Analysing the nature and extent of the reversibility of inpainting onto the surface of a paper object using a barrier layer

Nick Zihrul
Masters Student, Centre for Cultural Materials Conservation, University of Melbourne

Abstract

Inpainting may be applied to original paper surfaces to visually compensate for areas of media loss or damage. Barrier layers such as methyl cellulose and gelatin are commonly applied between the paper surface and the inpainting media to prevent or reduce the media penetrating the paper, allowing what is believed to be reversible or partially reversible inpainting. This study investigates the extent of the reversibility of inpainting onto an original paper surface with wet media over a barrier layer. Methyl cellulose and gelatin barrier layers were applied in varying concentrations to three paper types of different absorbency and texture. Watercolour inpainting was applied to these dried layers, and removed after a short aging time. The extent of the reversibility of this technique was assessed. From the experiments conducted, both barrier layer materials were found to allow wet media inpainting applied to be completely removed to the extent that it is no longer visually detectable in natural light, provided that the barrier layer application and concentration is appropriate for the type of paper being treated.

Introduction

Barrier layer use

Inpainting media may be applied to original paper surfaces to restore visual unity, to conceal damage and to restore the original aesthetic properties of an object so that it may be interpreted by the viewer as it was originally intended. Barrier layers (also referred to as isolating layers) may be applied between the paper surface and the inpainting media to prevent the media penetrating the paper, enabling what is believed to be reversible or partially reversible inpainting. According to Schenck (1994), an isolating layer increases, but does not necessarily ensure, the reversibility of wet media.

Appelbaum (1987) recommends that of all conservation techniques, inpainting treatments in particular must be carried out with the highest level of reversibility possible, ensuring that removability of any media is possible without posing any risk to the object.

Many of the arguments against the use of barrier layers are due to uncertainties regarding their reversibility. Poulsson (2003: 86) states that although they do improve reversibility, they do not do so "enough to justify the introduction of even more foreign material into the paper". Townshend (2002: 21) is also concerned about their effectiveness, as well as any gloss created, stating; "does the isolating layer really work well enough to allow removal? Too much of it will make the surface shiny". Smith (1988) voices another concern regarding barrier layer use in the risk of damage to the paper that complete removal of inpainting may pose, as well as the uncertainty that the barrier layer will provide "certain protection" against the wet media penetrating into the paper.

This research (Zihrul 2007), conducted as part of a Masters in Cultural Materials Conservation at the Centre for Cultural Materials Conservation, University of Melbourne, aimed to identify the following:

- to what extent wet inpainting media applied over a barrier layer can be removed;
- how reversibility is affected by different paper types and barrier layer combinations; and
- which materials and application methods allow the greatest reversibility?

As many paper conservation techniques are reversible to different extents (Smith 1988), it was decided that removal of inpainting to the extent that no media remains visually observable in strong natural light would be regarded as an acceptable and realistic level of reversibility for the purposes of this study.

Paint and paper interactions

Reversibility of inpainting applied to paper is affected by the solubility of the inpainting media, and the extent of the penetration of the media into the paper. Media solubility and wash fastness of original watercolour media has been the focus of previous research in paper conservation (Daniels 1995; Clarke 1998), to identify in which cases media can safely come in contact with water during aqueous treatment. Wash-fastness and solubility of a paint media when applied as a thick layer is largely related to the properties of the paint itself (such as the solubility of the binder); the interactions with the substrate are less important. In the case of thinner paint layers (recommended by Schenck 1994) for inpainting paper, the interactions of the media and paper substrate have a stronger relation to the solubility and removability of that paint (Daniels 1995).

Cellulose fibres possess a large amount of surface hydroxyl groups, which enable hydrogen bonding to pigments and to other cellulose fibres (Daniels 1995). As cellulose fibres are hydrophilic, sizing is added to paper to decrease its ability to absorb water, allowing more controlled application of wet media with less bleed. The presence of a sizing agent, the absorbency and texture of the paper are of importance to these wet media and paper surface interactions. Surface sizing agents such as gelatin cover “physical surface irregularities” as well as many of the hydrogen bonding sites available (Daniels 1995: 32), restricting the capillary action. Surface sizing agents may also form a “skin” on the paper surface (Dixon-Wright in Turner 1998: 24). Wet media such as watercolour is absorbed into crevices and between fibres by capillary action. With the evaporation of the water from the media, the paper fibres and media “particles are drawn closer together” (Daniels 1995: 32).

Without employing inappropriately forceful mechanical action, pigment particles smaller than approximately 0.2 μm are “virtually impossible to remove from cotton cellulose” once embedded (Jones cited in Daniels 1995: 32). The use of an effective barrier layer is thought to prevent or significantly reduce this embedding.

Media solubility and re-solubility

In a study into the wash-fastness of watercolour paint on paper, Daniels (1995: 36) found that:

> Wash-fastness of paints decreased as both the amount of sizing on the paper increased and the density of the paper decreased. The relatively extensive penetration of the particles into the paper may account for the good wash-fastness of paint on filter (unsized) paper.

This provides relevant information for barrier layer application: media on denser, heavily sized papers will be easier to remove, while media will penetrate unsized and porous papers and therefore be less-easily removed. In addition, the increasing insolubility of watercolour over time may prevent the complete removal of inpainting without causing damage to the paper surface. Many factors influence this: while the gum arabic binder in watercolour paints generally remains water-soluble, it may cross-link with certain pigments containing polyvalent metals such as cobalt or aluminium (Daniels 1995). Irreversibility of inpainting caused by this process may be avoided with the use of other wet media such as dry pigment in methyl cellulose (or another re-soluble binder), or by the addition of a re-soluble binder material, such as methyl cellulose, to watercolour media (Schenck 1994).

Experimental

The study was conducted using three types of paper sample sheets[1] that have varying absorbency and texture, representative of a broad range of artist's papers used for printmaking, drawing and watercolour painting. Between one and six layers of methyl cellulose and gelatin were applied in 2, 4 and 6% w/v concentrations to the sample sheet surfaces. Each concentration and layer number combination was created as four repeats to allow for any minor variations in application, and to allow for experimental error. Watercolour, which according to Evans (1994) is the most commonly used wet media for inpainting on paper, was applied to each barrier layer surface (Figure 1). Winsor & Newton Cobalt Blue and Rose Madder Genuine pan watercolours were chosen since the former is a colour that is readily detectable in normal daylight conditions, and that the latter is strongly fluorescent under ultraviolet (UV) light.

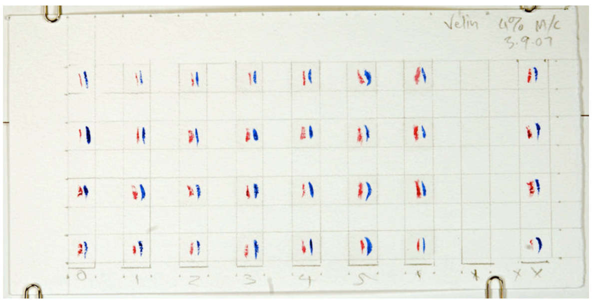

Figure 1: Example of sample sheet prior to inpainting removal; 4% methyl cellulose barrier layer on Velin paper.

After a short ageing time, the inpainting was removed as completely as possible from three of the four repeats (to allow a reference) for each barrier layer type, concentration, layer number and paper sample combination, using deionised water applied with a damp brush and a dry cotton swab. This work was carried out solely by the author, to ensure consistency of application and removal. However, as over 1500 layers were applied to the sample sheets, some minor variation between each individual layer applied is to be expected. Barrier layers were applied to the paper samples between the 28th August and 3rd September, 2007. Inpainting was applied to the samples on the 3rd September, and removed between the 25th and 28th September, 2007.

Visual examination and UV light of 254 nm and 365 nm were employed to identify the extent to which the inpainting could or could not be removed from different barrier layer and paper combinations, and whether remaining inpainting was visible in daylight viewing conditions. The appearance of this remaining inpainting was assigned a rating against a colour reference chart to objectively measure the effectiveness of each barrier layer and paper variation.

Papers

The papers used in this research[1] – Velin Johannot, Magnani Pescia and Arches Hot Pressed – were chosen to represent a wide range of the properties that most strongly affect reversibility of inpainting, and to represent a wide range of artist's papers. Porosity and surface texture are factors that influence the efficiency or inefficiency of a barrier layer, and the selection of a barrier layer application suited to that paper type (Schenck 1994). Papers representative of a broad range of these characteristics were used to investigate whether each barrier layer application (for example three layers of 4% methyl cellulose) was effective on a range of papers, or only on less porous and textured papers.

Barrier layer methods

Published treatment case studies commonly state what material was used as a barrier layer, but further information such as viscosity, concentration and method of application, are often not included. The *Paper Conservation Catalogue*, published by the American Institute for Conservation (AIC), provides basic instructional information to barrier layer application (Schenck 1994) but does not go as far as suggesting specific viscosities or concentrations of barrier layer materials, or recommending the number of layers necessary to create an effective barrier film on particular paper types.

Materials recommended in the AIC *Paper Conservation Catalogue* are for both sizing papers and applying isolating layers. They include wheat starch paste, cellulose ethers, gelatin and parchment size, acrylic resins and emulsions, and polyvinyl acetate resins and emulsions (Schenck 1994). Barrier layer materials may be applied as thin layers locally and allowed to dry, and multiple layers may be required to build a sufficient coating prior to inpainting (Schenck 1994). The AIC *Photographic Materials Conservation Catalogue* also suggests Acryloid B67 and B72, acrylic emulsions, gelatin and cellulose ethers (Hess Norris 1994).

Viscosity grade and concentration are briefly mentioned as being important in relation to the paper types being treated (Schenck 1994), although no suggestions are made. “About 4%” and “around 5%” were suggested concentrations of methyl cellulose A4C from personal dialogue with practising conservators; however solutions are often mixed by ‘feel’ of consistency rather than accurate measurement. For the inpainting of photographs, Morrison (2007) recommends the use of methyl cellulose or gelatin barrier layers applied “at about 4%”.

From the limited references to barrier layers available, gelatin and methyl cellulose appear to be the two most commonly used materials, and for this reason were chosen and prepared[2] for this study. In a show of hands during a discussion on inpainting between 200 paper conservators, “methyl cellulose is apparently most often used, although gelatin, Klucel and Aquazol were also suggested” (Walsh 2003: 106).

Preparation of sample sheets

Eighteen sample sheets were produced, one for each variation in barrier layer material, barrier layer concentration, and paper type. A grid was drawn on each sheet to provide a 10 x 10 mm space for each barrier layer application. All application variations were applied in ascending order to each sample sheet and repeated four times to allow for any variation in application.

A number “0” round synthetic brush was used to apply both gelatin and methyl cellulose thinly to the paper samples, without any impasto. For samples requiring more than a single layer application, subsequent layers were applied after the previous layer had dried. Once the barrier layer materials had fully dried, the watercolour inpainting was applied to the barrier layers and paper surfaces using a number "0" synthetic round brush, applied as a thin layer without any impasto, and with a relatively dry brush. The samples were then left for a short aging time of at least 22 days prior to removal.

Removal techniques

After testing a number of methods of inpainting removal, including rolling damp swabs and the application of dry blotter as suggested in the *Paper Conservation Catalogue* (Schenck 1994), the most effective method involved gently brushing and agitating the paint with a fine brush dampened with deionised water. Once some media had partially solubilised, a dry swab was rolled over the surface to absorb the media. Deionised water was applied to the centre of the inpainted area first, working outwards with each subsequent attempt (Figure 2). Removal of inpainting was carried out on three of the four repeats (to allow a reference) for each barrier layer type, concentration, layer number and paper sample combination.

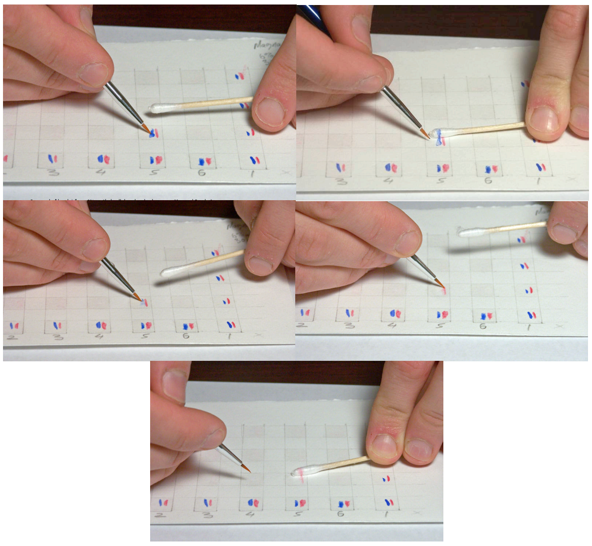

Figure 2: Series of photographs showing removal of inpainting sequence; 6% methyl cellulose barrier layer on Magnani paper

Light mechanical action was necessary as "pigment particles tend to aggregate and need mechanical action to break them up" (Daniels 1995: 32). Although care was taken not to saturate the area or spread the media, on occasion it was necessary to apply a small droplet of deionised water by brush to partially flood the inpainting area, then to swiftly apply a loosely rolled swab to ensure that all of the solubilised media was absorbed. This could only be carried out when the inpainting was over an effective barrier layer. If the barrier layer was not effective, the media would spread or be further absorbed into the paper. Swabs were changed as regularly as necessary to prevent the accidental reapplication of inpainting media to unprotected surfaces. Barrier layers consisting of multiple layers of a more concentrated barrier solution generally required less effort and fewer 'passes' to remove the media from the surface.

Attempts to remove media were discontinued if the media began to spread or penetrate further into the paper, or when media ceased to transfer to the swab. Effective barrier layers were found to prevent any further penetration of re-solubilised media; if excessive water was applied during re-solubilising, the wet media remained on the surface without penetrating.

Colour reference chart

Assessment of the remaining inpainting was conducted using a six-point colour rating chart (Figure 3). To make the chart, both rose madder and cobalt blue watercolours were applied to a sheet of Magnani Pescia paper in six different dilutions until barely noticeable against the white paper substrate (given a number "1" rating) to provide an objective reference with which to assess the amount of remaining inpainting on each sample, and to allow accurate tabulation of the data gained. Number "6" using the colour reference chart is the full strength colour as it was applied to the barrier layer surfaces; "0" was used to denote when no colour could be detected at all against the white paper substrate, indicating complete inpainting removal, and an effective barrier layer application. The samples were photographed prior to, during and after inpainting removal to document the changes and the success or failure of inpainting removal.

It should be stressed that even under strong natural light (much stronger than the 50 lux recommended by Michalski (1990) for the display of paper objects with light sensitive media such as watercolours), remaining inpainting assigned a "1" rating is barely visible against a clean white paper surface and may not be noticeable at all on a discoloured paper, or against surrounding media.

Figure 3: Colour reference charts

Analysis of results

The resulting sample sheets (example Figure 4) were examined in strong daylight and the remaining inpainting on each sample was assigned a rating against the colour reference chart. With few exceptions, UV examination (at 254 nm and 365 nm) and low magnification (x10 stamp loupe) failed to reveal anything that could not be observed in natural daylight.

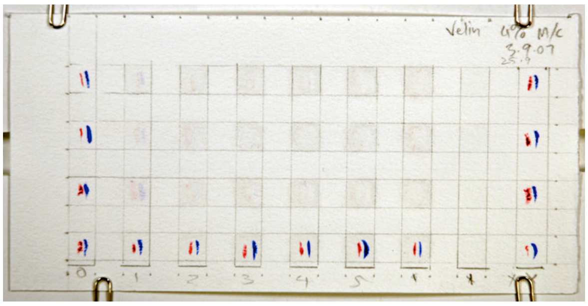

Figure 4: Example of sample sheet after inpainting removal; 4% methyl cellulose barrier layer on Velin paper

Observations

It should be noted that these experiments were conducted on new and undamaged paper samples. The reversibility of inpainting over a barrier layer may be affected by an abraded, aged or damaged paper surface. The sample papers used were all 'known'; information on their materials and manufacture is available. The "state of degradation" of the support, and degradation of sizing materials in a paper has a strong effect on the absorbency of a paper (Clarke 1998: 164). Despite this, it is expected that a paper conservator will be able to identify the absorbency of an unknown paper that they are treating.

Schenck (1994) suggests that varying concentrations or applications of barrier layer materials may be necessary depending on the absorbency of the paper. Four layers of 4% methyl cellulose proved to be the most effective barrier layer whilst creating minimal gloss or alteration to surface characteristics on all three types of paper tested, with an acceptable level of reversibility in all of the samples tested. No remaining media could be observed in strong natural light on any of these samples. Four layers of 4% methyl cellulose did not significantly affect the appearance of the inpainting applied to its surface. It was observed that the application of two or more layers ensures that a complete isolating film has been created.

Compared to 4% solutions, 6% solutions of both methyl cellulose and gelatin were found to create noticeable gloss and surface texture alterations without significantly increasing the reversibility of inpainting.

The differences observed between identical barrier layer applications on different paper types are quite significant. Three layers of 4% gelatin allowed almost complete removal of inpainting from the Arches and Magnani papers (a rating of "1" against the reference chart) whilst this application was quite ineffective on the Velin paper, rating between "4" and "5" against the reference chart.

Three layers of 4% methyl cellulose were found to be effective on all but one sample tested. A small amount of pigment (covering less than 1 mm area approx) became embedded in a slight irregularity on the Magnani Pescia paper surface. This embedded pigment could not be removed during subsequent attempts. This leads to concerns regarding inpainting and barrier layers applied to broken or damaged surfaces, or highly irregular surfaces. Data gained from this research may be less relevant to such applications.

It was observed that when applied to, and removed from more heavily applied barrier layers (for example five layers of 4% methyl cellulose), the inpainting media appeared to mix with the methyl cellulose barrier beneath, as the wet watercolour partially solubilised the barrier layer. This did not result in media being further absorbed by the paper, and may have contributed to the ease of inpainting removal on these samples. In many cases, the barrier layer itself was reduced or partially removed along with the inpainting. An increase in the solubility of the waterpainting media applied over methyl cellulose barrier layers was also noted, in comparison with no barrier layer at all. This was not observed on the gelatin layers.

Effective barrier layer and paper variations

The following trends for the different paper types were observed in *all* of the repeats tested.

On the porous and heavily textured Velin Johannot paper:

- Applications of at least three layers of either 4% or 6% methyl cellulose were effective (given a rating of "0").
- None of the 2% methyl cellulose applications were effective.
- Only six layers of 6% gelatin were effective. Gelatin is therefore not recommended for barrier layer use on very porous papers.

On the medium absorbency and texture Magnani Pescia paper:

- At least four layers of either 4% or 6% methyl cellulose were effective.
- At least five layers of 4% gelatin were effective.
- None of the 2% methyl cellulose or gelatin applications were effective.

On the less absorbent and minimal surface textured Arches Hot Pressed paper:

- At least five layers of 2% methyl cellulose, and at least three layers of either 4% or 6% methyl cellulose were effective.
- At least four layers of either 4% or 6% gelatin were effective.
- None of the 2% gelatin applications were effective.

In comparison to those combinations just listed, the following barrier layer applications created less gloss and distracting alterations to paint or surface texture characteristics. They allowed for reversible inpainting (a remaining inpainting rating of "0") in *most* of the samples tested. However, in either one or all of these samples tested, a very minor amount of inpainting media (rating no higher than "1") could not be completely removed. However, they did provide a significantly more reversible option than applying no barrier layer at all.

On the porous and heavily textured Velin Johannot paper:

- None of the 2% or 4% gelatin applications were effective.
- At least five layers of 6% gelatin were effective.
- Only six layers of 2% methyl cellulose were effective.
- Two layers of either 4% or 6% methyl cellulose were effective.

On the medium absorbency and texture Magnani Pescia paper:

- None of the 2% gelatin applications were effective.
- At least three layers of either 4% or 6% gelatin were effective.
- At least one layer of either 2%, 4% or 6% methyl cellulose was effective.

On the less absorbent and minimal surface textured Arches Hot Pressed paper:

- None of the 2% gelatin applications were effective.
- At least three layers of either 4% or 6% gelatin were effective.
- At least one layer of either 2%, 4% or 6% methyl cellulose was effective.

McAusland explains that although a priority in treatment, reversibility is not always a possibility, and in some such situations "often a small non-reversible retouch is preferable to a visual distraction on the work of art" (McAusland 2002: 18). If the use of barrier layers that are consistently rated "0" prevent a good inpainting match from occurring due to unacceptable gloss or distracting alterations to paint or surface texture characteristics, conservators may prefer to apply a slightly less effective barrier layer to allow for a better inpainting match, such as those in the second listing.

Conclusion

From the experiments conducted during this research, it was found that barrier layers do allow wet media inpainting applied to paper to be completely removed to the extent that they are no longer visually detectable in strong natural light, provided that the barrier layer application and concentration is appropriate to the type of paper being treated.

There is a dramatic difference in the extent of the reversibility of inpainting on the paper samples protected by a barrier layer, and the control samples that had inpainting media applied directly to the paper surface. Schenck's claim (1994) that the application of a barrier layer increases reversibility was affirmed: even a single 2% gelatin layer, the least efficient of those tested, increases the reversibility of inpainting on paper to some extent.

Methyl cellulose was found to be more effective overall than gelatin; it formed a protective surface film in lower concentrations, and with fewer applications. Four layers of 4% methyl cellulose were found to be effective on all of the papers tested, whilst creating minimal gloss or alteration to surface characteristics. No remaining media could be observed in strong natural light on any of these samples. Four layers of 4% methyl cellulose did not significantly affect the appearance of the inpainting itself. Three layers of 4% methyl cellulose were also found to be effective on all but one sample tested.

Bonet, Munoz-Vinas & Cases (2007: 29) state that:

> Nowadays, the complete reversibility of the conservation treatment is no longer considered to be a requisite for a conservation treatment to be admissible, but rather a factor that can be traded for others in the conservation decision making process.

As approaches to inpainting are subjective (Walsh 2003), and the extent of the reversibility of many conservation techniques is variable (or one of a number of factors to be compromised), two sets of recommended barrier layer applications have been included in the previous section. The first list allows reversible inpainting such that inpainting may be removed without leaving any trace visible in strong natural light. The second allows reversible inpainting to the extent that in most cases, inpainting may be removed without a trace, but occasionally may leave a very faint trace of inpainting visible only in strong natural light. This second set of recommended applications may be slightly less reversible, but will create less gloss and alteration to surface characteristics.

It is hoped that the results of this research will contribute to more informed treatment decision making, and to current dialogue regarding inpainting on paper within ethical frameworks.

Acknowledgements

Thanks go to Libby Melzer, Robyn Sloggett, Jude Fraser and Alice Cannon, as well as the many conservators that spoke with me regarding barrier layer use in their practice.

Materials

Winsor & Newton Cobalt Blue, pan watercolour; Series 4AA; containing cobalt/aluminium oxide PB28; Lightfastness 1.

Winsor & Newton Rose Madder Genuine, pan watercolour; Series 4B; Lake of natural madder NR9.

Magnani Pescia 2050/C white paper, 300 gsm; Cold Pressed; 100% cotton; Lightly tub sized with either a gelatin or vegetable based size - differs from batch to batch (Magnani Papers Australia 2007); Mouldmade wove sheet.

Arches Hot Pressed paper, 300 gsm; 100% unbleached cotton rag; internally sized and surface sized with gelatine; Mouldmade wove sheet.

Velin Johannot white paper, 240 gsm; either 100% cotton rag (according to distributor Arjo Wiggins Australia 2007), or 75% cotton : 25% esparto unbleached (according to Turner 1998:121); Mouldmade wove sheet.

Dow Methocel A4C STD, methyl cellulose.

Gelita Gelatine, A grade (115-135 Bloom).

References

APPELBAUM, B (1987) "Criteria for treatment: Reversibility". *Journal of the American Institute for Conservation* 26. 65-73.

ARJO WIGGINS AUSTRALIA PTY LTD (2007) Personal communication [phone 22.10.2007].

BONET, M, MUNOZ-VINAS, S and CASES, F (2007) "A note on the reversibility of cellulose ethers". *Restaurator* 28. 29-38.

CLARKE, A (1998) "The evaluation of relative movement between graphic media and paper substrates: watercolour as a case study". In: *IPC Conference Papers: Proceedings of the Fourth International Conference of the Institute of Paper Conservation*, 6-9 April 1997, London. Institute of Paper Conservation: London. 160-165.

DANIELS, A (1995) "Factors influencing the wash-fastness of watercolours". *The Paper Conservator* 19. 31-40.

EVANS, D (1994) "Loss compensation in paper". In: *Loss Compensation Symposium Postprints: Western Association for Art Conservation annual meeting,* 1993, San Francisco. Western Association for Art Conservation: Seattle. 25-27.

HESS NORRIS, D (Compiler) (1994) "Inpainting of photographic prints" [Chapter 4]. In: *Photographic Materials Conservation Catalogue.* American Institute for Conservation, Photographic Materials Group: Washington.

MAGNANI PAPERS AUSTRALIA (2007) Personal communication [phone 22.10.2007].

McAUSLAND, J (2002) "The practicalities and aesthetics of retouching: rationality versus intuition". *The Paper Conservator* 26. 13-19.

MICHALSKI, S (1990) "Towards Specific Lighting Guidelines". In: *ICOM-CC Preprints Vol. II, 9th Triennial Meeting,* 26-31 August 1990, Dresden. International Council of Museums – Committee for Conservation: London. 583-588.

MORRISON, P (2007) "Inpainting photographs" [Lecture handout]. Colour Intensive Course 108-539, University of Melbourne.

POULSSON, TG (2003) *Retouching of works of art on paper: History, ethics and methods.* Nasjonalgalleriet: Oslo.

JOHN PURCELL PAPER (nd) "Printing papers" [online]. [Available: www.johnpurcell.net/magpres.html ; accessed 06.2007]

SCHENCK, K (Compiler) (1994) "Inpainting and design compensation" [Chapter 30]. *Paper Conservation Catalogue.* American Institute for Conservation, Book and Paper Group: Washington.

SMITH, RD (1988) "Reversibility: A questionable philosophy". *Restaurator* 9(4). 199-207.

TOWNSHEND, P (2002) "Toning with 'paper extract'". *The Paper Conservator* 26. 21-26.

TURNER, S (1998) *The book of fine paper*. Thames & Hudson: London.

WALSH, J (2003) "Evolution in inpainting discussion". *The American Institute for Conservation Book and Paper Group Annual* 22. 105-107.

ZIHRUL, N (2007) *Analysing the nature and extent of the reversibility of inpainting onto the surface of a paper object using an isolating layer* [Masters Research Thesis]. Centre for Cultural Materials Conservation, University of Melbourne.

Notes

1. The papers used in this research were:

   Velin Johannot white: Coarse surface texture, very absorbent, "NOT" (Cold Pressed) (Turner 1998: 121). Velin Johannot has a light structure and strong intaglio properties, and is recommended by Turner (1998) for wood engraving, letterpress and linocut applications. Contains a small amount of internal gelatin size (Arjo Wiggins Australia 2007). The wire side is smoothest: the felt side has a much heavier texture and was used for the barrier layer application.

   Magnani Pescia 2050/C white Medium texture and absorbency. Magnani Pescia is a multi purpose 100% cotton paper most commonly used for printmaking, but is also recommended for drawing and watercolour painting (Purcell 2007). The wire side of the Magnani paper is slightly smoother and was used for the barrier layer application.

   Arches Hot Pressed: Very smooth surface, heavily gelatin sized. 100% unbleached cotton rag. Most commonly used for watercolour painting, Turner (1998: 199) suggests this paper for use with any water based media, as well as for calligraphy, platinum printing, letterpress, pastel and crayon. The wire side of the Arches paper is marginally smoother and was used for the barrier layer application.

2. The preparation of the barrier layer materials was as follows:

   Methyl cellulose preparation: 2, 4 and 6% w/v solutions were prepared for application onto sample sheets. 2, 4 and 6 g of Methocel A4C were added to separate beakers and deionised water added to make 100 mL solutions. The solutions were stirred vigorously during and after the addition of the water, and left overnight. Through observation and anecdotal evidence from conservation practice, Methocel A4C is most commonly used for barrier layers. Methocel A4M was tested during initial experiments, and found to have poor working properties for barrier layer application.

   Gelatin Preparation: 2, 4 and 6% w/v solutions were prepared for application onto sample sheets. 2, 4 and 6 g of solid gelatin granules were added to separate beakers and deionised water added to make 100 mL solutions. The granules were left in the deionised water for 30 minutes at room temperature to swell: stirred only during the first and last five minutes. The mixture was then heated to 45°C for 3 minutes in a double boiler. The solution was covered and stored in a refrigerator, and reheated in the double boiler prior to each use. Gelatin solutions were applied to the sample sheets at around 30°C so that they remained liquid. To maintain fluid working properties, beakers containing gelatin were placed in a second container of warm water while the solutions were applied to the samples. As they cooled to room temperature (22°C), 4% and 6% solutions were found to clot on brush ferrules and handles. Fresh warm water was added to the container holding the beaker of gelatin as necessary to maintain the temperature and prevent clotting.

AUTHOR BIOGRAPHY

Nick Zihrul is a recent MA graduate of the University of Melbourne Centre for Cultural Material Conservation, and has a particular interest in works of art on paper. He has previously worked at the State Library of Victoria, Preservation Australia and Strand Art Conservation. Until recently he was involved in a large collection survey at the Cunningham Dax Collection in Melbourne, and can now be found working at the Australian War Memorial as a Paper Conservator.

nick.zihrul@awm.gov.au