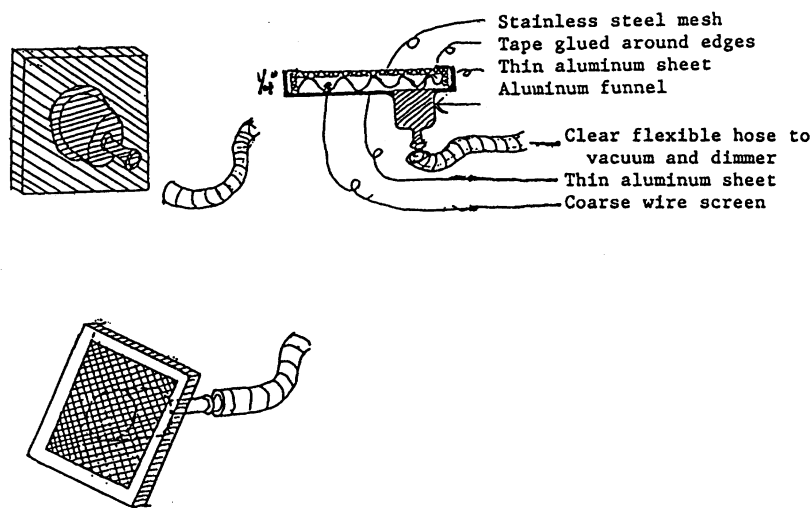


Fig. 5. Michalski Spot Suction Plate.

object can be overall relaxed with ultrasonic mist or solvent fumes can be evacuated during local treatments. I also have a sturdy camera stand and an attachment that allows me to place the body of my binocular microscope on the stand so that I can work over the suction plate during particularly delicate treatments.

During my recent visit to Japan I was able to discuss with the mounters at the Tokyo National Museum the steam vaporizer that they are using to consolidate crackled paint on Oriental scrolls and panel paintings using their suction table. Their system is similar to the use of the ultrasonic mist/gelatin solution. However, they have not been able to control the flow of steam as well as we can with the ultrasonic mist humidifier/air compressor system.

Other tools that have been used for consolidation of flaking paint include various kinds of air brushes, spray guns and the Preservation Pencil⁸. But they are often too strong or cover too large an area for setting down the crackle in the delicate tempera and gouache paintings on paper supports.

Using the apparatus described above I have found to be the optimum technique for applying a consolidant. There are three control points in the apparatus: the air pressure of the compressor; the amount of ultrasonic mist put out by the humidifier; and the force of the suction pressure. Using a binocular microscope while applying the consolidant with these controls allows the conservator to treat even the most delicate painting. In my attempts to produce the gentlest, most controllable mist jet possible I have successfully used an aquarium air pump in place of the air compressor. The need to control the suction pressure during the drying out of the consolidant is also very important. The pressure must be

sufficient for drying but not strong enough to pull the consolidant beyond the crackled paint and into the paper support.

Fig. 7 shows one of my successful consolidation treatments for crackled and lifting gouache paint on paper using this apparatus. Sources of the equipment and supplies described above are listed in the references⁹.

CONCLUSION

I mentioned in the beginning of this paper "while the damage or deterioration more often occurs in the paper support it is the media on the surface of the paper that determines what can or cannot be done to treat it". The aesthetic appearance of a work of art on paper takes precedence over problems in the paper support. If a proposed treatment would seriously change the appearance of the medium used by the artist the treatment (such as removal of stains, discoloration or acidity in the paper support) should probably not be attempted - unless it is really a last resort or considered "experimental".

Overwetting causes the most serious problems that occur during the types of treatments discussed above. These problems can occur during both overall and local treatments. These problems and how I try to avoid or keep them to a minimum are:

A. Flooding of the paint:

1. Keep air pressure into the solution bottle as low as possible using an aquarium aerator rather than the air compressor, if necessary.
2. Use as small an opening in the mist tube as possible - such as a pipette.
3. Work under magnification.

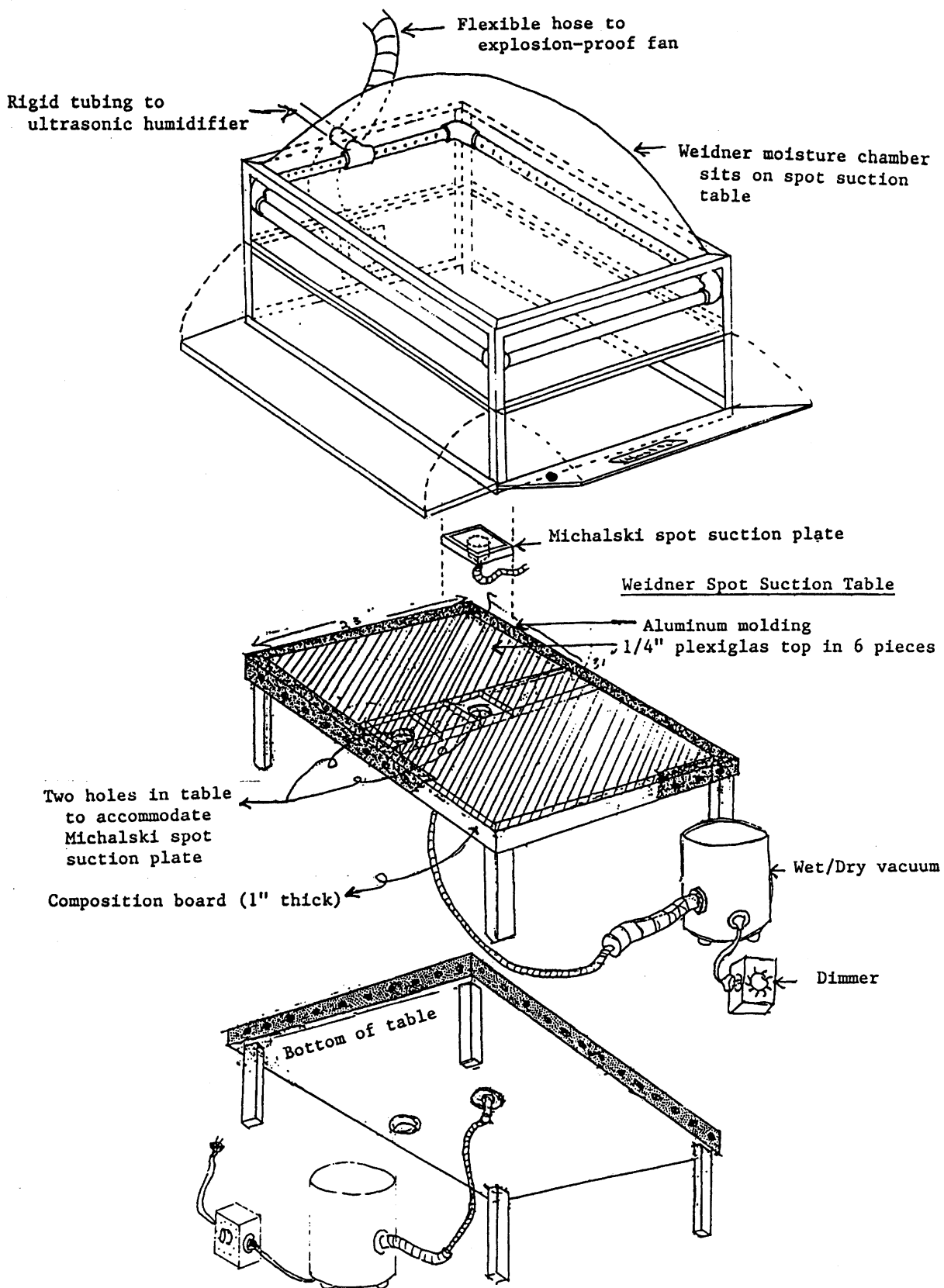
B. Loss of shine/mat appearance of the media:

Use many short exposures to the ultrasonic mist rather than one long exposure.

C. Cockling of the paper support:

1. Work on a regular suction table rather than a spot suction table with the opening in the mylar mask corresponding to size of object.
2. Use overall ultrasonic mist to relax the entire paper support, then apply ultrasonic mist to appropriate areas locally with the tube keeping the entire object flat with suction.

Fig. 6. Weidner Moisture Chamber and Spot Suction Table for Michalski Spot Suction Plate 1993.



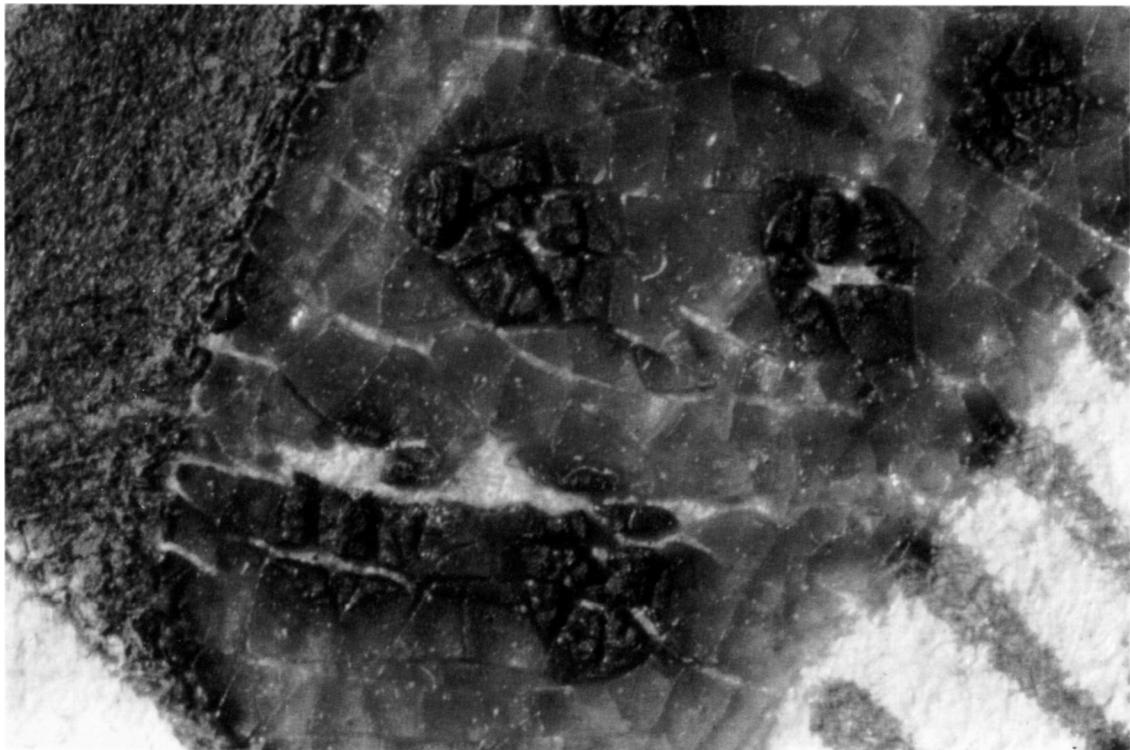


Fig. 7. A crackled gouache painting consolidated with ultrasonic mist/gelatin. Before treatment.

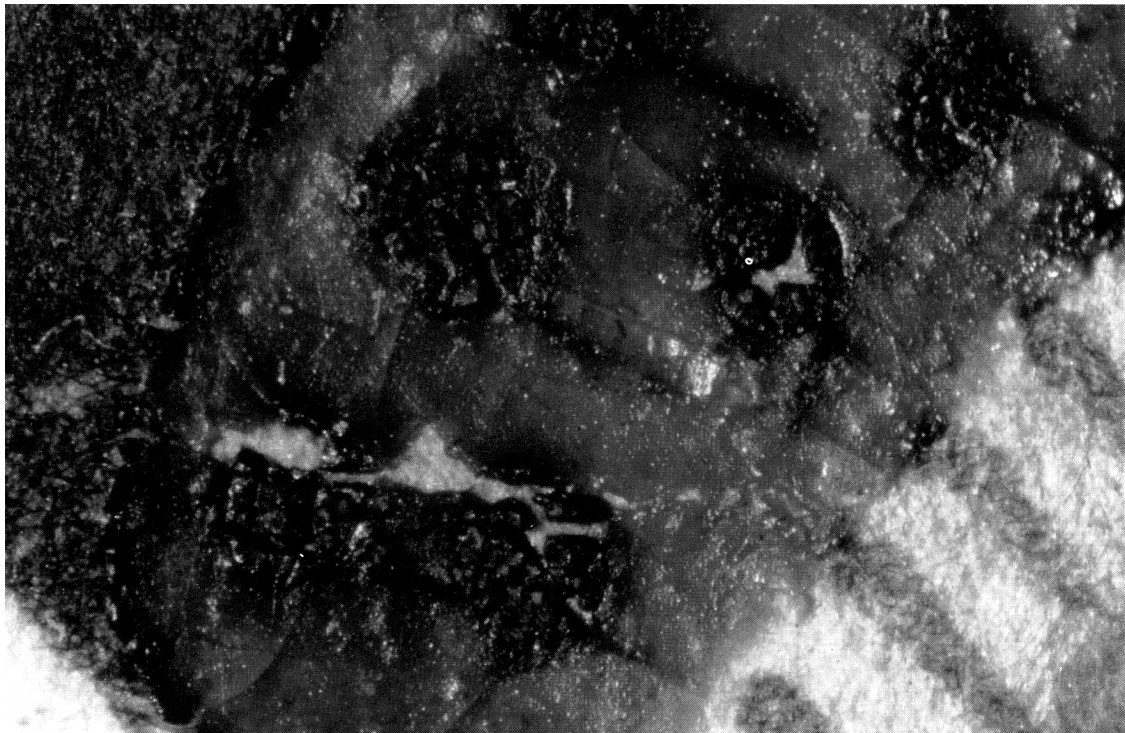


Fig. 7. A crackled gouache painting consolidated with ultrasonic mist/gelatin. After treatment. Microphoto by Holly Moxson

3. When the media is dry to the touch (through polyester web) remove the object from the suction table and continue drying between polyester web, blotters and felts, under light weight.

OR

4. After treatment, weight the edges and let the object stretch dry, without using suction.

D. Pull-through of the media:

1. Reduce the suction pressure using a dimmer on the vacuum pump.

2. Always check the blotter beneath the object for any signs of movement of the media.

3. Use polyester web between the reverse of the object and the blotter to slow down "wicking" into dry blotter.

Other advice I can offer is:

1. Always support the object on polyester web and blotter when using the suction table.

2. Spraying chemicals (such as deacidification sprays) or drawing resinous discoloration products directly into the suction table surface can clog the screen. If chemicals or stain remains in the screen it could wick back up into a succeeding object.

When a blotter is used between the object and the suction table top the stain or chemical is drawn into the blotter. Constant checking during treatment tells when to remove the dirty blotter for a clean one. Once there is no more staining visible in the blotter the treatment can be stopped. One of the advantages of using the suction table is that the conservator can so easily detect when a treatment should be stopped.

3. When flattening on the suction table the edges should be weighted. The edges dry out first and pull away from the surface if not weighted.

4. When stretch drying with weighted edges, just as it is with stretch drying on a drying panel, if the paper has expanded greatly it may be necessary to release the edges and even shut off the suction table for a second to allow the paper to contract. This avoids the danger of the paper splitting. Then the weights can be replaced on the edges. After flattening of the paper has been achieved with the suction table the vacuum can be turned off and the object allowed to dry, in place on the suction table without any further release of the edge weights, for an extended period of time, in the closed moisture chamber until the RH inside the chamber is the same as the room RH.

Hopefully, these techniques will help to make treatment of these delicate objects "safer" although not necessarily "quicker".

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3. Museum Services Corp., 4216 Howard Ave., Kensington, MD 20895.
4. Weidner, M.K. "Water Treatments and Their Uses Within a Moisture Chamber on the suction table", *Preprints*, proceedings of the A.I.C. Annual Meeting, Washington, D.C., May 1985, pp. 127TM 140.
5. Weidner, M.K. and Shannon Zachary. "The System: Moisture Chamber/Suction Table/Ultrasonic Humidifier/Air Filter", Unpublished.
6. Michalski, Stefan and Carole Dignard. "A New Method of Consolidating Powdery Paint: The Ultrasonic Mist". Unpublished.
7. Caldararo, Niccolo. "Effects of Ultrasonic on the Humidification of Paper". *AIC Book and Paper Annual*, 1992.
8. Preservation Pencil. *Archival Quality Materials*, University Products, Inc., 517 Main St., P.O. Box 101, Holyoke, MA 01041-0101.
9. Weidner Sources of Equipment and Supplies (See diagrams in Figures 3, 4 and 5):

APPARATUS (As developed by Marilyn Weidner)

- A. **Moisture chamber.** Built by Roswell Weidner.
- B. Suction table. Built by Franklin Shores.
- C. Spot suction table. Built by Roswell Weidner.
- D. Suction Plate for spot suction table. Built by Stefan Michalski.
- E. Wet/dry vacuum. Kent Industrial Wet/Dry Vacuum, Model #Kt-100, 115 Volts, Hertz 60, Ampt. 7.4, PH1, Serial #22809, The Kent Co., Elkart, Ind.
- F. Dimmer 15-A. Purchased from National Hardware Co., Phila., PA.
- G. Ultrasonic humidifier. Corona Ultrasonic Humidifier Model UF-40 & UF-30. Purchased from Brookstone, King of Prussia, PA.
- H. Compressor. Badger Model 180-II, Diaphragm Type Air Compressor. Purchased from Charette Art Supply, Phila., PA.
- I. Pressure Regulator. Badger Piggy-back/Filter Regulator #50-054. Purchased from Charette Art Supply.
- J. Explosion-proof exhaust fan. Purchased from Lab. Safety Supply, Janesville, WI.
- K. Aquarium air pump. Purchased from a pet store.

CONNECTOR TUBES AND ACCESSORIES

1. Clear rigid PVC pipe. Excelon-R-4000, Item #4307, 1 1/2". Purchased from New Age Industries, Willow

Grove, PA.

2. Air filter. Automobile carburetor filter. Purchased from Pep Boys, Phila., PA.
3. Flexible PVC ducting (for solvent extraction). Purchased from Lab Safety Supply, Cat. #QB-5768.
4. Flexible wet/dry vacuum hose. Purchased with vacuum.
5. Nalgene (2006 Series) narrow mouth bottle. Purchased from Thomas Scientific, Cat. #1708-H40-250ml.
6. Clamp. Purchased from Thomas Scientific, Cat. #2831-D70.
7. Support stand. Purchased from Thomas Scientific, enameled steel base, Cat. #8835-B50 series.
8. Clear, flexible, plastic tube (for water and/or water gelatin mist). Purchased from plastics supply company, Phila., PA.
9. Plastic tip. Received from S. Michalski but similar to pipette tips from Thomas Scientific, Cat. #7740.
10. Clear, flexible, plastic tube (for air). Purchased from plastics supply company, Phila., PA.
11. Hole in plastic for #9.

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