STEPHANIE WATKINS

# Practical Considerations for Humidifying and Flattening Paper

ABSTRACT

Relaxing and flattening papers are routine conservation treatments. The goals are to introduce and remove moisture using rates and techniques safe for the items. The humidification methods overviewed include chamber, ultrasonic, damp blotter, Gore-Tex and Teflon packs, mist or spray, and local application. The flattening methods overviewed include air dry and double-screens, blotter and felt stacks, friction mounts, presses including heat, drying screens, Dutch strainer, and vacuum-suction table. A few procedures are illustrated with hand-drawn diagrams. Issues specific to archives, library, and manuscript collections are discussed. A brief, select bibliography is included. This paper developed out of an informal presentation by the author given at the Archives Conservators Discussion Group (ACDG) session of the 30th Annual Meeting of the American Institute for Conservation (AIC) in Miami, Florida, in June 2002.

Conservators and technicians decide two basic things when humidifying and flattening paper materials: (1) How to introduce moisture to relax the paper support and at what rate, and (2) How to remove the moisture from the item and at what rate. The methods used to achieve the desired goal will be determined by the sensitivity of the media, aesthetic of the item, type of item and intent of collection mission, the available resources, and experience of the practitioner. The concepts behind the procedures are important, not whether a specific tool is available. Procedures may need to be repeated or combined for best results. As variations on the methods to humidify and fla t-ten are considered, the ultimate goal is safe processing of cultural and artistic heritage.

This overview developed from the discussion at the Archives Conservators Discussion Group at the 30th Annual Meeting of the American Institute for Conservation in Miami, Florida, June 2002. Possible methods and considerations for approaching humidification and flattening of paper materials will be mentioned, but this overview is not intended to be an instruction manual nor a minutes of the meeting. It will not cover all of the possible procedures, or many of the nuances inherent with the procedures.

## HUMIDIFICATION

The aim of humidification is to reintroduce moisture into the paper support to relax the fibers. There is a popular notion that if a paper is creased, folded, or curled, humidification must occur. To be certain, brittle papers need to have moisture reintroduced before physical manipulation can safely occur. For more robust materials, humidification is not always needed. Gravity and time, or pressure and time, can be as effective, depending on the relative humidity of the storage area. Curled paper that is sturdy can be hung from flat clips, such as paper-protected bull clips, and left over a short time to slowly uncurl (e.g. panoramas, large blueprints, etc.). Protect the items from dust and light exposure during this process as it may take several weeks.

However, humidification relaxes the paper in a faster manner and fibers are less likely to be stressed. Water is a tool and can be used in many forms (gas or liquid) and size (droplet, mist, or vapor). The amount of moisture used will vary on the type of paper and the ambient humidity in the room. Questions to ask before deciding the appropriate procedure might include: What are the risks of local versus overall humidification? What should the item look like in the end and how best to approach that goal? How much moisture should be introduced and what

An earlier and shorter version of this paper was presented as part of the Archives Conservators Discussion Group session on June 10, 2002, during the AIC 30th Annual Meeting, June 6–11, 2002, Miami, Florida.. Received for publication Fall 2002.

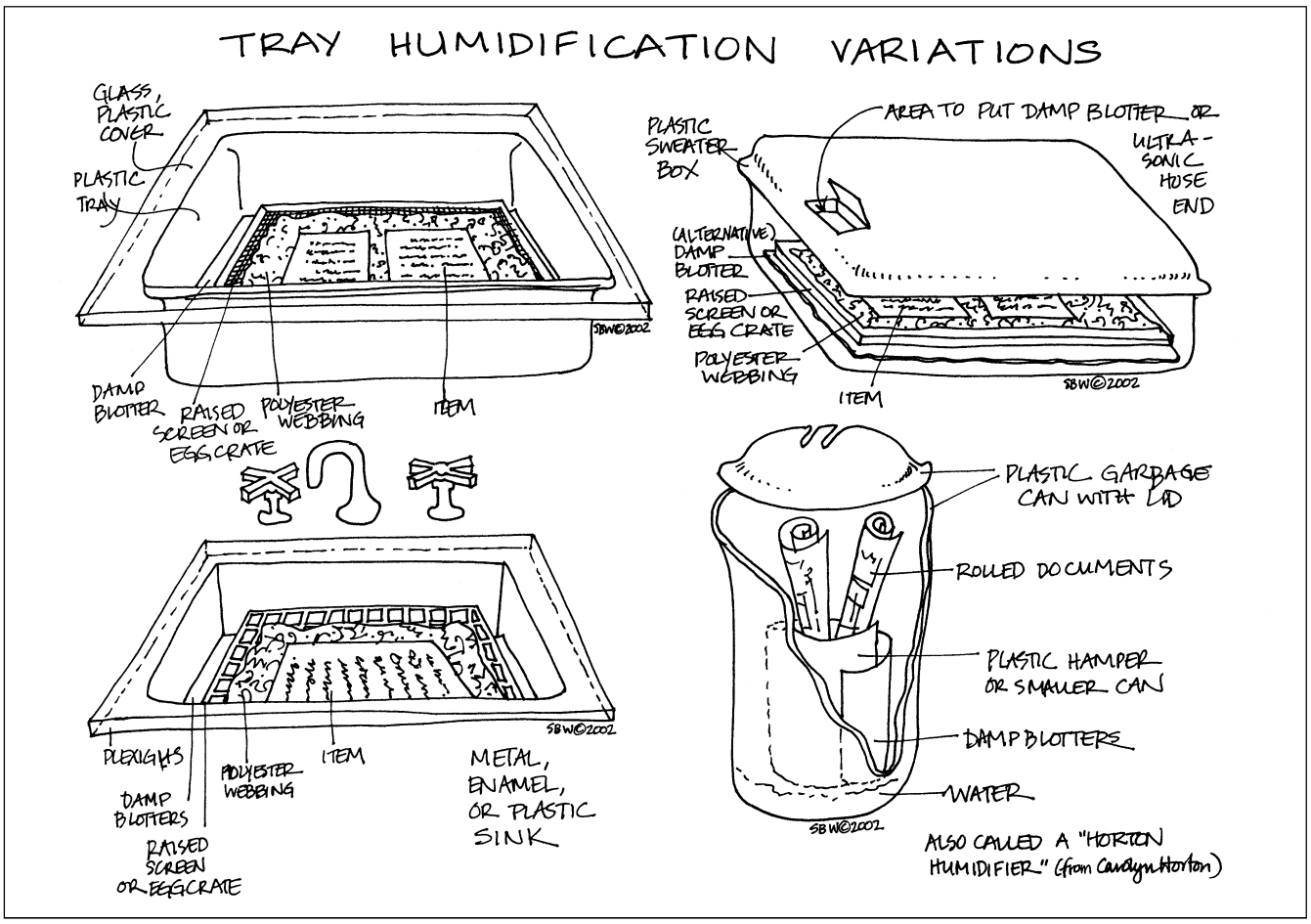


Fig. 1. Tray humidification variations

method should be used to introduce it? How damp does the item need to get for the desired procedure and how long should it be exposed to moisture to achieve that end safely?

A conservator's opinions are based on the information to which they have been exposed, empirical observation of different techniques and different kinds of papers gained through experience, and familiarity with local environmental conditions. Ambient relative humidity and temperature will influence the rate of humidification; a technique suitable for a tropical climate may not be as efficient in a cold damp climate or in an arid climate. Environmental controls (HVAC) systems may mitigate much of this concern, but not all conservation labs have the luxury of 100% efficient HVAC systems when they do exist. The humidification technique chosen may put the item at risk for mold growth or physical stress, resulting from too much moisture too quickly or insufficient moisture distribution. Adjustments need to be made as appropriate to the aim of humidification, the local climate, the resources available, the vagaries of the item, and skill of the practitioner.

## VARIOUS HUMIDIFICATION METHODS

### Chamber (Gas) in a Small Tray, Rack, Room (fig.1)

Creating a chamber to contain gas is a very common and safe way to introduce moisture into a paper item. The temperature of the base water can vary (cold, room temperature, hot). Hot water humidification (steam) goes much faster, but can be riskier than cooler water temperatures (vapor) to potential movement of material within the paper and softening of media. Room temperature/cool water chambers are less likely than hot water chambers to form condensation on the chamber's cover. Slower humidification can penetrate more evenly for some types of papers, such as heavyweight, multi-ply ones. If a taut window screen or egg-crate is not available to separate the item in a tray from the water during humidification, a barrier sheet of poly (ethylene terephthalate) film (Mylar Type D or similar) can be used on top of a blotter stack for short humidification sessions.

Damp blotters placed in the bottom of a tray can contain the water and reduce potential damage from moving water if bumped. Some conservators fear mold growth in blot-

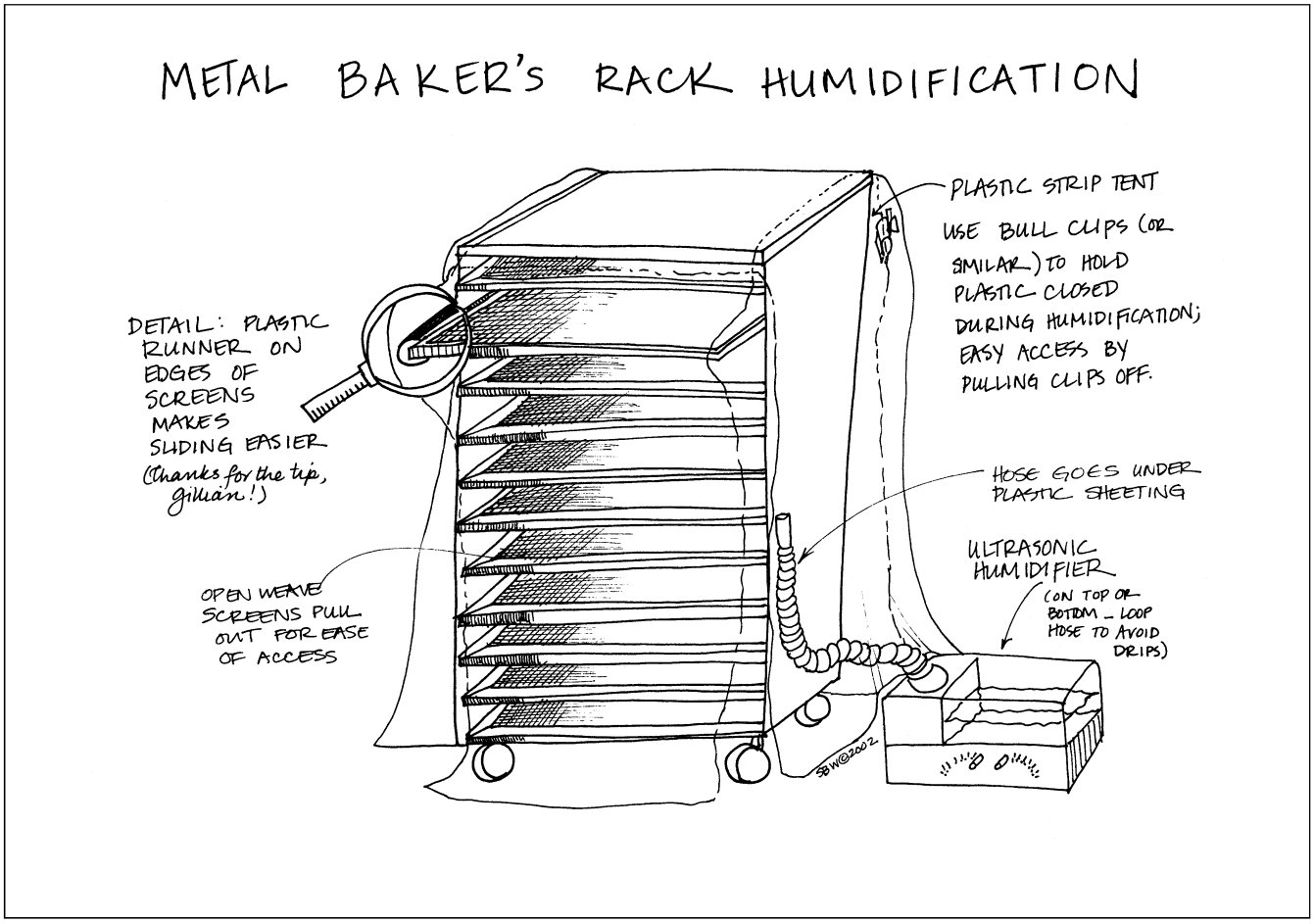


Fig. 2. Metal baker's rack humidification

ters, so prefer to use freestanding water in the bottom of the tray or tub. Others combat a mold threat with the addition of fungicides and chemicals, such as thymol and ortho-phenyl phenol. These chemicals are not benign. They pose a significant health risk to the practitioner and detrimental effects to many types of materials.

A method commonly described and illustrated is for on-site humidification utilizing a lidded plastic garbage can or a shallow, lidded plastic container designed for clothes storage (such as for sweaters). This method was popularized by Carolyn Horton and is referred to as the "Horton Humidifier" on occasion. If this method is used, it is imperative to identify the unit as exclusive for humidific a-tion. As it utilizes a trashcan/bin, unidentified cans/bins will be used as trash receptacles by unsuspecting souls. Creating a humidity chamber in a room or closet takes much longer to raise the humidity level. However, for large batch projects, a dedicated humidity room can help increase work flow by increasing the number of possible materials being humidified and flattened within the conditioned environment at one time.

Ultrasonic (Vapor/Small Gas) (fig. 2)

Introduced to conservation in the 1980s, ultrasonic vapor machines produce cool, small (vapor sized) droplets. The machines are easy to maintain and adapt for use in humidification systems. Humidification with ultrasonic vapor is good for sensitive media as the vapor can slowly penetrate and can quickly evaporate. The machines can be used in combination with a chamber or an enclosed multiple rack system. The machines can take a few minutes to generate the vapor. Droplets can form along the nozzle of an attached hose or other opening of the machine. Use of a ribbed hose, creating a down loop in the hose, and pumping the vapor up rather than down can reduce accidental water spotting onto materials. When using a rack system, items farthest from the ultrasonic source will be less humidified than the items closest to the spout end. A tip of appropriate size can be fabricated out of glass, syringe, blotter, or plastic hose connectors (such as a barbed coupler) if local humidification is desired. The machine should be emptied of water after each use. Do not use industrial cleaners to clean the interior. Potentially, residuals from the cleaner deposit in the plastic, then are

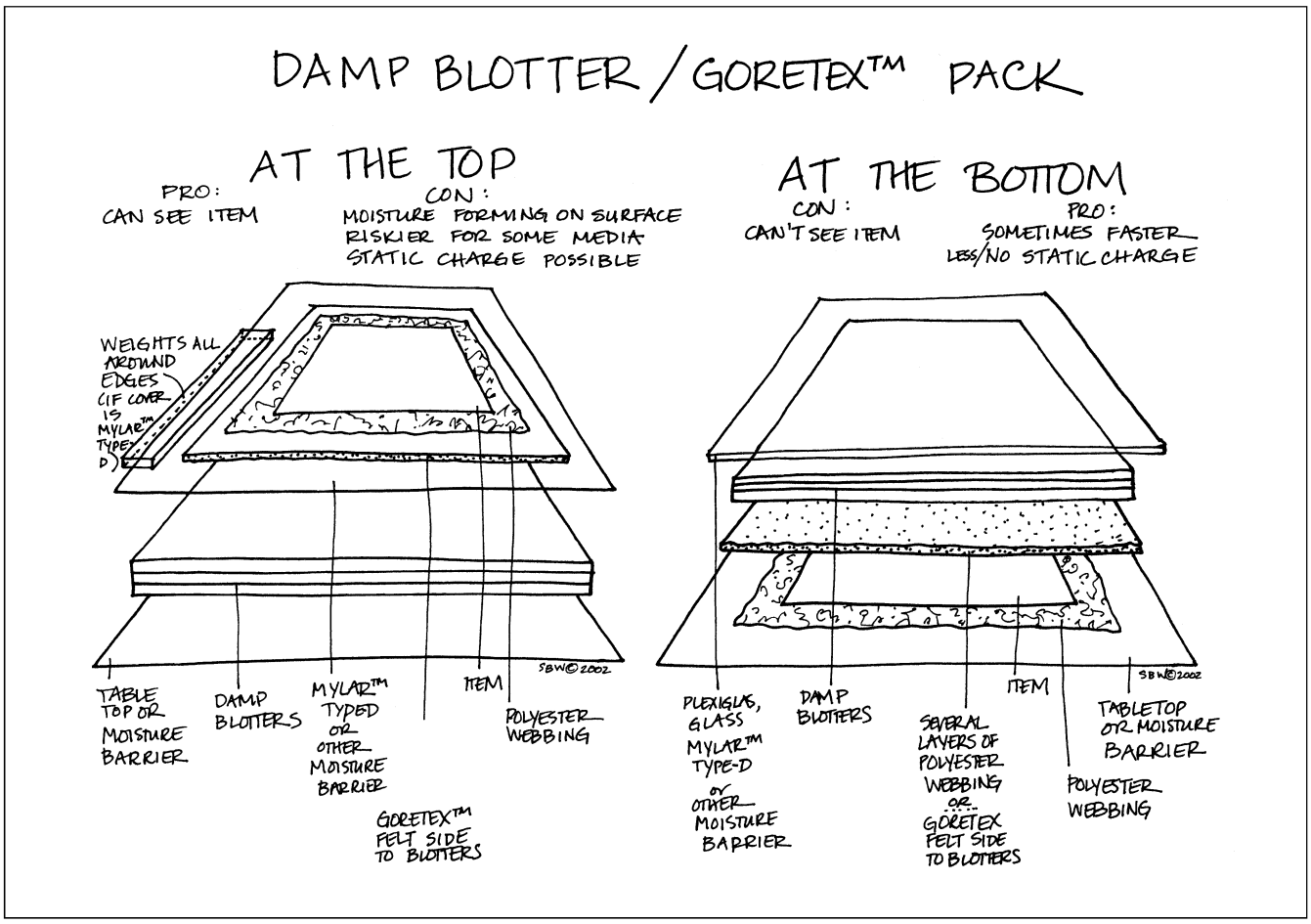


Fig. 3. Damp blotter/Gore-Tex pack

vaporized into the air, breathed by the operator, and settled on or penetrate into the document.

Damp Blotter Pack (Contact, Liquid) (fig. 3)

A damp blotter pack slowly humidifies supports from moistened blotters placed above and sometimes below the item. Damp blotter packs pre-date Gore-Tex felt use. Multiple layers of polyester webbing between the items and damp blotters reduces the possibility of tidelines forming from water in the blotters, but irregular expansion of the sheet and media moving is still a risk. The advantage over a humidification chamber is the ability to maintain a high level of humidity or dampness in a particular area while another part of the document is not being humidified. This can offer a prolonged working time for softening adhesives and supports. For example, when doing a backing removal, an adhesive can be kept moist at one end of an item while a backing is removed from the other end. Benefits include shorter time span for relaxation of paper than Gore-Tex and use of inexpensive, on hand, reusable supplies.

Gore-Tex (felts), (Contact, Vapor/Gas) (fig. 3)

Introduced to conservation in the late 1980s, Gore-Tex felts are used similarly to a damp blotter stack. Gore-Tex, poly (tetrafluoro ethylene), is manufactured in a variety of ways including threads, smooth sheets (membrane), and membrane backed felts. Gore-Tex felt is expensive to purchase and may be difficult to find as conflicting reports periodically surface regarding continuing manufacture or discontinuance. Subsequently, Tyvek (spun-bonded poly (olefin), high density poly (ethylene)) has been used as a cheaper, durable, reusable, readily available alternative to Gore-Tex. Water can be sprayed directly onto the Gore-Tex felt side or introduced with dampened blotters. The smooth membrane side generally goes next to the paper and must be kept wrinkle and crease free for optimum use. Gore-Tex should be used in a continuous sheet that is larger than the item (for overall humidification) and larger than the area (for local humidification). Items humidified with Gore-Tex must be pressed immediately as the moisture evaporates quickly. Items are most effectively humidifie d when in contact with Gore-Tex; therefore, other humidification methods can be better options for items that are

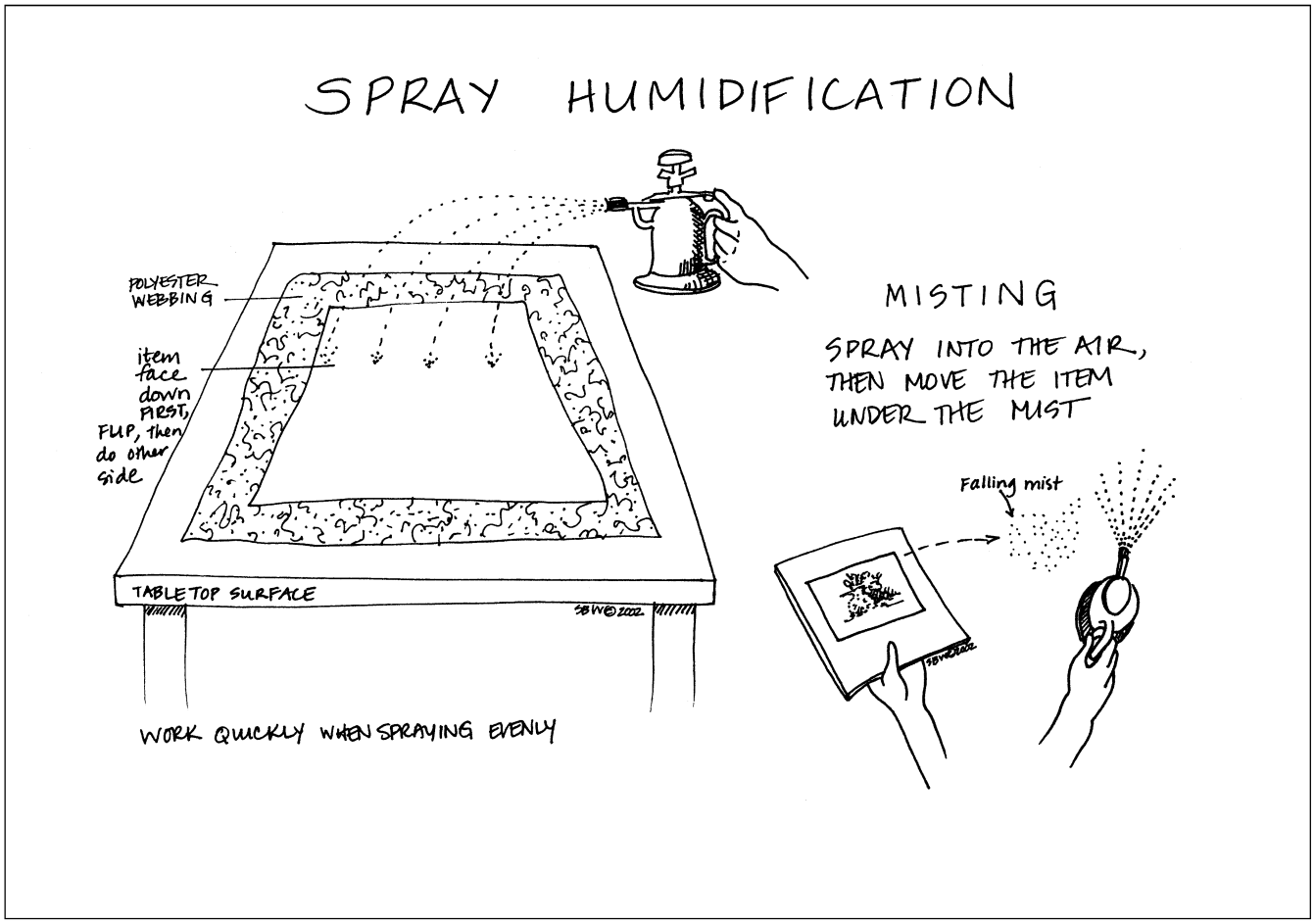


Fig. 4. Spray humidification

stiffly distorted or need humidification for unrolling (although Gore-Tex can be wrapped around the roll.) Repeated humidification attempts are likely to be necessary for stiff items when this method is chosen.

Mist or Spray (Liquid) (fig. 4)

Humidifying with mist or spray is a fast, direct method of humidification. The suitability of practical use is dependent on the quality of the sprayer and the sensitivity (knowledge and experience) of the practitioner. Larger droplets are possible than with gaseous methods. Many beginners either over- or under-wet the material through this method. Some are taught to mist the air and move the supported item into the mist. Others are taught to mist the item directly while supported on a table beginning with the back and doing both sides. For batch treatments, mist application can become unnecessarily time consuming. Too strong of a spray, or applied too close, or at a directed angle can move media. Too light of an application can cause uneven expansion and contraction. Ethanol and water-ethanol mixes are sometimes used, but the reason for use should be considered before routine application. Ethanol, isopropanol, and 2-propanol can penetrate and wick water into paper faster than water can penetrate alone, but these polar solvents can also more easily move media and paper components including discoloration that water alone might not disturb. However, some media and coatings respond favorably to alcohols.

Local, Direct Application with Brushes and Swabs (Liquid)

Water on a small brush or cotton swab applied locally along a fold or crease line can easily humidify paper to relax it. Use of a damp brush, such as a Japanese *Mizubaki*, is traditional for humidification of paper. Damp blotters, small sponges, and small sponge brushes such as "postal stamp dampeners" or "brush pencils" have also been used for locally humidifying paper. As with other local humidi fication technique where the item comes in direct contact with water, tidelines may occur. Observation under a long-wave ultraviolet source after application can often distinguish where local applications occurred (Eusman 1995). Remember to wear appropriate eyewear protection and avoid looking at the source of the light.

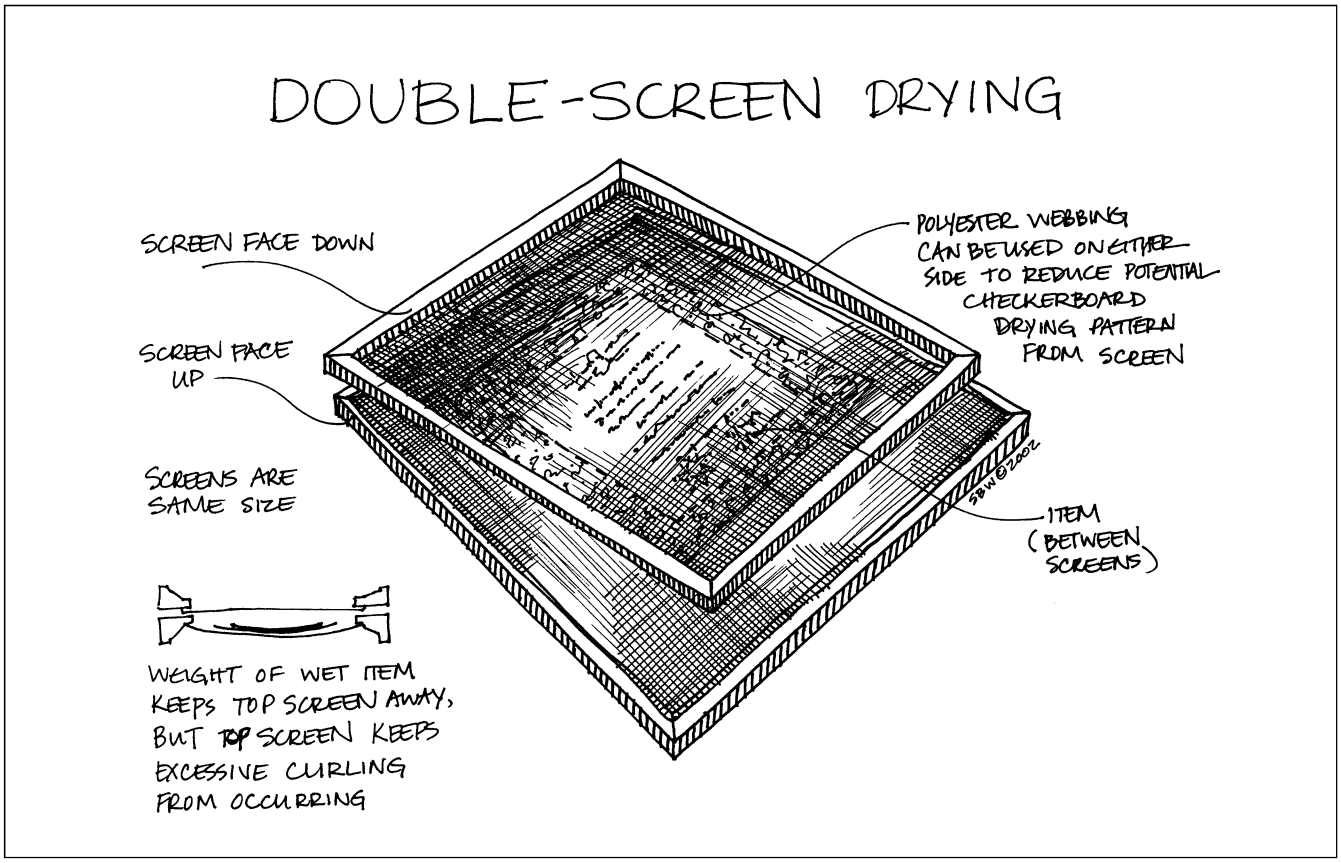


Fig. 5. Double-screen drying

## DRYING, PRESSING, AND FLATTENING

The aim of flattening is to return the paper to planarity. Moisture introduced from humidification is reduced during this process. Just as humidification is sometimes unnecessary, so is flattening. Storage in a folder may be suitable for items in an archives or manuscript collection when the end use of that item is not impeded by slight undulations and creases. If the item is more informational than aesthetic or when the risk of abrasion or loss of information is negligible, time may be better spent on other preservation activities.

When needed, drying, flattening, pressing, and stretching can be more challenging than determining how to humidify an item. Potential questions to ask include what drying method will retain paper integrity and aesthetic concerns? What method may return it to the dimension it started before expansion from humidification? What is the media sensitivity? At what rate should it dry? To what degree can the rate be controlled within the method chosen? How much stretching can this historic item withstand?

## VARIOUS DRYING, PRESSING, AND FLATTENING METHODS

### Orientation of Item

The orientation of items while drying directly impacts results. Any residual discoloration that might have moved in humidification is more likely to form on the side facing up during drying. Therefore, media permitting, some conservators like to place the item face down during drying.

### Air-Dry

An obvious method for drying wet or damp items it to let water evaporate, or air-dry. Taut, inert plastic screens meant for a rack or elevated off a tabletop make nice supports for smaller items while drying. Polyester webbing secondary supports can be very helpful when moving items from the humidified state to the screen. Items placed on polyester webbing to dry are less likely to form discoloration on the edges of the paper, as the discoloration is more likely to be drawn to the edges of the polyester webbing away from the paper. Formation of discoloration at the edges is more likely to occur as the dampness of the sheet increases. Use of polyester webbing also reduces the

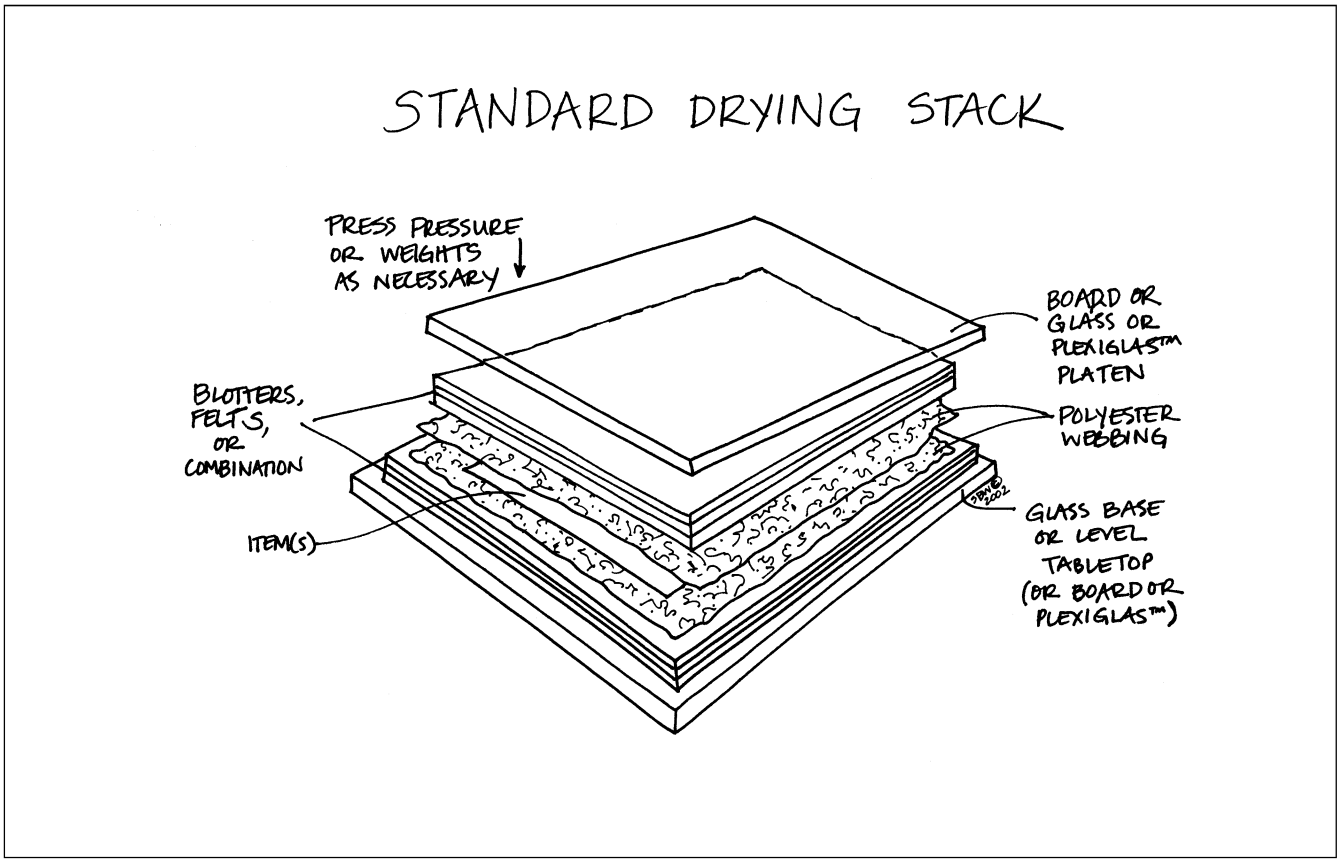


Fig. 6. Standard drying stack

chance of a regular screen or egg crate ghost pattern forming as the item dries.

Double-Screen (to Prevent Curling) (fig. 5)

The double-screen technique is helpful for items that are likely to curl upon drying. Place a screen upside down on top of a thin or very damp item meant to air-dry on a screen. The weight of the item on the screen will create a slight air gap. As the paper dries and curling is more likely, the screen on top will be a gentle restraint against the creation of undulations and curling. If media permits, use of polyester webbing on both sides of the document will reduce the likelihood of a screen pattern forming on the item. This technique can be helpful for lightweight papers or during treatments when a full flattening is not required.

Dry on Slant (on Glass, Plexiglas, on Screen)

Sometimes paper items become too wet for immediate flattening. Air-drying until dry and re-humidifying is one option. Another is to reduce the excessive dampness to an appropriate level of moisture, then flatten. Getting wet things to a damp state for drying in a press (without having to change out blotters) or air-dry on a screen (without puddles forming) can be accomplished by beginning to air-dry the paper on a low slanted (15° to 30° angle) glass, Plexiglas, or screen. Turning the item 180° half way through drying will even out the drying process within the paper. When the paper is in a "humidified" state rather than a damp state, the item is ready to be flattened. This technique is risky for papers with media that is swollen or might run or bleed during drying.

Blotting

Gently blotting the surface can quickly reduce excess moisture. However, care should be taken to ensure that the medium is not swollen or friable before placing something directly over it while wet or damp.

Blotter Stack (Blotters/Platens/Weights) (fig. 6)

Pressing items between blotters or felts (discussed later) is a traditional conservation method of flattening. Thickness varies in blotter manufacture as does sizing, thereby affecting the absorbency of moisture during drying. Photographic grade or water-weight blotters should not have optical brightening agents or other additives that will affect the original materials. Commercially available blotter paper may be sized with starch-based adhesive. This is not a concern usually, but should be considered

when flattening materials that are ultra-sensitive to shifts in pH. If so, a blotter with a synthetic alkyl dimer size may be safely used for flattening, or an alternative flattening method may be chosen. Supplies cut to standard sizes or to sizes appropriate to available boards, presses, tabletops, and the collection can be cost- and time-efficient.

Choose the type of blotter to meet the desired end result. For example, using thin blotters with the items against the screen (smooth) side, gives a nice crisp flatness to machine-made, late nineteenth, twentieth, and twenty-first-century papers. Heavyweight, soft felted blotters are wonderful for flattening rag cotton/linen western papers, and papers with letterpress, slight embossings, and plate marks.

Smooth polyester webbing (Holytex, Reemay, Cerex, etc.) without creases, folds, and burrs is best to use when flattening. Many different kinds of paper will easily mimic the support beneath or on top of it during the drying process and can pick up creases from the polyester webbing. Be kind to your flattening supplies, especially the polyester webbing, and it will be good to your documents. Likewise, keep up with housekeeping in the work area as dust can interfere with a good flattening result as well.

Another discussion point is the changing of blotters during the drying process. Some conservators maintain that changing blotters is necessary and stress a precise timetable for this. Other conservators strongly feel that the drying stack not be compromised during the drying process. A related consideration is the length of time of flattening. Some conservators humidify in the morning, and flatten in the afternoon, removing the material the next day. Other conservators leave items in blotter stacks for several days, weeks, or months. How long items are left in a pressing stack as well as changing the blotters may be determined through consideration of many issues including how crumpled, creased or curled the items began, the type of paper, how much moisture was introduced, the size and thickness of the items, the number of items in the stack, the height of the stack, the thickness and layers of blotters and boards, use (or non-use) of polyester webbing materials, air exchange frequency, and temperature and humidity of the air, and the desired, final appearance of the items in question.

Lighter applications of weight should be chosen for papers with letterpress printing or embossing, as the textural quality of these elements can be pressed out with too much pressure. How to determine exactly how much pounds per square inch (psi) to apply is seldom discussed. Weights located at the perimeter of glass or Plexiglas rather than in the center will give even pressure. Some conservators feel that weights are not appropriate at all, believing it is the planarity of the platen and the length of time that creates flattening of the paper.

### Use of Mat board, Corrugated Boards (Printer's Method) (fig. 7)

A variation on the use of blotters is the use of mat board and corrugated boards in a drying stack. Smooth 2-, 4-, 6- or 8-ply mat boards can be used between blotters or against the item in a stack to help absorb moisture or create a more rigid stack as needed. Likewise, corrugated boards cut with the holes on the longest exposed edge, can help air to move through, thus speeding up drying in a stack. These techniques were adapted from the procedures of commercial printers. Commercial printers and allied industries also use pulled vacuum and blown-forced air techniques for drying papers. The pulled vacuum works on the principle that a vacuum creates an anaerobic consistent pounds/grams per square inch/centimeter of pressure. Blown-forced air works on the principle that drying will occur faster with increased air circulation. Temperature will drop with fan use, of course; so heated air can be incorporated with this method. Both approaches are theoretically less likely to create mold-favorable situations.

### Felts

Drying between felts is a tradition in paper manufacture. Felts can be made of cotton, wool, and synthetics, but wool and cotton are preferred. Different kinds of felts can have different surfaces, thickness and weights. Felts are often avoided in humid climates because of the threat of mold growth within the felts, as items placed in felts can take longer to dry than in a blotter stack. Adjusting internal building environmental controls to reduce humidity and placing only damp items, instead of wet ones, can mitigate this risk, however. Felts can be used in conjunction with blotters. Items that expand greatly may benefit from slow, controlled drying that is possible in a felt stack. Felt stacks can be preferred when flattening a rag paper, a textured sheet, or when retention of letterpress printing or a plate or embossed mark is of concern.

### Cotton Looped Towels or Blankets and Cloth

Thinner papers can be air-dried by smoothing out on top of a looped, cotton towel. The nubs will grab onto the paper while drying, helping it to dry planar with little tension. This method works best if the support is very damp.

### Plate-Mark, Seals, and Paper Attachment Protection

Items that need to be flattened but have three-dimensional components require special attention. Template or spacer collars fitting the plate-mark can be torn out of blotters to accommodate the added thickness. Likewise, wax and paper seals, paper attachments, and embossments can be accommodated by torn holes in as many blotters as necessary to create the appropriate depth. Tearing provides a soft transition versus cutting that gives a sharp edge. Care should be taken when assembling the stack or thick felts

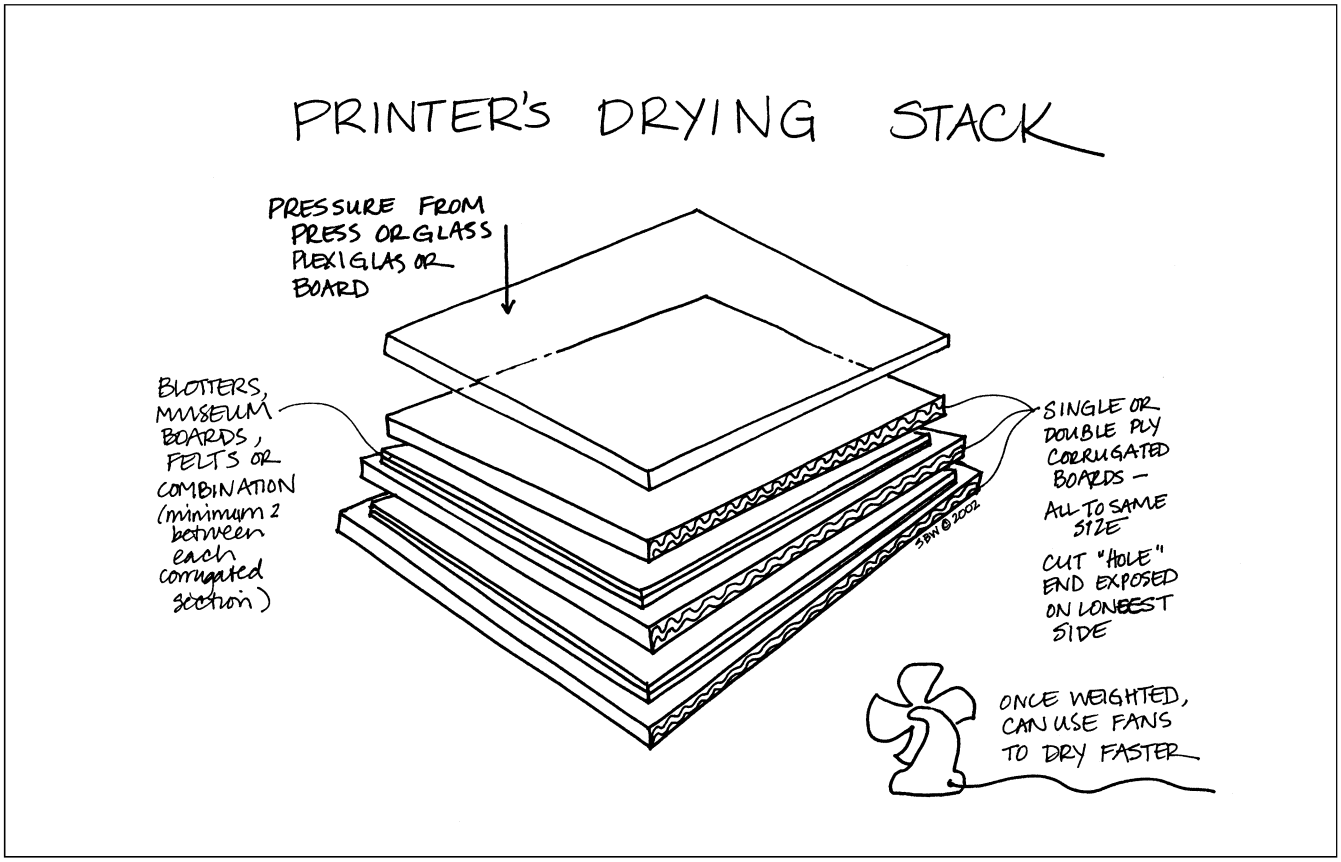


Fig. 7. Printer's drying stack

to ensure that the holes are placed appropriately. Tearing holes in blotters slows down the process of flattening significantly unless standardized hole sizes can be determined for the collection in question for multiple uses of the blotters.

Friction Mounting (fig. 8)

Friction mounting is an adaptation of traditional Japanese scroll mounting techniques. The late Keiko Mizushima Keyes introduced it into western paper conservation practice in the early 1980s. Friction mounting can effectively flatten problematic, thin papers such as eastern papers, tracing papers, onionskin, and gossamer type papers. With two larger sheets of heavier paper on either side, the item is flattened as part of a larger, heavier paper that is less likely to curl or undulate upon drying. Friction mounts can be done with adhesive around the border and air dried, or fiber-to-fiber bonds generated around the border, then put in a blotter stack or nipped in a press with light weight (Keyes 1984).

Press (Nipping)

A fast, easy method for flattening is to adapt a large book press into service as a blotter stack with boards on either side. Use of a book press can "set" a flattening of paper, vellum and parchment. It can give a wood pulp paper (late twentieth/early twenty- first century) a desirable smooth, "crisp" surface. To "nip," the book press screw is spun until it stops and then the screw pressure released a bit. The screw is not tightened down, but pressure of a nipping varies with the person spinning the screw. Some argue that weight is not needed at all to get a suitable flattening result. Over-flattening, reducing the texture and other distinguishing features of the paper, can be easily achieved with this procedure! Therefore, sensitivity to the level of humidification of the item, weight of the stack, and pressure from the screw is necessary for controlling the results. Prints, posters, and drawings are often much larger than book presses. Attaching boards that extend out either end of the platen and screw base can extend size limitations. The longest dimension becomes the shortest side, but predictably, the extended ends can receive less pressure than directly under the platen (depends on the ratio of the extension to the press size, weight of stack materials, and pressure from the screw).

Heat (Dry-Mount Press)

Dry-mount presses have been used on the lowest temperature levels to flatten paper by releasing the inherent water in a sheet of paper to humidify and flatten it. Clean,

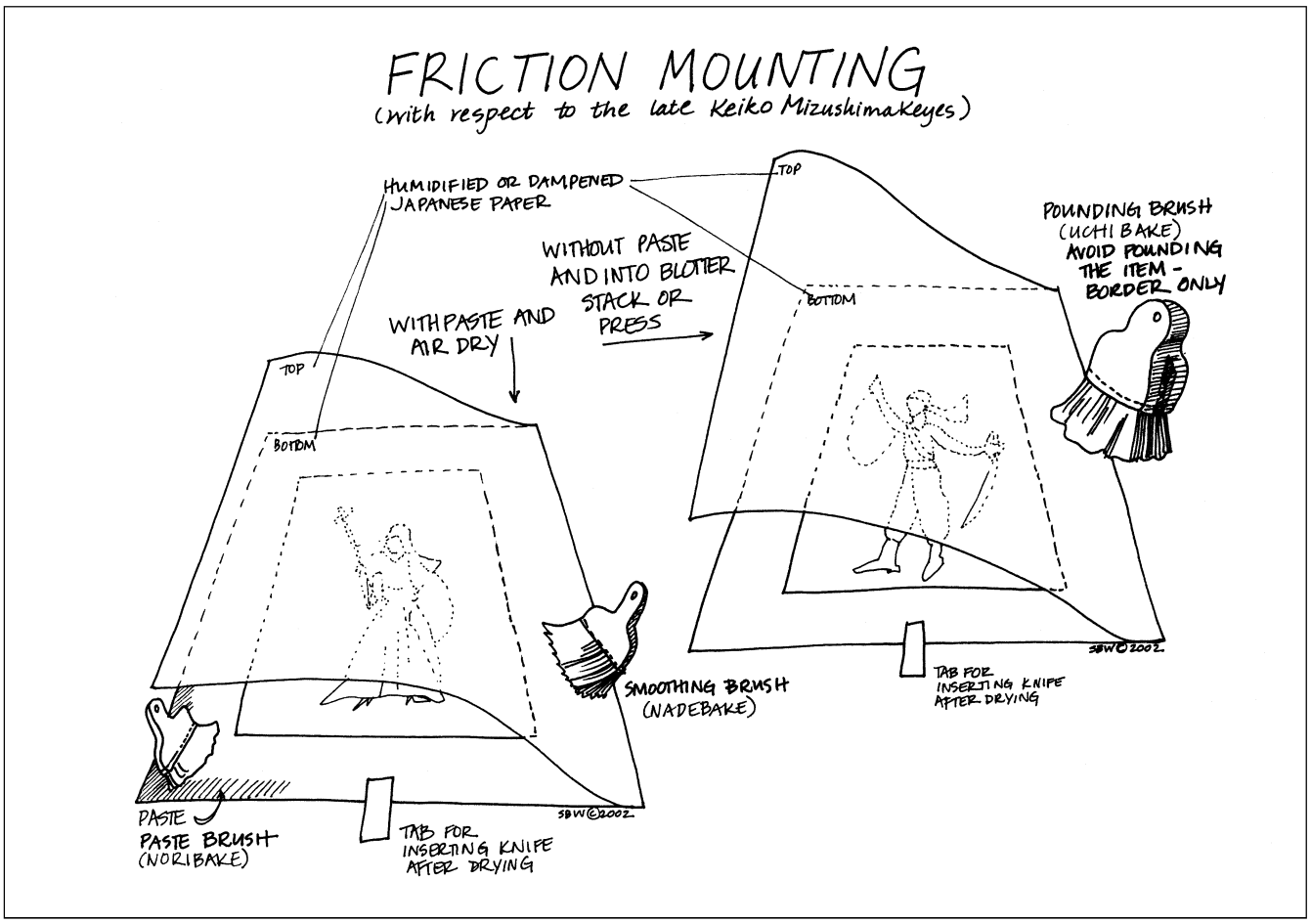


Fig. 8. Friction mounting

smooth (crease-free), release paper is necessary as is a long, cool dwell time for flat results. If done improperly, damage can occur from heating, creasing, and differential expansion. Problems with this method include potential decrease in life of items from use of heat, labor-intensive as only one to four sheets can be processed at a time, and expense of press and electricity. It can be an option for items that have moisture-sensitive coatings, media (such as highly water-sensitive dyes in inks, copy prints, or photostats), or paper fillers. Curved, very stiff, or distorted materials should not be flattened in this manner, as they will likely break under the weight of the press platen before flattening can proceed.

*Karibari* (Drying Board), Gatorboard, Stretch Mounting (figs. 9–10)

Use of drying boards, mounting wet paper onto paper and wood lattice boards, are a traditional Eastern method for drying. Wood boards are familiar to papermakers. The traditional Japanese board (*Karibari*) allows more airflow from both sides of the board, whereas use of Gatorboard as the drying board surface limits the drying to one side. Drying boards are portable, making this method easy to use in a small space or in a production routine. The tension produced from the mounted drying can cause ripping of weak areas within the paper, such as found in aged, short-fibered western papers that are already torn and discolored. Eastern papers respond well to this method, as can large items (Webber and Huxtable 1985; Nishio 1988.) Medium- and heavyweight papers with cloth and heavy paper backings respond well to stretching methods.

Plexiglas/Perspex (as Part of Lining Process [Dacron/Linen/Cotton])

This procedure usually follows a complete washing, but the use of a multi-layer cloth/paper backing/lining system is also a method to flatten through stretching. Like the Gatorboard, and *Karibari*, multiple items can be put on one board. After drying horizontally overnight, the Plexiglas can be stored in an upright position for a few weeks while drying is completed. Disadvantages are that items dry through the front (movement of discoloration could move to the front as with Gatorboard), and adhesive remains on the back of the backing material after mounting is com-

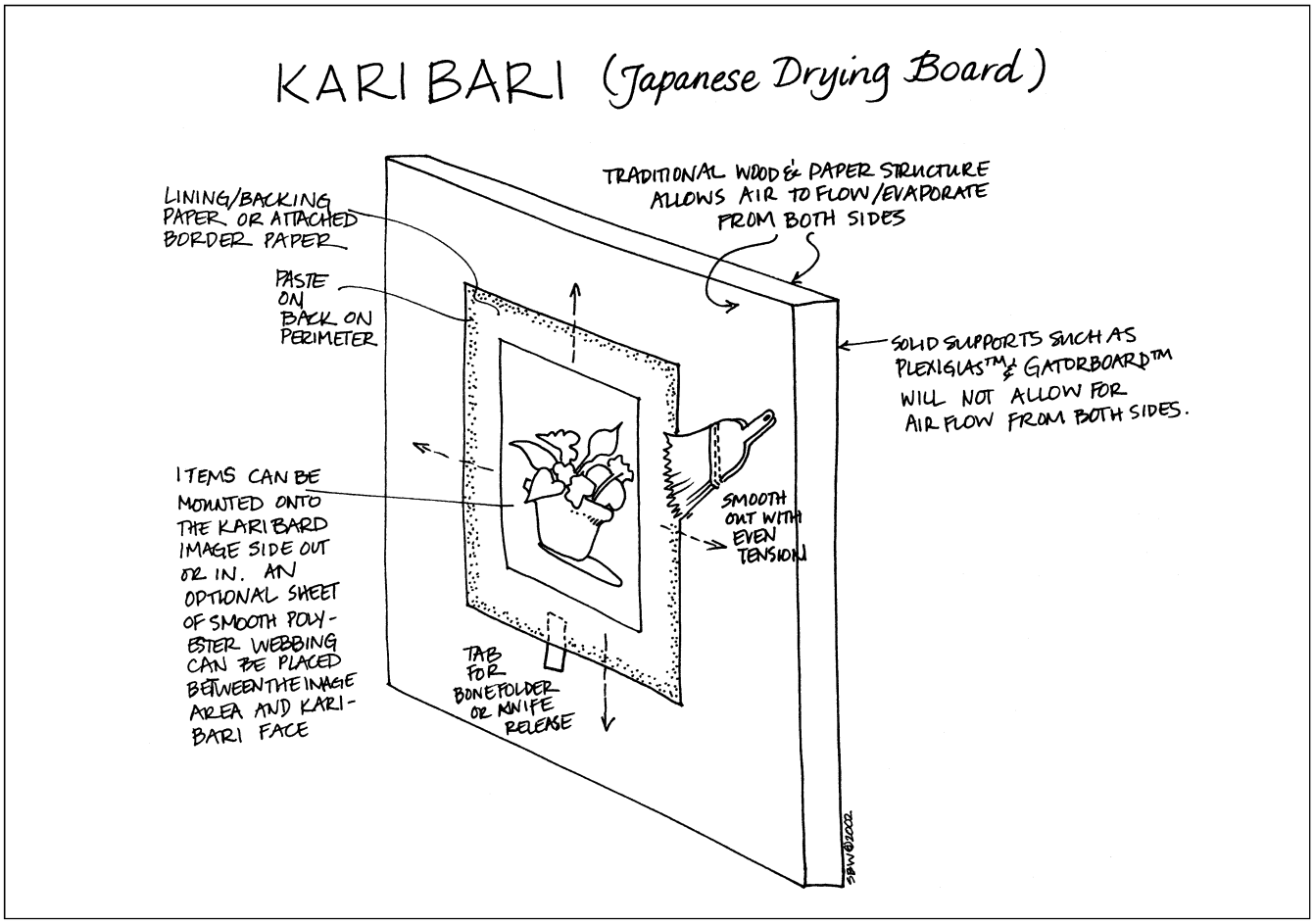


Fig. 9. Karibari (Japanese drying board)

plete. In addition, items are expanded under stress while drying that can lead to curling or tearing upon release from the rigid Plexiglas support (Albright and McKlintock 1982).

"Dutch Strainer," Stretch Mounting (fig.11)

The "Dutch strainer" technique is used in paintings conservation and utilizes a wooden stretcher or strainer as a frame to support an item. Strips must be adhered along the (usually back) sides, or the borders of a lining or backing can be used if strong enough. The humidified item is placed evenly spaced and parallel to the wooden frame. The border or edge strip is then wrapped around the wooden supports and secured to it as evenly as possible to ensure equal pressure and thus, even flattening upon drying. This method is good for cloth mounted items, large items, items with sensitive media, or those that need stretching, not pressing, for drying. An assembly line approach can be done if the quantity is sufficient, but the method can be time-consuming for a few items.

Vacuum-Suction Table

Since the invention of the vacuum-suction table by Marilyn Weidner and Franklin Shores in the 1970s, practitioners have been finding more ways to utilize it. It is unknown how widespread the use of vacuum-suction tables is in drying sheets of paper. It can be beneficial for removing much of the moisture within a sheet of paper, for animal skins, or for items where flattening under a stack situation is inappropriate. However, it can dry things in an unnatural, expanded state and curling, distortion, and tearing can result. Also, drying individual sheets on the vacuum-suction table can be time-consuming for archival work. Machines can be expensive to purchase (less so if homemade construction) and cost of electricity should be considered (Weidner 1984, 1986).

## ISSUES SPECIFIC TO ARCHIVES, LIBRARY, AND MANUSCRIPT COLLECTIONS

Maintaining Order

Keeping track of the order can be time-consuming and frustrating for the conservation professional, but impera-

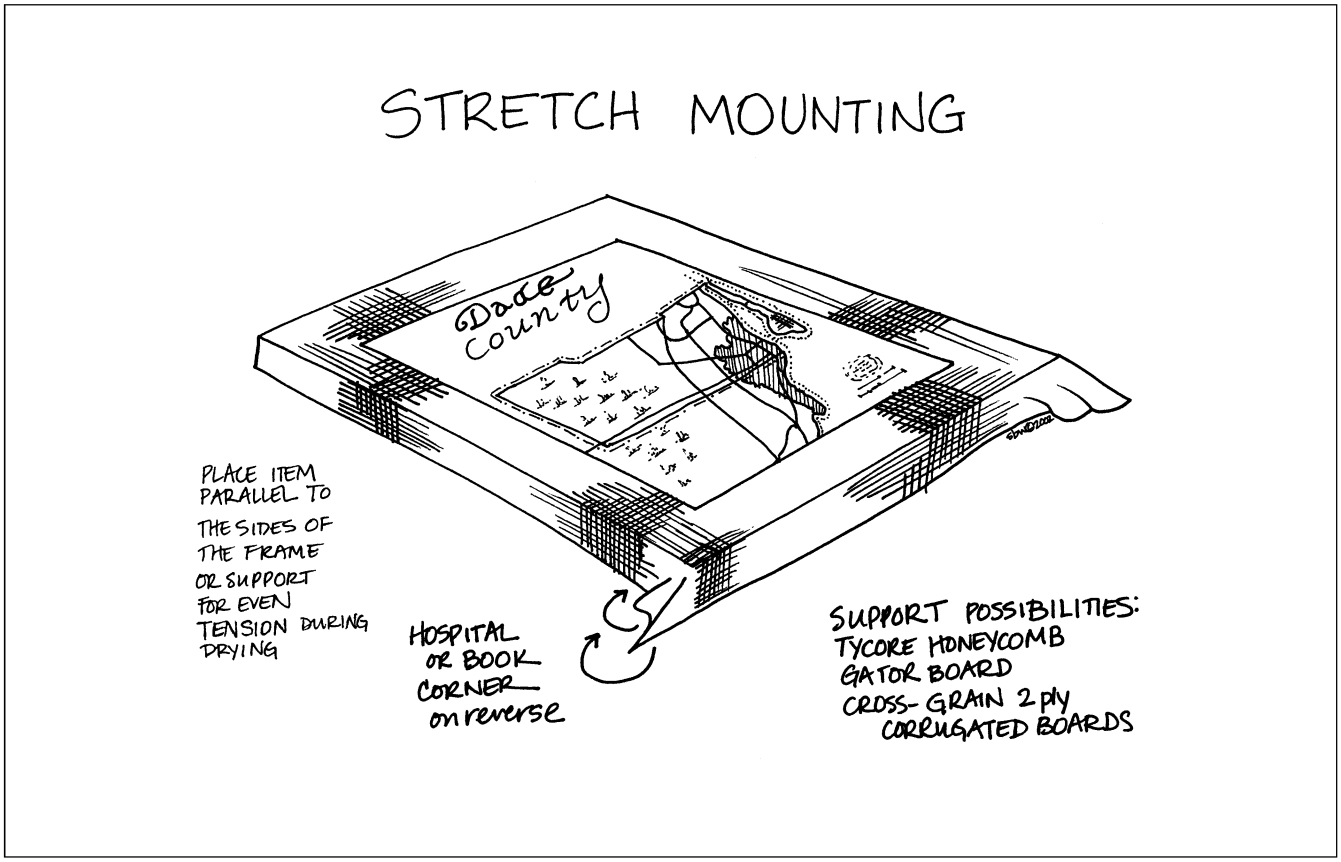


Fig. 10. Stretch mounting

tive. To maintain order during humidification and flattening, paginate (odd or even) or foliate the items before anything is done. For letters organized by dates, they can be relied upon only if all are dated. Check before starting. While working, tag or barcode each humidification screen, then carry this organizational scheme to the blotter stack. Remain consistent in the laying down of materials and get into a routine to reduce the likelihood of misplaced items or loss of order.

Media and Colored Papers, Methods of Testing (Solubility/Moisture Spot Tests)

There are numerous ways to test whether media or paper elements will move or be altered during a humidification and flattening procedure. Often referred to as solubility tests, procedures will vary and can indicate different conditions. Observing the rate of movement and circumstances for results can often lead to an appropriate humidification and flattening technique for each item, even for "soluble" media. Some of the various techniques include, but are not limited to use of a damp small round brush absorbed off; a miniscule dropper drop absorbed off or run through a vacuum-suction apparatus; a dampened miniscule (usually self-rolled) cotton swab that can be rolled or dabbed; or a small, dampened filter paper or blotter (gently pressed with a finger or use the corner to wick up the damp spot). These tests do not need to be conducted if gravity or other non-moisture, non-solvent methods are used.

Fe II Movement of Iron-Gall Ink (Iron Gallo-tannate)

Recent, ongoing research in the Netherlands suggests that because of the destructive internal chemical cycle between the ink and paper support that is generated, in part, by the presence of water, humidification should not be done to documents that have iron-gall ink. Full treatment including washing with alkaline reserve (for the paper) or no treatment is currently felt best. Other options may be possible in lieu of humidification, but at present are limited. Flattening without humidity or with very low humidity (despite the chemical reactions incurred) seems to be the most prudent, course of action for these materials at this time (Eusman et al. [2002]).

Copy-press Inks

Humidification can easily blur copy-press inks and they can transfer in a pressing situation. Consider using cold vapor or gas (very slightly!) for humidification and very smooth, thin polyester webbing when flattening, or use a dry-mount press. Localized, selective flattening and ten-

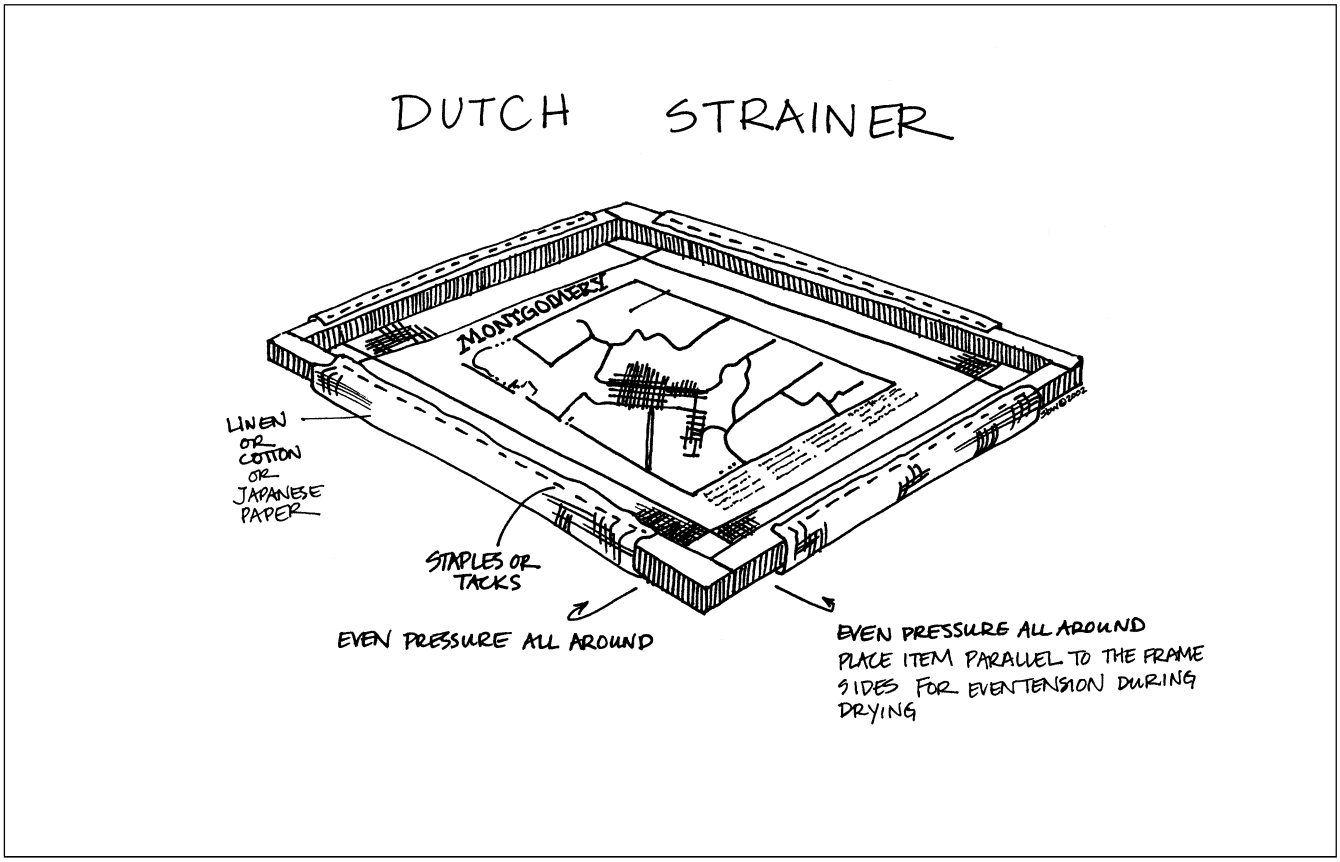


Fig. 11. Dutch strainer

sioning can be labor-intensive, but potential solutions for the most sensitive materials. Heat pressing can also be problematic, but must be assessed on an individual basis.

Surface Cleaning Prior to Humidification

Surface cleaning can reduce the need to replace polyester webbing and other supplies used in the humidification and flattening processes. For archives and library collections, clean the most dirty and sooty items during a batched humidification and flattening regime. The idea is to reduce the dirt or debris that might otherwise spread throughout the collection through item use or transfer (cross contaminate) during the humidification and flattening procedures. Dirty items can be potentially hazardous to patrons as well. More concentrated cleaning efforts will be required of items where the information is blocked by dirt. Ground poly (vinyl) erasers in shaker dispensers are very useful for this procedure. Cleaning with block erasers can be time consuming and over cleaning is easy. Architectural cleaning pads can be too abrasive and manufactured with inconsistent quality regarding eraser content. Smoke sponges are sometimes efficient, but can potentially be abrasive or leave a residue. For batch treatments, a three-sided tray made from a smooth material such as glassine, backing, or wrapping paper can be used to contain the crumbs and debris in one area. The paper tray can be easily dumped of its contents as needed. Poly (ethylene terephthalate) film (Mylar Type D) does not work well for the tray material because of its characteristic static charge. Large, soft haired brushes, like *Hake*, are useful for quick elimination of debris on the surface and key to reducing residual ground eraser crumbs from the surface (erase once, brush twice). Erasers and brushes are ineffective for soot or dirt that has been imbedded into the paper or present for a long time.

Mold-Damaged Papers

It is imperative to use a support of polyester webbing or paper when working with mold-weakened papers. Materials contaminated with mold should be aspirated in an isolated area and the working supports and housing materials discarded as cleaning proceeds to reduce cross-contamination of material. Vacuums with HEPA filters (e.g. Nilfisk, 3M Electronic) can be used to quickly reduce mold spores. Use a wide mesh screen to vacuum through to prevent loose pieces of paper from being dislodged by the force of the vacuum. There are still questions whether alcohol use is effective in causing dormancy of mold. Also, some stains can grow in alcohol. Remember to wear personal protection equipment. This is especially important if

money or resources are unavailable to have the specific mold type identified.

Many moldy materials will be semi-relaxed from weakness already and humidification and flattening may not be necessary. Mold-damaged materials can be humidified, but usually a much shorter time is necessary for the paper to become sufficiently relaxed prior to flattening. Pressing rather than stretching methods are generally recommended for mold-damaged items.

### Fasteners

If and how fasteners are removed from papers within a collection is dependent on the type of collection and condition of the fasteners and paper. Some archivists cut the paper in the area of the fasteners when located in the margin areas and the size of the sheet isn't essential for provenance. However, conservators may find this an extreme option and many cannot condone the practice. To retain the integrity of the item, fasteners can be removed with a microspatula by working to lift the metal away from the paper. Fasteners are removed from the back if removing a staple or from the front if removing a paperclip. Use of staple removers can be damaging because their sharp points can easily tear paper.

### Varnished Maps

Limited humidification in a chamber is often a preferred method for humidifying varnished maps, to try and avoid blooming of the coating from excess water. Some coatings can be reformed, but this procedure involves solvents (sometimes more than ethanol for shellac), takes time, can drive the varnish further into the paper, and isn't always even. If unrolling is the reason for a flattening request, on occasion gravity can be used when the original and backing materials are sufficiently strong enough. Let gravity work by attaching the item with multiple clips along a line (or wooden dowel) and hang in a darkened area protected from dust. This procedure can take several weeks.

### Lined Maps/Laminate Materials

Multiple laminate items can be very problematic to humidify and flatten as each layer can absorb moisture at different rates, expand differentially, or separate. Usually, much grief and lost time can be avoided by humidifying with a chamber (or Gore-Tex or Tyvek to unroll, then chamber) and choosing air-drying stretching versus flattening techniques.

### Panoramas/Oversized Items

Panoramas can be made of many materials, from architectural linens to heavyweight papers with synthetic additives. As they can be quite stiff and crack easily upon unrolling, repeated humidification is often necessary to safely unroll these. Use of continuous (not pieced), very smooth polyester webbing and large smooth blotters, such as from a roll, are helpful to obtain good results when pressing any type of panoramic or oversized item. If the item is larger than stock supplies, taping the backsides of blotters along the seams and staggering seam placement in the blotter stack can help to reduce potential creases when pressing. Stretching techniques (when condition of the items allows) can be easier than pressing methods and can take up less space.

### Blueprints (Cyanotypes)

Dr. Michael Ware's research (Ware 1998a; Ware1998b) into cyanotypes indicates that the amount of moisture used during humidification should be kept low. Cyanotypes can be very brittle by the time of treatment. Pressing, rather than stretching, is generally preferred for these items.

### Documentation Issues

Documentation of treatment can be potentially more time-consuming than the treatments in an archive collection. For tracking treatment procedures, documentation in a checklist format or generalized summary is efficient for large, batch treatments. For example, where it is important to know variations on the general procedure specific to individual items, a check list, whether on paper or in a database, will speed things along. For large groups of items where treatment procedures were not varied (such as with media testing, surface cleaning, and humidification and flattening), a general summary of the breadth of the collection treated and a count of how many items per day, month, or week can be easily kept for production statistics. There's also the anti-documentation approach, where it is not considered effective to document minor, routine procedures such as surface cleaning, humidification, and flattening. Some archives and libraries impose restrictions on conservation practitioners not to document in any way, feeling documentation an unnecessary luxury impeding production. Educating administrators slowly and politely is recommended. Documentation is not optional.

According to the AIC Code of Ethics and Guidelines for Practice, photographic documentation of the items to be treated should be performed also. Practical solutions are sought to meet the AIC standards and reasonable constraints on time. A common practice is to photographically document representative and extreme examples within one collection and periodically document labels, stamps, and format for future researchers. Photographic documentation with 35-mm black and white silver-based film is still acceptable for long-term preservation. Photocopying, and, while not yet an "archival" format, color transparencies (slides) have also been used, and digital photography is gaining popularity as a documentation format because of quick gratification for the user, ease of use, and compatibility with already existing computerized data systems.

### Training Non-Conservation Professionals

There is a pervasive notion in the popular press that things ought to be humidified and flattened. Sometimes just putting a crumpled letter in a folder in a box with other papers pressing against it will reduce the creases over time. When humidification and flattening are necessary, there can be easy procedures that can be batched for work efficiency. Training of non-conservation professionals to do this work can be productive; however there is often little follow-up, especially if training is off-site. There can be high rates of turnover of staff or volunteers so each person may learn from the person before them, or not. Different people have highly variable skill and comprehension levels between them. The type and number of procedures that the trainer introduces may depend on the skill level exhibited by the workers. Well-meaning people wanting to *do* something to *help*, can take on more than they ought, sometimes without knowing how damaging their well-intentioned actions can be. Problems that can be encountered by training those not versed in materials and technology are identification of media and supports. The novice worker with disastrous results can miss identification of photostats, copy prints, copy pencils, vellum-parchment versus papers, etc. Empower the newly initiated to take responsibility for their choices and their actions, be available to answer questions, and re-demonstrate procedures while personnel build self-confidence.

## IN CONCLUSION

Humidifying and flattening well can be beneficial to the preservation and conservation goals of collections. There are numerous variations on techniques and reasons why procedures are preferred. The initial ACDG session and the brief overviews published in the *Book and Paper Group Annual* will perhaps generate further discussion on this topic at next year's meeting in Virginia.

## ACKNOWLEDGEMENTS

The idea for the AIC-ACDG session and encouraging my participation in the discussion regarding humidification and flattening originated with Kathy Ludwig and Kristen St. John. Ms St. John and Nora Lochshin, who took notes at the session, have helped refine this paper for inclusion in the *BPG Annual*. They have my sincerest appreciation for their expertise, time, and efforts.

## REFERENCES AND BRIEF, SELECT BIBLIOGRAPHY

Albright, Gary, and Thomas Kevin (T. K.) McClintock. 1982. The treatment of oversize paper artifacts. *Book and Paper Group Postprints [Annual]* 1:1–6.

Alper, Diana. 1993. *How to flatten folded or rolled paper documents.* Conserve-O-Gram 13.2 (rev.). Harpers Ferry, WV: National Park Service.

*Care of photographic moving image and sound collections,* ed. Susie Clark. Leigh: Institute of Paper Conservationn, 115-123.

Clapp, Anne F. 1987. *Curatorial care of works of art on paper.* New York: Nick Lyons Books.

Eusman, Elmer, et al. [2002] *The iron gall ink corrosion website.* Amsterdam: The European Commission on Preservation and Access. At <http://www.knaw.nl/ecpa/ink/)> (accessed 12 Dec 2002).

Eusman, Elmer. 1995. Tide-line formation in paper objects: cellulose degradation at the wet-dry boundary. In *Conservation research 1995: studies in the history of art,* 51:11–28. Washington, D.C.: National Gallery of Art.

Glaser, Mary Todd. 1999. *Relaxing and flattening paper by humidification.* Conservation Technical Leaflet #4. Andover, MA: Northeast Document Conservation Center. At <http://www.nedcc.org/plam3/tleaf64.htm> (accessed 12 Dec 2002).

Hamburg, Doris, and Timothy Vitale. 1984. Drying /flattening [Draft]. *Paper Conservation Catalog* ed. 1, chap. 28. Washington, D.C.: American Institute for Conservation Book and Paper Group.

Hamburg, Doris, Dianne van der Reyden, and Timothy Vitale. 1984. Humidification [Draft]. *Paper Conservation Catalog* ed. 1, chap. 22. Washington, D.C.: American Institute for Conservation Book and Paper Group.

Hofmann, Christa, Dianne van der Reyden, and Mary Baker. 1992. The effect of three humidification, flattening and drying techniques on the optical and mechanical properties of new and aged transparent papers. In *Conference Papers, Manchester 1992,* ed. Sheila Fairbrass. Leigh: The Institute of Paper Conservation, 247–256.

Keyes, Keiko Mizushima. 1984. The use of friction mounting as an aid to pressing works on paper. *Book and Paper Group Annual* 3:101–104.

Nishio, Yoshiyuki. *Karibari* (drying board) made with new materials. *AIC preprints.* American Institute for Conservation 16th Annual Meeting, New Orleans. Washington, D.C.: AIC, 280 [abstract]. And personal notes from this presentation.

Sugarman, Jane, and Tim Vitale. 1992. Observations on the drying of paper: five drying methods and the drying process. *Journal of the American Institute for Conservation* 31(2):175-198.

van der Reyden, Dianne. 1992 and 1995. Paper-based materials guidelines. In *Storage of natural history collections: a preventive conservation approach: volume 1*, ed. Carolyn L. Rose, Catharine A. Hawks, and Hugh H. Genoways. Pittsburgh: Society for the Preservation of Natural History Collections, 327–353. At <http://www.si.edu/

scmre/relact/paperdocs.htm> (accessed 12 Dec 2002).
Ware, Mike. 1998a. Cyanotypes: their history, chemistry, and conservation. In
Ware, Mike. 1998b. *Cyanotype: the history, science and art of photographic printing in Prussian blue.* London: Science Museum and National Museum of Photography, Film & Television.
Webber, Pauline, and Merryl Huxtable. 1985. Karibari: the Japanese drying board. In *Hyogu: the Japanese tradition in picture conservation,* ed. Paul Wills and Nicholas Pickwoad. *Paper Conservator* 9:54-60.
Weidner, Marilyn Kemp. 1984. Demonstration of paper suction table techniques. *Book and Paper Group Annual* 3:122-130.
Weidner, Marilyn Kemp. 1986. A moisture chamber/suction table/ultrasonic humidification/air filtering system for use in the treatment of art on paper. In *New Directions in Paper Conservation, Conference Notes,* comp. Alan Howell. The Institute of Paper Conservation 10th Anniversary Conference, Oxford. London: Institute for Paper Conservation, D73–D74.

STEPHANIE WATKINS
Head of Paper Conservation
Conservation Department
Harry Ransom Humanities Research Center
The University of Texas at Austin
sbwatkins@mail.utexas.edu.