PAPERS FROM THE

AUSTRALIAN INSTITUTE FOR THE CONSERVATION OF CULTURAL MATERIAL

PAINTINGS GROUP SYMPOSIUM 1995

LORNE, VICTORIA

16 - 17 MARCH 1995

Compiled by Robyn Sloggett and Linda Waters

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The fifth Symposium of the AICCM Paintings group, held in Lorne, Victoria from 16-17 March, proved to be as popular as the previous four. It was attended by forty-five conservators and conservation scientists and twenty-three papers (of varying degrees of seriousness and gravity) were presented over the two day period. In addition, the Group was presented with an informative presentation of vacuum table and suction unit equipment by Robin Hodgson, and was involved in some interesting discussion at the end of the Symposium, particularly in relation to the Code of Ethics and its relevance to private practice.

The range of papers presented reflects the interests and experience of the Group. The papers in this publication are published as they were presented to the Symposium convenors, and have not been edited. One of the much stated aims of the Paintings Group is to provide an informal, low key atmosphere which promotes the flow and exchange of ideas. For this reason, all papers which were submitted were presented at the Symposium. Members of the Group who attended the Lorne Symposium will remember two papers which have not made it into the published papers, these are John Hook's paper on pizzas and Stewart Laidler's paper on Mardi Gras (or should that be Mardi Gris in the plural). Both these papers were worthy contributions to the field, but both presenters declined to commit themselves to paper. Those present will understand why. Several presenters also felt that they could only present abstracts for publications, some of them will be expanding their papers for future publication.

The Adelaide contingent of the Paintings Group has graciously offered to host the next Symposium. We look forward to meeting in Adelaide.

Finally, the convenors would like to thank Alister Shew from the National Gallery of Victoria and Rie Law from The University of Melbourne Conservation Service for their administrative support in the organisation of the Symposium, and all the contributors and attendees who made it worthwhile.

Linda Waters,
National Gallery of Victoria.

Robyn Sloggett,
The University of Melbourne
Conservation Service.

PAINTINGS GROUP SYMPOSIUM, LORNE 16 & 17 MARCH 1995

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INITIAL OBSERVATIONS OF PIGMENT INDUCED CHANGES IN RELATIVELY NEW EGG TEMPERA PAINT FILMS

by
Narayan Khandekar and Alan Phenix

It has long been observed that egg tempera as a binding medium dries into an insoluble film (Cennini, 1960). Despite its long recorded useage there have been few studies into the drying process and the effects of ageing (Karpowicz, 1981; Khandekar *et al*, 1994). The samples used in this study are the same as those used in an earlier study (Phenix *et al*, 1993; Khandekar *et al*, 1994)which examined changes in colour, and the effects of solvents on egg tempera paint films.

The aim of this study was to measure the change in the molecular weight of the proteins in egg tempera films during the initial stages of drying and after some artificial ageing as an indicator of the effects of the pigments on the proteins.

The molecular weight of a selection of samples of artificially aged egg tempera bound pigments were analysed by gel electrophoresis. The samples consisted of:

1. vermilion
2. lead white
3. verdigris
4. unpigmented egg yolk
5. azurite

Two ageing régimes were employed:

A. unaged control

Régime 1
B. light aged 192 hours
C. light aged 192 hours, thermally aged (70°C, 55% RH) 21 days

Régime 2
D. light aged 412 hours
E. light aged 412 hours, thermally aged (70°C, 55% RH) 21 days

This study showed that pigments affect the drying of proteins in egg tempera paint films. It appears that azurite and vermilion accelerate the cross linking of proteins. During thermal ageing vermilion also affects the proteins by reducing the molecular weight of some proteins.

Verdigris degrades proteins in an egg tempera paint film. This possibly due to the inherent acidity in the pigment which degrades the amino acids in the proteins.

Lead white appears to have no effect on the drying of proteins.

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ABSTRACT FOR PAINTINGS SYMPOSIUM TALK

LORNE, VICTORIA 1995

STABILITY AND HANDLING PROPERTIES OF A RECENT PAINT MEDIUM

ARCHIVAL OILS

Sarah Powell, Artlab Australia

Evaluation of the stability and handling properties of a recent oil painting medium was conducted as part of final year studies in Conservation at the University of Canberra. The manufacturer claims his modified oil paints, Archival Oils, containing poly-butyl acrylate acrylic plasticiser, perform like traditional oils but endure like acrylics. Some of their proposed improved qualities include permanent flexibility, even drying of all colours and a reduced tendency to yellow. Samples of batch one Archival Oils and reference Art Spectrum and Grumbacher standard oil paints of known and acceptable ageing characteristics were exposed to various accelerated environmental conditions. Tests designed to document their behaviour including colour change, visual surface defects, hardness, solubility and flexibility were conducted before, during and after ageing. While it is not possible to directly correlate a given accelerated exposure with a number of actual years, the paints which perform better with artificial ageing generally perform better in practice. Concluded that the endurance of batch one Archival Oils was equivalent to standard oil paint, but that difficulties exist with their physical properties.

Sid Long: deterioration and *improvement* of his early paintings.

ABSTRACT:

Sid Long's painting *Pan,* 1898, underwent conservation treatment at the Art Gallery of New South Wales in 1994. Examination of the painting and recently found archival material, raised the problem of the artist reworking *Pan* some time *after* it was exhibited at the Society of Artists Spring Exhibition and acquired by the Art Gallery of New South Wales in 1898. Sid Long himself writes about "improving" a number of his paintings at dates after their initial completion, exhibition and sale. The reasons for this are not explicitly stated in the Art Gallery of New South Wales correspondence, although the paintings themselves suggest that it was probably due to premature cracking. Several later letters begin to give a clearer picture of the problems that Sid Long was forced to confront with the deteriorating condition of these early paintings.

Paula Dredge
Painting Conservator
Art Gallery of New South Wales

The Art Gallery of New South Wales has a strong holding of early paintings by Long (1871-1955). The frames on these had been looked at for some time as part of a continuing project for the Frame Conservators, to return the 19th Australian permanent collection frames to their original finishes. The frame on *Pan*, was the first of the Long's to be worked on, and the painting also underwent conservation treatment at this time. The treatment of the painting took much longer than the frame, well over a year. The conservation work was not in itself complex or unusual, but there was difficulty deciferering original from reworking, from restoration. *Pan* as it appears today, is quite different to how it must have looked when it was first exhibited in the 1898 Society of Artist's Spring Exhibition, and acquired directly from this by the Trustees of the Art Gallery of NSW, (then the National Gallery of New South Wales). It has been possible to trace these changes through some unique gallery records, which illustrate some bizarre early accessioning and deaccessioning policies, the nature of relationships between Trustees, artists and government, and early solutions to conservation problems, which included sending paintings back to the artist to repaint. These records also suggest however, that some of the responsibility for *Pan*'s deterioration must also rest on the shoulders of Long himself.

Initial examination showed that the painting had been aggressively attacked by mould. The 1954 conservation report gives an account of the treatment for this[1]. It was no surprise to find evidence of the radical treatment described, on the painting. To give a bigger picture however of the enormity of the problem of mould on paintings caused by storage in "damp and dark conditions" is an undated photograph of frame storage. In an effort to improve this, annual reports throughout the 1960's included humidity and temperature readings, and the numbers of paintings damaged by mould every year. By 1963 a dehumidifier had been designed and installed in the storage area. (It was emptied by hand as the bucket filled.)

Despite the radical treatment of *Pan*, there were some relics of original features left when the painting was examined in 1994. Remnants of an original loose lining were still present, although it had been cut out around stretcher members to access the back of the canvas for tear repairs. The loose lining was a coarse jute fabric, primed on the side away from the painting canvas, and stretched while the priming was fresh enough to imprint onto the

[1] "This painting is in very bad condition. Fungi has eaten into paintfilm [sic] in most parts of the picture even light areas which are usually resistant to fungi attacks. Treatment consists of softening paintfilm with solvents and scraping off outcrops with scalpel. So extensive is infection that it is impossible to remove all traces without skinning the painting. A compromise is aimed at that will render the painting at least presentable. Paintfilm and canvas will treated [sic] to kill fungi spores and surface treated with wax polish."
Conservation treatment record. 5/4/54

stretcher. It is unclear if the primary object of the loose lining was to act as a long term support, or as a firming support during painting.

Pan had been photographed a year after its exhibition and purchase in 1899 for publication in the international design and Art Nouveau magazine *The Studio*. A photograph and glass plate negative were traced, which appeared to be the source of the published photograph. In comparing the painting with this photograph, the unfortunate deterioration is immediately apparent. The foreground which was once clearly a lily pond has darkened so that it is almost indecipherable. There are deep drying craquelure across the painting. Pentimento in the trees has become visible with age, but these 'changes of mind' were made prior to the 1899 photograph. Reflected infrared photography was ineffective at enhancing this pentimento, but transmitted infrared photography gave some spectacular results.

The change from the menacing early tree on the left to the more stylised tree forms, that we associate with Long's paintings, demonstrates a working out of this signature design directly on the canvas. What was even more surprising, was the presence of a ghost of Pan himself. This figure had, at an earlier stage, been almost twice the size, and quite different in profile. This is more easily seen in the x-ray radiograph taken of the painting after the transmitted infrared result was so successful. The extent and type of major pentimento suggests an artist working over and over on the canvas to finalise the composition. Scale and types of forms were determined as he painted, building up in areas that thick and heavily layered paint film. Through craquelure and losses, various and different coloured paint layers are visible through this, and the heavily worked character of the paint film is visible even on the 1899 photograph.

The diagonal reeds in the lower right of the painting, which appear to have been added after the 1899 photograph, caused some concern about their origins and the possibility of more subtle later additions. This was a critical point as the painting was undergoing removal of varnish and discoloured overpaint layers. Of particular concern was a patchy and partially removed green scumbled paint layer through the sky. Under the stereo microscope it was clear that this layer lay over a varnish film and was sitting in drying craquelure, and that underneath this layer, the sky was a brilliant mauve. Due however to the consistent use of this green through the sky, it was not entirely clear if this was just a restorer's overpaint. Feeling generally uneasy at this stage in the treatment, I decided to do some research into the history of the painting, beyond what was known of the 1950's conservation treatment.

One source for information on works in the collection of the Art Gallery of NSW is the Trustee's minutes, which are large bound hand written volumes. Another source, which was

discovered by trying to trace the whereabouts of a letter referred to in the Trustee's minutes, is the gallery correspondence. This was found in cabinets in the Registrar's office. It consists of unrecorded, uncatalogued and mostly unknown files of ingoing and outgoing correspondence from the 1850's to the 1920's. Incoming letters are stored by year date only. Outgoing correspondence is recorded in bound volumes of handwritten copies.

The combination of the Trustee's minutes and correspondence told a bizarre story of the exchange of paintings between the gallery and Sid Long. In 1898 *Pan* was proposed as a purchase from the Society of Artist's Spring Exhibition, on the condition of the return to the artist of an earlier acquisition, *Mid-day.*

"Note:- In considering the purchase of the above picture, the Meeting realised the difficulty that presents itself in the possibility of unduly multiplying examples of any Artist of merit, - with the alternative of ceasing to purchase that Artists' Works; - and, as a way of escape from this situation it was Resolved to suggest, tentatively , to Mr Long, the painter of the picture "Pan" that, - subject to the Minister's approval, - the Trustees would be prepared to pay him the sum of fifty guineas (50^{Gs}), and return to him his picture "Mid-day" purchased from him in 1896, for £76/15/- in exchange for "Pan" -priced per catalogue £105[2].

Further reading of the minutes revealed that *Mid-day* was retained, (28.9.1898). The reasons for this were not recorded, but described in a later letter to be due to the Minister insisting that the price of the "resale" of *Mid-day* back to the artist, be returned directly to Treasury, and the new painting brought outright, thereby not directly saving the gallery money. *Mid-day* was however returned to the artist for 'repainting', (28.9.1898, *"The Artist, per letter 23/9/98, asked permission to do some more work on this picture").* [3]

On 12 January 1899 Sid Long writes to the Gallery: "I have the picture "Mid-day" nearly finished. I found that I had to repaint the whole thing nearly. I should like to retouch it a little in the frame before I send it in..."[4]

Clear reasons for the need for such extensive repainting of *Mid-day* were not given in the Minutes or correspondence.

A letter from the Gallery to Long in November 1898 did provide the first real evidence of a problem with Long's paintings.

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[2] Art Gallery of NSW Trustee's Minutes. 25 Aug 1898. p 25.
[3] Art Gallery of NSW Trustee's Minutes. 28 Sept 1898. p 39.
[4] Letter from Sid Long to Mr Layton, (Art Gallery of NSW) undated. Received 12.1.1899.

15 November 1898;

"Dear Mr Long

Should much like you, at your convenience, to look at your recent work "Pan", -some "cracks" are showing"[5]

Pan was cracking within a year of being completed, exhibited and then purchased by the Gallery!

Later, in 1902, the Minutes revealed that a second exchange was proposed, and this time it actually proceeded with very little discussion recorded, (and it seems probably no Ministerial permission). ***Pan* was returned to the artist in exchange for *Flamingoes*, a recently completed and exhibited work by Long.**

4 Sept 1902

Offer to S. Long for his Oil painting Cat. N°. 21. -"Flamingoes"- £105 cash, and return to him his allegorical picture "Pan", previously purchased from him, if Mr. Long will be good enough to make some slight corrections,- to be pointed out to him by Dr Manning.[6]

(Note Mr. Long accepted the above offer).

Like *Pan*, there is pentimento on *Flamingoes*, which has become visible over time. Any part of this may account for the "*slight corrections*" requested by the Trustees, such as overpainted flamingoes at top centre, and the back of the forward most figure.

After its deaccessioning and return to Long in 1902, *Pan* was not returned to the collection of the Art Gallery of New South Wales until 1943, when it was presented as a gift by a Trustee of the time. Given that the painting was returned to the artist who is known to have repainted at least one other earlier painting, it is possible that the reeds in the lower right may have been added by the artist after 1902. Further repainting is also possible given that *Pan* had begun to crack 3-4 years earlier. Is this the source of the patchy grey paint in the sky? Could this be Long's repair work? Although this layer was incomplete from previous cleanings, I decided to leave what remained for the present. The painting was varnished, retouched and returned to it's newly conserved and restored frame, (the treatment of the frame is a story in itself).

Although I had begun to feel that Long was involved in repainting *Pan*, because of a problem with premature cracking, this could not be confirmed from the ambiguous correspondence and

[5] Art Gallery of NSW Letter Book No.15. 18 June 1898 to 7 June 1899. p 333.
[6] Art Gallery of NSW Trustee's Minutes. 4 Sept 1902. p 488.

Minutes. It was only after the painting had been returned to display that the most definite evidence came to light, from Sarah Powell at Art-Lab in Adelaide. Sarah had been working on *The valley* by Long, painted the same year as *Pan,* and rang to talk about the treatment. She had found the most fantastic letter where Long finally openly acknowledged ongoing problems with his paintings.

Long to HP Gill of the Art Gallery of South Australia.

30 July 1899

Dear Sir

I regret very much to hear that "The Valley" is commencing to crack & the only reason for it doing so is that being very solidly painted some of the underneath colours have dried more slowly [sic] the ones placed over them & in doing so have caused the top colours to crack,

I notice in many of the solidly painted pictures in our own Gallery the upper coats have cracked in just the same way. Of course when these colours have dried thoroughly the danger of any further cracking will cease.

Of the three pictures of mine in our gallery one "Midday" did just the same thing so I asked the Trustees to allow me to repaint the parts that had cracked & I am glad to say that the picture is quite sound now & that the cracking has not gone any further.

I do not think that anything could be done to it over there. If your Board would approve of it I should be very glad to repaint the parts that have cracked in the same way that I did to "Midday"

I think that it would be advisable to give it another month in order to be sure that it has finished cracking before repainting it. I may mention that it is not due to any barriers or mediums as I never use any. These in nine cases out of ten are the causes of Pictures cracking.

No solidly painted picture that is painted without them will crack provided it is given a proper time to dry between each painting & owing to the rush very often in getting pictures ready for Annual Exhibitions that is not always possible.

I am deeply sorry that it has done so in this case for when it occurs in pictures in Sydney it is more easily remedied, however if your Board is willing to let me have it back for a Month they will not have Cause to Complain of it cracking again"[7]

[7] Letter from Sid Long to Mr P. Gill (Art Gallery of SA). Dated 30 July 1899.

It was the combination of information gained, from both looking directly at the painting and at associated archival material, which helped to decipher part of the complex history of this painting. Even so, given this bulk of information, the true and whole story behind repainting and restoration is still a great deal of conjecture, enhanced also by what we know of the history of other paintings by Long. This story perhaps illustrates more usefully the type of interactions between the Trustees and artists. The Trustee's were quite prepared to express their aesthetic opinions and demand alterations, from this artist at least. Even more contrary to contemporary ideas of the roles of the artist and Trustee, is the apparent willingness, and even enthusiasm, of Long to make these changes. In my mind this may well have also been because Long found it impossible to stop working on a painting even after exhibiting and selling it. The gulf that now exists between the role of Trustee/curator and artist does not seem to have been that great in the late 19th, and early part of the 20th century. But perhaps Long is a special case, he did after all become a Trustee of the Art Gallery of NSW himself from 1933 to 1949.

Behind the brushwork, X rays and infrared photographs of Streeton paintings.

John Payne
Senior Conservator of Painting, National Gallery of Victoria

In 1993 and again in 1994 the conservation department of the National Gallery of Victoria shared small Australian Research Council grants with the Potter Conservation Centre at Melbourne University, to research the materials and techniques of Arthur Streeton. We had applied for a major project grant, proposing a wide ranging study including archival research, but were awarded two small grants which limited the scope of the project considerably. However a number of fields of interest were able to be explored and the beginning of the documentation of works held in the collection of the NGV was begun. The grant allowed the continued employment of Lois Mathieson at the Potter and Deborah Lau-Grieg at the NGV to carry out analytical work. We began with questions such as were the small painted panels prepared in someway before painting. There are contemporary manuals offering approaches to painting on wood and in Europe painting on unprepared panels had been advocated as early as the 1870's. An interest in this had come out of looking at some of the panels in the collection, in particular, *Circular Quay,* 1893, acc.no. A34/1980, which is unvarnished. In the end it is possible probably to surmise that the panels are not sized, certainly not given a ground layer, but it remains too difficult to determine if they have been oiled or treated with volatile solvents such as turpentine before painting. Louis began at the same time to carry out analysis of ground layer samples from works on canvas, looking for trends in material content in what are largely prepared colourmens grounds. Deborah began to work on the problem of determining whether an analytical method is available for the identification of genuine madder in samples from paintings. A quest which has led to some worthwhile observations and at the moment no conclusive result- though HPLC would appear to be the only viable analytical tool. Some of the material gathered around these themes will form part of an essay in the catalogue being prepared for the exhibition the Gallery will be assembling at the end of the year. Along with a comprehensive data base for the works in the NGV collection we took the opportunity to do infrared photography and X radiography of a number of paintings. The infrared photographs of works on unprimed panel have provided rewarding insights into Streetons development in drawing as well as painting, and at the same time lead to a re-appraisal of infra-red imaging. Apart from some revelations in pentimenti and old damages the radiographs also provide documents of painting technique.

Circular Quay is on one of the long thin panels painted in Sydney in 1893. Probably a drapers board given the light radius on the top and bottom edges. It dates from 1893, its not the earliest Streeton in the collection, but like the other panels it provided the best infrared images we have made. The underdrawing in the panel is revealed in the infra-red photograph. Despite the paintlayer appearing very confident with strongly hatched square brush work, the drawing is perhaps best described as restless. The constant drawing over lines and repeated working up of the forms in an image that was to be completely covered with the paintlayer can be read a number of ways. On one level it might be read as indicative of concern with the development of form and space. A single line might easily have provided the skeleton for the paintlayer. On another level it might be seen as thinking through the articulation of space that is developed in the image. A similar quality of expression is seen in the underdrawing in **Elizabeth bay,** 1894, acc.no. 1376/4, a year later. When we compare the underdrawing with the study from Heidelberg in 1888, five years earlier we perhaps see the origins of the drawing style but can't help but observe that this very deliberate process, strongly related to learning the process of drawing, has not been translated to the preparation of a painting five years later.

Examination of *Circular Quay* also revealed that the painting has never been varnished but more importantly that reserves of timber left in the image have been stained to increase contrast. These effects are particularly subtle and surely would be lost if the work were to be varnished.

The Long Wave Coogee , acc.no. 313/5 is another long thin panel. This time probably recycled silky oak. It dates from 1895. Perhaps because of the landscape format, or the fact that it was painted *en plein aire* the underdrawing in this work is minimal. The radiograph reveals an uncharacteristic lack of lead white in the sky, but in doing so renders the grain of the panel. With the *Long Wave* we again have an unvarnished panel, with reserves of timber in the image and more distinctive in fact, grains of sand emmbedded in the surface. There are photographs of Streeton working on the beach with panels propped up on driftwood and we certainly have evidence that the *Long Wave* was painted in the open.

Hawkesbury River , acc.no. A36/1980, is on canvas, a standard 20 x 30" Winsor and Newton format. Curiously we had trouble getting the quality of infrared images of works on canvas that we achieved with the unprimed panels and there is clearly a lot to tease out about the process. We did in the end register some feint drawing in this painting but the evidence from the panels would suggest there is more there than we are seeing. What is interesting with this painting is the radiograph. We have a sense when studying this work that the image lacks the final finishing detail that we expect in Streeton. Though these works might be based in direct observation and begun and sometimes finished in the field, there is a lot of detailed articulation of the surface which builds the completed image. That detail is lacking here. One reading of the X radiograph would suggest the picture may have been conceived differently to the image we have. There are reserves in the left and right sides of the image, particularly the sky, which have been worked over to complete the sky. Streeton leaves reserves in the sky for trees to fill, for instance in the radiograph of *Spring,* 1890, acc. no. A14/1978. Perhaps in *Hawkesbury River* we see the difficult process of working in the field and trying to resolve compositional problems, exposed before us. The reverse of the painting throws up another view of Streetons drawing. Infrared photographs reveal doodles which might be studies for the *portrait of Ned Hogan.*

Before moving on we will move back to 1892 and the **Portrait of Professor Marshall Hall,** acc.no. 1615/2. Thinking that Streeton had difficulty with figure studies and having registered the underdrawing in the panels we tried to pull up the drawing that would surely exist in this somewhat rare Streeton portrait. The reflected image from the front didn't give us much but transmitted IR did reveal the drawing amid some changes in the density of paint and some pentimenti. We register some variation in the nose, chin, ear and shoulder lines. Maybe not as hesitant as we might have thought, certainly not as worked up as *Circular Quay*, but still reflecting the function of the underdrawing.

Two panels from 1907 push the story a bit further. One **Mosman Bay**, acc. no. A39/1980 reveals a looser drawing style, approaching the style that carries through in drawings and watercolours as late as the sketch of the Harbour from 1926. Now the lines are more confident and almost cursury in the description of form and detail.
The other panel **Point Piper,** acc.no. A38/1980, throws up a considerable contrast to *Mosman Bay.* There are a number of paintings with the distressed surface that this painting presents. Notable in the contrast between the X radiographs. There is an appearance that the paint film has been radically altered in cleaning. The forms blur, the brushwork looks smudged and loaded with patination. These effects are particularly noticeable in details of the works. But again there are other readings of these images to be made. If we look at *Mosman Bay* we see the paintings that Streeton sold readily. The deft brushwork the predictable composition. This is all altered in *Point Piper*, the space is flattened the

composition less predictable. The now celebrated brushwork is pushed aside. Does *Point Piper* suggest the painterly boundaries that Streeton wanted to push against.

This theme is taken up fully in the painting **Crayfish**, acc.no. 1788/3 from 1925. This is not an inspired image but it reflects a pre-occupation in Streetons late works, a return to a kind of academic beginning that had never been, perhaps even reflected in the nature of that early underdrawing we looked at. But under this image the radiograph reveals a Harbour view. We dont know the date yet, it could be quite late, but what we do have is the ultimate erasing of the *Mosman Bay* style of image.
We know Streeton became disastisfied with the single track that his acceptance as a painter moved down, what we perhaps lack is a real sense of where he wanted to head and why. Apart from beginning to provide a core of technical data to call on the study, so far, begins to broaden our view.

I am grateful to both Jaqueline MacNaughton and Bronwyn Ormsby for thought provoking discussions following the presentation of this paper, leading to the present text. The nature of the underdrawing in Arthur Streetons paintings is worthy of considerable reflection.

RAMAN LASER MICROPROBE SPECTROSCOPY AND THE ANALYSIS OF MATERIALS FROM OIL PAINTINGS

Lois Mathieson

Kerry W. Nugent

Abstract

Raman microspectroscopy has already been demonstrated to be an extremely effective technique for the *in situ* analysis of pigments in medieval manuscripts. In the application of the Raman laser microprobe to the analysis of materials from oil paintings, limitations and difficulties have been identified, and specific advantages over other analytical methods illustrated. In the light of the current interest and activity in new developments in Raman technology, it is probable that Raman microspectroscopy will have a broader application to the analysis of artists' materials.

Footnote

This talk was presented by Lois Mathieson at the AICCM Paintings Symposium, Lorne, 16 March 1995. The work reported was carried out in collaboration with Dr. Kerry W. Nugent who runs the Laser Raman Facility in the Microanalytical Research Centre, Physics Department, The University of Melbourne.

RAMAN LASER MICROPROBE SPECTROSCOPY AND THE ANALYSIS OF MATERIALS FROM OIL PAINTINGS

Raman spectroscopy is not new. Since 1928, when C.V.Raman published a paper about the special nature of light scattered from an irradiated substance, the technique has been one of the standard spectroscopic methods for revealing information about molecular structure through the interaction of light with matter.

When a beam of monochromatic light is focused onto a sample, it is found that the wavelength of a small proportion of the scattered light is slightly modified according to the molecular composition of the sample material. Spectroscopic analysis of the scattered light will therefore give a spectrum which is uniquely characteristic of the molecular composition of the irradiated sample. Because such a small proportion of the scattered radiation is affected, Raman spectra obtained by means of traditional optics have been extremely weak, and would not have yielded useful data for the analysis of very small particles. Moreover, because it was not possible to produce pure monochromatic radiation, and because the irradiating beam was divergent, the irradiation of individual, very small pigment grains would have been precluded.

Laser technology has changed the situation. A laser is an intense parallel source of highly monochromatic radiation. In the Raman laser microprobe, a microscope is coupled to the spectroscope. The microscope is used both for selection of the particle to be sampled, and for the laser optics; final positioning and focussing of the laser is carried out by means of a colour television monitor. Field size (area of laser excitation) is limited only by the microscope optics.

Raman microprobe spectra of pigments were first published in the early eighties[1]. Since then, in a series of papers, Stephen Best, Robin Clark and co-workers have demonstrated the value of the technique for the in situ analysis of pigments in medieval manuscripts[2,3]. There have also been published results for pigments and dyes from works on paper[4,5]. Analysis of materials in oil paintings requires a somewhat different approach because of object size, the structure of the paint layer, and because of the chemical characteristics of binders and varnishes.

Over fifty samples from twenty eight paintings have been analysed on the DILOR XY Confocal Laser Raman Spectrometer in the Microanalytical Research Centre (Laser Raman Facility), Physics Department, the University of Melbourne.The microscope incorporated into the DILOR instrument is an Olympus BH2, with maximum magnification of X1000; it is possible to focus on particles as small as 1um. All experiments have been carried out with the green line of an argon laser (514.5 nm); because the laser energy is concentrated onto such a small field, power is necessarily very low, in the order of mW.

The main advantages of the technique may be summarized as follows:

1.Direct method; no special conditions for measurement

When the incident (exciting) radiation is in the visible region, aqueous solutions and suspensions are not precluded, nor are special optical materials required, in contrast to infra-red spectroscopy (FTIR) where non-glass components must be used in the light path, and contamination of the sample by water or water vapour must be avoided. Unlike scanning electron microscopy, where measurements must be carried out in vacuo, there are no such restrictions for Raman measurements which can be conducted in the laboratory environment. It is for these reasons that, with a special stage, artifacts of modest size such as medieval manuscripts can be examined under the microscope and analysed in situ. Unfortunately, since such an arrangement is unlikely to be a possibility for a large oil painting, micro-sampling then becomes necessary for materials analysis. However, sample fragments may be analysed without preparation, while for detailed information about the paint layers, embedded cross-sections or microtomed thin sections are equally suitable. FTIR is less versatile in that to obtain the most reliable, reproducible spectra, with good resolution, for paint layers in very small samples, transmission through thin sections is advisable. X-ray diffraction is applicable to the analysis of crystalline substances only, and as it is susceptible to interference from other substances which may be present, pigment grains within a paint layer cannot easily be analysed by this method.Some X-ray equipment requires an amount of material which is unacceptable for paintings analysis.

2.Excellent resolution

Because the microprobe can focus on a particle as small as 1um, spatial resolution is excellent. Moreover, Raman spectra might be described as lean and clean, with mostly narrow, sharp peaks. As a result, interpretation is considerably facilitated. In an FTIR spectrum, because some peaks are very strong and broad, and because the minimum field size is much larger than 1um across, there is much band overlap, and interpretation can be difficult. The scanning electron microscope on the other hand has excellent resolution.

3.Complete compound identification is possible

Whereas a method such as the scanning electron microscope, with X-ray emission, might reveal the presence of lead, and possibly carbon and oxygen[6] in a small pigment grain, the Raman microprobe will tell us whether the compound is, for instance, neutral lead carbonate, basic lead carbonate (lead white), lead acetate, or perhaps a small amount of lead oxide present as a contaminant in one of these (see Table 1). FTIR also gives complete sample identification, but for very small samples,there are limitations to the range of compounds which can be identified:many inorganic compounds of simple composition have spectra in the far infra-red in which region an extra-sensitive detector cannot be used. X-ray diffraction also gives complete compound identification, as long as the substance is a crystalline solid.

The Raman method can distinguish between substances such as:

(a) hydrated and anhydrous forms of the one compound, e.g. $CaSO_4$ (anhydrite) and $CaSO_4.2H_2O$ (gypsum).

(b) different oxides of the one metal, e.g. PbO (massicot, litharge) and Pb_3O_4 (red lead).

(c) compounds of exactly the same formula, but different crystalline structure, e.g. PbO (litharge and massicot) (Figure 1).

(d) different forms of ultramarine (violet, blue or green)[7].

(e) $PbCO_3$ (neutral lead carbonate) and $2PbCO_3.Pb(OH)_2$ (basic lead carbonate/lead white) (Figure 2).

(f) the two forms of lead tin yellow (Figure 3).

A useful feature of the DILOR laser microprobe is the facility to map for a specific compound (Figure 4).

As with all techniques there are some idiosyncracies and disadvantages. In Table 1, pigments which in this study have been found to be difficult to detect, are indicated.

The Raman method is about structure rather than quantity (though it can be used in a quantitative way to calculate, for example, the degree of unsaturation in an oil)[8]. Some compounds exhibit Raman spectra which, through resonance, are enhanced hundreds of times; such compounds can be detected even when present in extremely low concentrations. This can be an advantage, but also may distort the overall composition picture. Ultramarine and chromate yellows are pigments in which resonance spectra are produced by argon laser excitation. The Raman spectrum of ultramarine is so sensitive under these conditions that one sometimes has the feeling that the pigment is in the very air we breath. However, a sensitive, unambiguous method of detection for French ultramarine, in particular, is a bonus, since it is a finely divided pigment, and it may not be possible to distinguish it from other alumino silicates by electron microscopy or FTIR. Some substances are very poor scatterers; Prussian blue gives a very weak spectrum, and is difficult to detect. Since its presence can be significant for authentication (Prussian blue was first made at the beginning of the eighteenth century), it is fortunate that it has an extremely strong and distinctive band in the infra-red and can be detected by this method in the very low concentrations in which it may be present. The Raman spectrum of zinc oxide is also weak and, because the infra-red spectrum is in the far infra-red, there may be difficulty in detection without the use of other techniques.

Some pigments, such as vermilion, decompose readily in the visible argon laser, though by reducing the laser power, it has been possible to obtain characteristic spectra. Localized heating of the binder matrix may sometimes cause the decomposition of other pigments; one therefore must be cautious in deducing, for instance, that massicot which may

have been identified in a sample is there as a drier, rather than as a decomposition product of, say, lead chromate (chrome yellow) or lead white. To avoid error one should watch for any spectral changes during data collection.

A major problem for organic materials, when a visible laser is used, is fluorescence; materials which under normal conditions do not appear to fluoresce, may do so with such intensity under laser excitation that the Raman spectrum is swamped. Samples of natural organic binders and varnishes[9] which we have tested have failed to yield Raman spectra because of fluorescence; one organic material which has been found not to fluoresce in the argon laser is the polyester in which samples are embedded. Sadly, because of fluorescence, we have not been able to record a Raman spectrum for lake red grains within a pigment layer.

Not surprisingly, medium-rich pigment mixtures are especially susceptible to the extent that it is difficult to obtain Raman spectra for the pigment. In general though, fluorescence has been found to be less of a problem for thin (6um, microtomed) sections than for embedded cross-sections.

Several examples will serve to illustrate the strengths and weaknesses of Raman microprobe analysis for oil based pigment samples.

Arthur Streeton Untitled ('Still-life with Chops and Eggs'), n.d., oil on canvas

The still-life subject is chops and eggs, a bottle of wine and a few grapes. The work is in old master tones and is something of a curiosity because infra-red imaging has revealed stencilled lettering in white, under the image, which reads "Alpine Club Caller". Streeton exhibited twice at the Alpine Club in London, in 1909 and 1919. The sign, or notice, is in white on a blue glaze background. A white ground lies under the blue. Above the blue layer is a another ground, in off-white. The still life is painted over this. The condition of the painting is poor, with much cracking. Table 2 gives the Raman microprobe results for the blue and off-white layers in a sample taken from the still-life background. For these two layers, the investigation was plagued by fluorescence troubles, and the analysis would have been incomplete without the availability of other methods (optical microscopy including polarized light microscopy, scanning electron microscopy (with EDX), and FTIR): although Prussian blue, cobalt blue and zinc white were identified in the blue layer by these other methods, the Raman investigation failed to detect them. On the other hand, in spite of the fluorescence, a small amount of ultramarine was detected by Raman but not by scanning electron microscopy or FTIR.
In another sample (taken from the white of the egg shell) (Table 3), fluorescence prevented any readings at all from the off-white ground. It seems likely that massicot, which has been identified in the blue of both samples, is a degradation product of lead white; the inclusion of massicot as a drier in the porridge of fillers which makes up the off-white ground (Table 2) is however a possibility.

The Raman results are more interesting for the lead

white in the painting: in the still-life image (the egg shell), the white ground, and in the lettering of the sign. The spectra reveal that these whites contain a significant amount of neutral lead carbonate together with basic lead carbonate.

An investigation by Keisch[10] into the possible effect of production method on the composition of lead white indicates that traditional processes (chamber and stack) result in a low percentage of neutral lead carbonate (Keisch's data gives a mean of 3) as well as the main constituent, basic lead carbonate. Alternative 'modern' methods, introduced from the latter part of the 19th century, are likely to produce a more rather than less basic product. Of 27 late 19th century - early 20th century works investigated by Raman or FTIR[11], in only two others have significantly larger than expected amounts of neutral lead carbonate been found in lead white, viz. in one other Streeton (the ground of Arkwright's Valley, England, n.d.(c.1911)[12]) and in one Rupert Bunny, (Portrait of Percy Grainger, London, 1903-4). The atypical composition of these lead whites may indicate a common method of production and could suggest possible sources of supply.

John Russell Portrait of Dr Maloney, 1886, oil on canvas[13]

A sample from John Russell's Portrait of Dr Maloney has yielded results which demonstrate that the Raman microprobe can do a good job of identifying pigments in an oil painting. Table 4 lists all pigments known to be present in other than trace amounts and indicates those detected by Raman. Most of the pigments had already been recognized by polarized light microscopy, and confirmed by scanning electron microscopy, with FTIR for binder recognition and any incidental compound identification of pigments. Because of unfamiliarity with Russell's work, it was of interest to see if the Raman microprobe might turn up anything else, especially as Russell had some very definite ideas about paint additives. In fact, no driers were found, but again a small amount of ultramarine was unambiguously identified; this was of special significance since, together with the other pigments found in this sample and elsewhere in the painting, it makes up the set of preferred pigments listed by Russell in 1887.

Conclusion

The choice of an analytical technique depends on whether one requires, for example, to identify a specific compound in a pigment sample, or a pigment grain in a paint layer; to find out everything possible, in detail, about the composition of a paint layer; or, perhaps, authenticate a work. It may also depend on how much preliminary investigation has been carried out.In spite of limitations, because it is a direct method, with excellent resolution, giving complete identification of a compound without ambiguity, the Raman laser microprobe is a powerful technique for oil paintings analysis. It is important to appreciate that, for a complete analysis of a complex paint sample, a set of standard spectra is necessary and that even so, without prior investigation by optical microscopy, compounds

may be missed, or (as with ultramarine) resonance spectra may give a distorted composition picture. But the method is particularly valuable for rapid identification of very small pigment grains in a paint matrix and for distinguishing between closely similar compounds, or compounds of the same chemical formula but different crystalline structure

I should add that only the one visible laser, argon 514.5nm, has been used in the work reported here; the use of alternative visible lasers is a well known practice which can avoid some of the difficulties caused by resonance.

Clearly fluorescence is a problem, especially with organic binders and varnishes. But there is currently intense activity in the Raman world aimed at overcoming this.With FT Raman giving faster data collection and much improved signal to noise ratios; with fluorescence reduced by using near-infra-red lasers, and with a new generation of detectors and gratings spectrometers, it may not be too much to hope for a microscope instrument that will be sensitive enough to deal with a much wider range of oil paintings materials on a microscopic scale.

Acknowledgments

The work was supported by grants from the ARC for which acknowledgment is gladly given.
Acknowledgment is given for the cooperation of collectors and museums for allowing access to their paintings, and in particular to Ms. Frances Lindsay and the University of Melbourne Museum of Art, and to The National Gallery of Victoria for allowing access to the Portrait of Dr. Maloney for the ARC funded John Russell research project. The Arthur Streetons from the NGV collection were studied as part of the joint (IPACC/NGV) research project; John Payne and Deborah Lau Grieg are acknowledged for their cooperation.
Dr. Stephen Best is acknowledged for making available un-published data, and for helpful comments. Robyn Sloggett and Dr. Stephen Prauer are acknowledged for their support.

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12 From the National Gallery of Victoria collection (one of the works included in the joint ARC Streeton Prolect)the

13 From the National Gallery of Victoria collection.

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TABLE I COMPOUNDS/PIGMENTS FOR WHICH STANDARD SPECTRA HAVE BEEN OBTAINED

D SiO_2/quartz

PbO/massicot

PbO/litharge

$Pb(CH_3COOH)_2$/lead acetate

$PbCO_3$/neutral lead carbonate

$2PbCO_3.Pb(OH)_2$/basic lead carbonate/main constituent of lead white

$PbSO_4$/lead sulphate

ZnS/zinc sulphide

D ZnO/zinc white

$CaSO_4$/anhydrite

$CaSO_4.2H_2O$/gypsum

$CaCO_3$/calcite/chalk

D $Al_2(OH)_4Si_2O_6$/kaolin/clay

TiO_2/rutile

$BaCO_3$/witherite

$BaSO_4$/blanc fixe

D C/graphite

$CoAl_2O_4$/cobalt blue

$2CuCO_3.Cu(OH)_2$/azurite

D $Fe_4[Fe(CN)_6]_3$/Prussian blue

ultramarine

cerulean blue

smalt

phthalo blue

$Cu(CH_3COOH)_2$/copper acetate/neutral verdigris

$Cu(CH_3COOH)_2.3Cu(AsO_2)_2$/emerald green

$Cr_2O_3.2H_2O$/viridian

Cr_2O_3/chromium oxide green

MnO_2/manganese dioxide

$Fe_2O_3.H_2O$, clay/raw sienna

$Fe_2O_3.H_2O$, clay/yellow ochre

Fe_2O_3, H_2O, MnO_2/raw umber

$Co_3(PO_4)_2$/cobalt violet

$SrCrO_4$/strontium yellow

$CaCrO_4$/calcium yellow

$ZnCrO_4$/zinc yellow

$PbCrO_4$/chrome yellow

$PbCrO_4.Pb(OH)_2$/chrome orange

$BaCrO_4$/barium yellow

CdS/cadmium yellow

CdS,Se/cadmium red

TABLE 2 Arthur Streeton Still-life ('Chops and Eggs)
Pigment analysis
[ ] denotes a minor constituent

Sample	Pigment detected	Method of detection				Comments
		Light microscopy	SEM-EDX	FTIR	Raman Microspect	
1 Grd(1)						
Blue layer	Massicot		Pb		*	Fluorescence
	Lead white Zinc oxide		Pb Zn		*	
	Cobalt blue	*	Co Al			
	Prussian blue		Fe	*		
	[Ultra-marine]	*			*	
	[Silicate]		Al Si K			
Off-white layer	Silica/ quartz		Si			
	[Lead white]		Pb		*	
	[Massicot]		Pb		*	
	Yellow ochre	*	Fe		*	
	Zinc oxide		Zn		*	
	[Silicate]		Al Si			
	[Cadmium yellow]				*	Trace only
	Black particles	*				
			[Cu]			Trace only

Table 3 Arthur Streeton Still-life ('Chops and Eggs)
Pigment analysis
[ ] denotes a minor constituent

Sample	Pigment detected	Method of detection				Comments
		Light microscopy	SEM-EDX	FTIR	Raman Microspect.	
4 Grd	Lead white	*	Pb	*	*	some neutral lead carb. (FTIR Raman)
			[Al]			Trace only
Blue layer	Prussian blue		Fe	*		
	Lead white	*	Pb			
	Zinc oxide		Zn			
	Massicot		Pb		*	
	Cobalt blue		Co Al			
	[Silicate]		Al Si K			
			[Cu]			Trace only
Off-white layer	Lead white	*	Pb			
	Yellow ochre	*	Fe			
	Zinc (oxide)		Zn			
	Silicate		Al Si K			
	Brown/ black	*				
			Ca			
White image layer (below eggs)	Lead white	*	Pb	*	*	some neutral lead carb (FTIR, Ram
	Zinc oxide		Zn			No sulphur present
	Ultra-marine	*			*	
	Vermilion	*			*	
	Cobalt blue		Co Al			
			[Fe]			Trace only

TABLE 4 John Russell Portrait of Dr Maloney Pigment analysis
[ ] denotes a minor constituent

Sample	Pigment detected	Method of detection				Comments
		Light microscopy	SEM-EDX	FTIR	Raman Microspect.	
3 White layer/ grd.	Lead white	*	Pb	*	*	
	[Ultra-marine]	*	[Al Si]			Trace only
	[Cadmium yellow]	*	[Cd]			Trace only
Blue/ green	Viridian	*	Cr	*	*	
	Cobalt blue	*	Co Al		*	
	[Vermil-ion	*	[Hg]		*	Trace only
	[Ultra-marine]	*	[Si] Al		*	
	Emerald green	*	Cu As	*	*	
	Lead white		Pb			Not a major constituent
			[K,Cd Ca]			
			[Zn,Fe,Ni]			Trace only
Green-ish layer	Emerald green	*	Cu As	*	*	
	[Vermil-ion]	*	Hg		*	
	[Lead white		[Pb]	*		
	[Ultra-marine]		[Si] Al		*	Trace only
	[Cobalt blue]		[Co] [Al]			Trace only
			[Cr,K]			Trace only
Between layers	Madder lake	*				

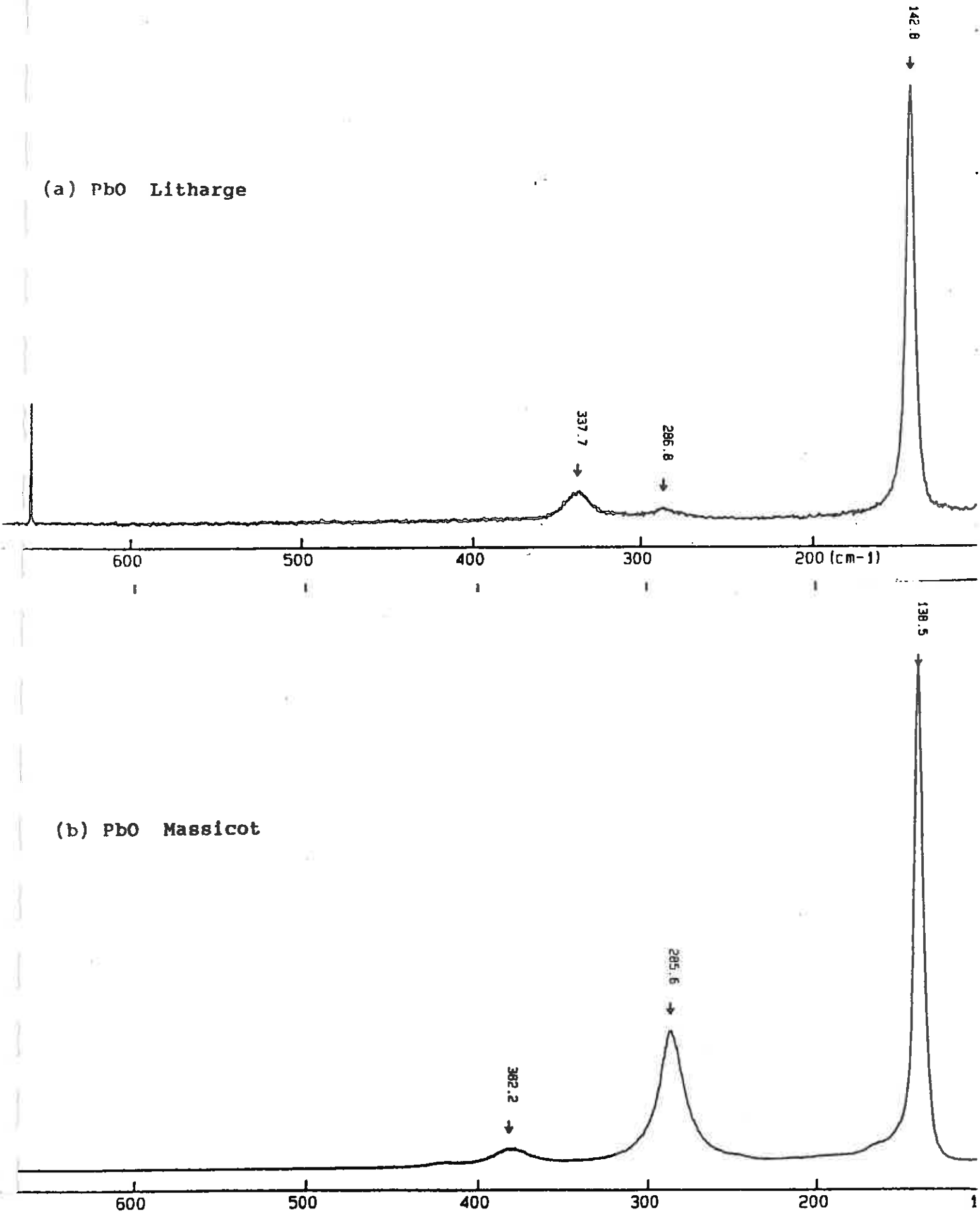


FIGURE 1 Raman spectra of two forms of lead (11) oxide:
(a) litharge (b) massicot

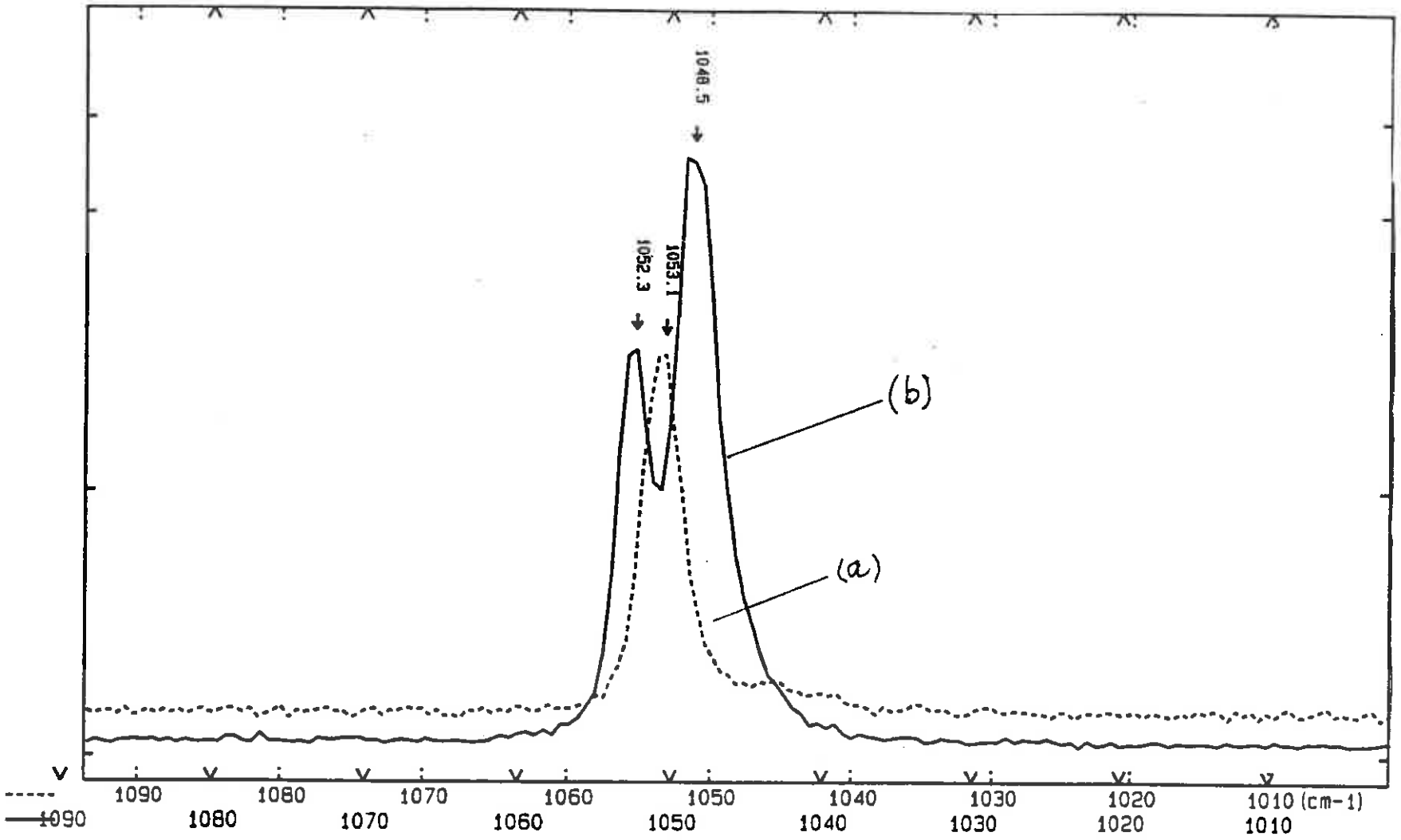


FIGURE 2 Raman spectrum of (a) neutral lead carbonate;
(b) basic lead carbonate with some
neutral lead carbonate (lead white)

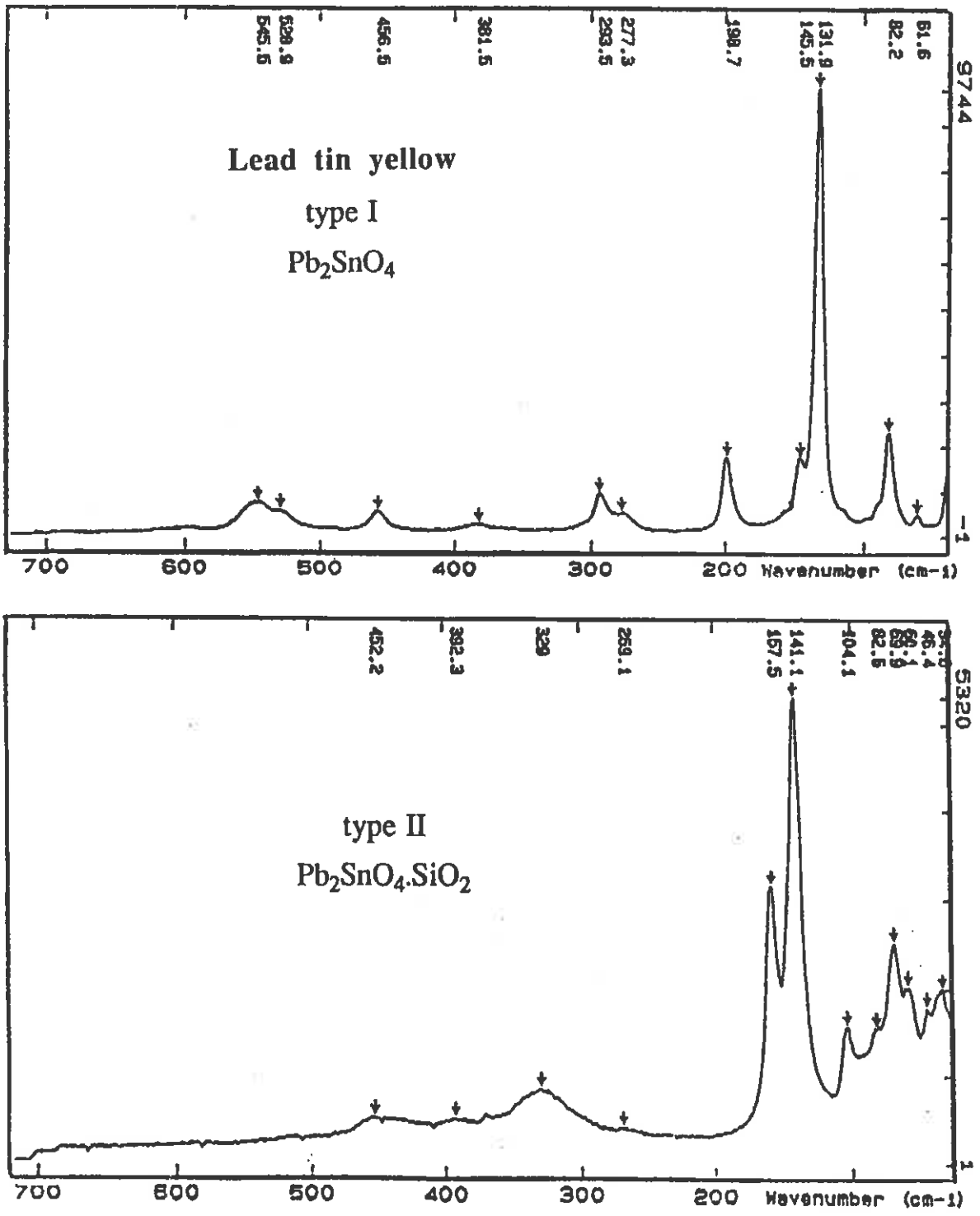


FIGURE 3 Raman spectra of the two forms of lead tin yellow (unpublished data provided by Dr Stephen Best)

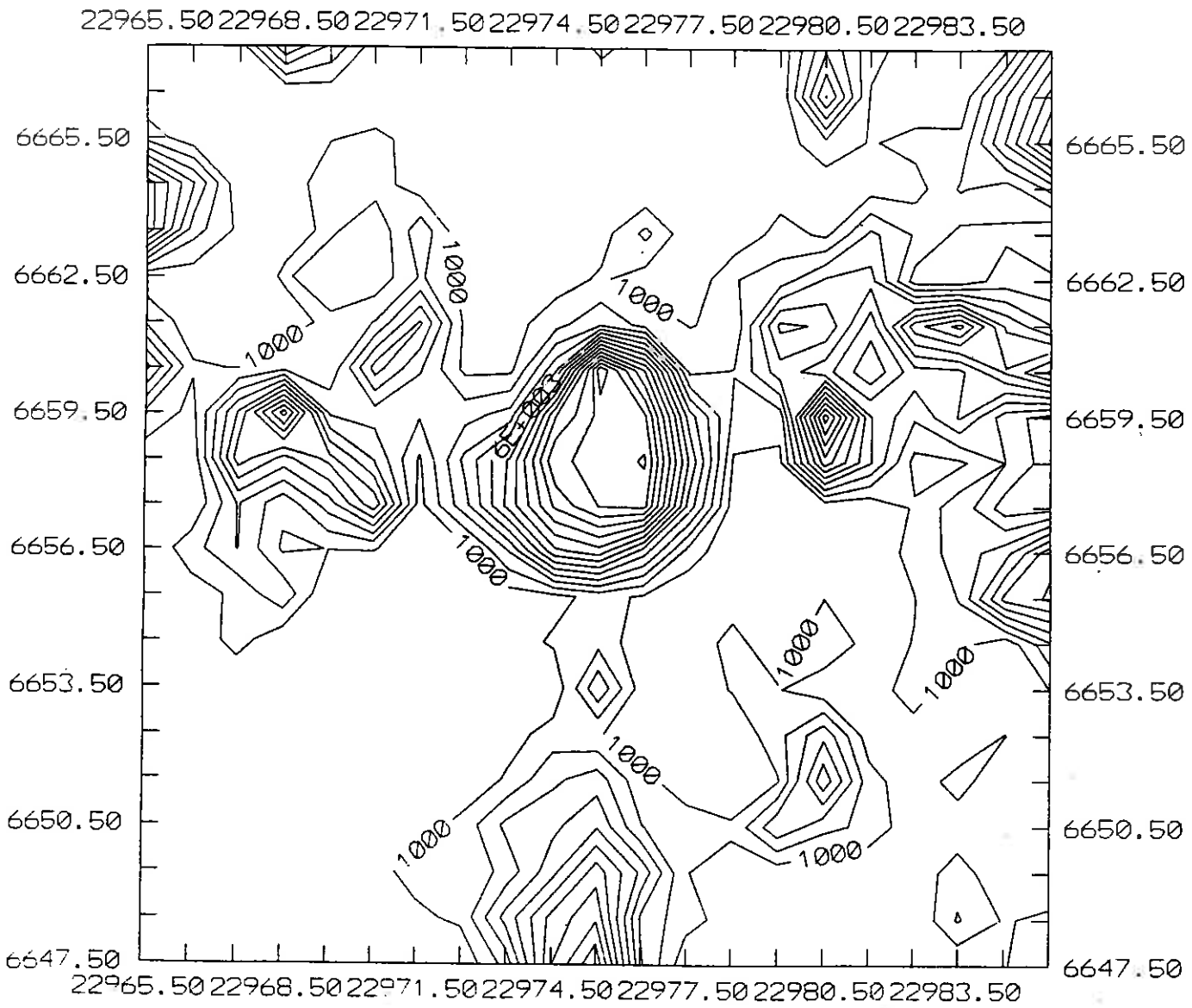


FIGURE 4 Ultramarine in thin section, mapped over 20x20μm

10 March 1995

Abstract of Paper to be Presented at the AICCM Paintings Group Symposium, Lorne, March 1995

Deborah Lau Greig

• An Evaluation of the Instrumental Techniques Suitable for the Analysis of Pigments

This paper considers nearly twenty methods of instrumental analysis which have been reported to have application or relevance for the analysis of materials in Conservation. Of these, eight have demonstrated suitability for the analysis of pigments in paint layers. The methodology of those eight is discussed; mode of operation; sample preparation and operating limitations. This should allow the Paintings Conservator to make the critical decision as to which is the most suitable method of analysis for the pigment in question. Also discussed is the increase in statistical error associated with limited sample size and number, and the increase in the probability of a successful identification with multiple methodologies, including non-instrumental techniques.

An Evaluation of the Instrumental Techniques Suitable for the Analysis of Pigments

Deborah Lau Greig
March 1995

1. Scanning Electron Microscopy/
   Energy Dispersive X-Ray Spectroscopy (SEM/EDX)
2. Raman Spectroscopy
3. X-ray Diffraction (XRD)
4. Infrared Spectroscopy (FTIR)
5. High Performance Liquid Chromatography (HPLC)
6. Mass Spectrometry

1. SEM/EDX

1.1 Principle

- Identification based on atomic constituents.

1.2 Sample Presentation

- Embedded, ground, cross section
- Microtomed sections
- Pigment grains
- Sample placed on stub, conductive coating applied

1.3 Applications/ Suitability

- Elements >Na (AW = 11)
- Inorganic pigments
- Lake mordants

1.4 Disadvantages/ Advantages

- Unlaked organic pigments undetected (eg, indigo)
- Energy overlaps (eg, S and Pb)
- Colour image needed for pigment location
- Extremely small target area (0.1μm)

2. Raman Spectroscopy

2.1 Principle

- Identification based on characteristic shift in monochromatic incident illumination

2.2 Sample Presentation

- Embedded, ground, cross section
- Microtomed sections
- Pigment grains
- Sample placed on glass slide under Raman microscope

2.3 Applications/ Suitability

- Inorganic and organic pigments

2.4 Disadvantages/ Advantages

- Thermal decomposition can occur
- Fluorescing pigments cannot be measured
- Non- destruction of sample
- Minimal sample prep
- Small target area (1μm)
- Identification of compound, not elements

3. XRD

3.1 Principle

- X-ray diffraction pattern is unique for each crystalline compound

3.2 Sample Presentation

- Powder diffraction
- Single crystal analysis

3.3 Applications/ Suitability

- Crystalline samples

3.4 Disadvantages/ Advantages

- Sample manipulation can be difficult
- Adhering media can interfere with diffraction
- Unique and characteristic spectra for species (eg, Cu greens/blues)

4. FTIR

4.1 Principle

- Measurement of the absorption in the infra-red region

4.2 Sample Presentation

- Larger samples ATR, MIR, diffuse reflectance
- Small samples microscope - microtomed sections
  - diamond anvil
  - squash on disc

4.3 Applications/ Suitability

- Molecular samples
- Organic (where discrete) and inorganic

4.4 Disadvantages/ Advantages

- Unsuitable for 'complex' samples
- Unsuitable for non-covalent samples (eg, Vermillion)
- Large variability between samples
- Chemically similar samples (organics) give similar spectra
- Especially suitable for analysis of media / coatings
- Sample retained

5. HPLC

5.1 Principle

- A separation technique based on the affinity of the analyte for the column.

5.2 Sample Presentation

- Paint sample solubilised, injected onto column

5.3 Applications/ Suitability

- Organic pigments

5.4 Disadvantages/ Advantages

- Time consuming
- Only method for identifying non-discrete pigments (glazes).

6. Mass Spectrometry

6.1 Principle

- Analyte is fragmented, proportions of fragments measured.

6.2 Sample Presentation

- GC inlet
- Direct probe
- Laser Microprobe

6.3 Applications/ Suitability

- Any species

6.4 Disadvantages/ Advantages

- Unless volatile enough to GC, must be pure sample

Other Methods of Pigment Analysis

- Transmission Electron Microscopy/ Electron Diffraction Spectroscopy
- Nuclear methods (PIXE, PIGME)
- Optical microscopy (morphology/ polarized light, etc)
- Microchemical tests

CONCLUSIONS

- The choice of method of analysis ultimately depends on the nature of the sample.
- Selection criteria:

  Discrete pigment grains
  Organic / Inorganic
  Properties eg; crystallinity

All methods of analysis have inherent error, and using multiple methodologies serves to minimise error and increase the probability of a correct identification.

RECENT OBSERVATIONS ON MATERIALS TECHNIQUES AND CONSERVATION

Gillian Osmond

This paper examined paintings in preparation for the recent Fairweather retrospective exhibition. Observations on technique were made of paintings from three broad media categories: oil, gouache, and synthetic polymer paint, representing chronological development of Fairweather's work. Detailed surface examination gave surprising insight into Fairweather's working practice and his experimentation with materials. Examination of cross sections and scanning electron microscopy-energy dispersive X-ray analysis were also referred to. Informations seems to correlate with writtten and verbal accounts regarding Fairweather's work. The condition of Fairweather's paintings was discussed. In most instances, deterioration can be linked to the materials and techiques used by the artist. Aesthetic and structural issues were raised. Conservation of several paintings prepared for exhibition (and for travel) was described.

ADULTERATION IN ROBERSON'S PIGMENTS

by

Narayan Khandekar and Sally Woodcock

When the firm of Roberson ceased trading in 1985 the majority of the contents of their workshops were bought by the Hamilton Kerr Institute, Fitzwilliam Museum University of Cambridge. Further purchases have been made of Roberson stock. In 1993 Sally Woodcock was appointed by the Institute to examine and interpret the archive.

Samples of unbound pigments and samples from a watercolour sketch book dated to c. 1887. (inside the front cover was handwritten 9/3/87) were analysed. 56 of the 96 colours were sampled from the book. The selection was based on the findings of the analysis of the unbound pigments mostly twentieth century. This amounted to approx 150 samples, analysed by polarised light microscopy and fluorescence microscopy. The address of Roberson's changed frequently this and the change of labels allowed dates of manufacture to be estimated for each of the samples.

Problems of complex nineteenth century nomenclature, purity of supply, pious fraud, different recipes for various media and changing recipes were considered in analysing the results.

Results of Analyses.

It is important to note that well over half of the 19th century pigments analysed match the reported composition. A substantial number, however, had been substituted or contained additional material.

It was found that there were no microscopically identifiable adulterants in blacks, earth colours, natural and synthetic ultramarines, cobalt green, most red lakes, vermilion, orange vermilion, aureolin, cadmium and chrome yellows and Indian Yellow. Not necessarily all cheaper pigments

There are a number of pigments which have other minor additions of pigments presumably to correct the tone e.g. smalt which had the addition of green lake and dyes or malachite where a yellow lake and artificial ultramarine are present. No attempt has been made to replace the unstable malachite. Ultramarine ash contains some artificial ultramarine.

The main adulterant in the watercolour pigments is the addition of extenders. Extenders are not listed as ingredients in Roberson's watercolour cakes. (gum arabic, gum senegal, isinglass, honey, sugar, "Chinese liquid")

Olive green does not agree with any recipe.

The well publicised adulteration of vermilion with organic pigments was not detected.

Emerald oxide of chromium was found to be the same pigment as viridian.

Comparison with Twentieth Century Pigments.

Emerald oxide of chromium was a mixture of viridian and another green oxide of chromium. Viridian was found to be mixed with charcoal. Transparent oxide of chromium was found to be possibly copper resinate, certainly not an oxide of chromium. Emerald Green in the nineteenth Century book consisted of artificial malachite whereas in the twentieth century samples it is composed of an aceto arsenite of copper, as expected mixed with green oxide of chromium. Some of the adulteration in the nineteenth century samples was corrected later on in production.

Brown pink in the nineteenth century samples were made from a yellow lake. The twentieth Century sample was made of a mixture of Indian Yellow, Van Dyke brown, raw umber, verdigris and a green lake.

Sap green was found in the watercolour book to be a mixture of two green lakes, in accordance with recipes in the Roberson Archive. The dry twentieth Century pigment was found to be a phthalocyanine green, yellow lake and red lake, again a mixture of pigments to approximate the original colour.

In the nineteenth century the alizarin yellows were found to consist of yellow lakes, in the twentieth century there is an addition of a non transparent iron yellow to the pigment mixture.

Note

The results are taken from two papers. The first will appear in 'The Conservator' vol. 19, by Joyce Townsend, Leslie Carlyle, Sally Woodcock and Narayan Khandekar. The second to be published in the Conservator next year authored by Sally Woodcock and Narayan Khandekar.

THE CLEANING OF A POLYURETHANE VARNISH FROM ARTHUR STREETON'S *EVENING WITH BATHERS*

INTRODUCTION

Evening with bathers by Arthur Streeton was painted in 1888, making it the earliest Streeton in the collection of the National Gallery of Victoria. An extremely thick and drastically discoloured surface coating existed on the work when it came into the building in 1982. The extent of the disfiguration however, had not been fully realised until the recent examination of the picture. This examination revealed a complex structure, comprising original material, the artist's later alterations, a damaged paint film, subsequent overpaint, and several layers of varnish. The most immediately disturbing aspect of the appearance of the work was the surface coating which was so thick as to completely obscure colours and texture of brushwork, with areas of impasto appearing as formless lumps in a plasticky film. The coating was extremely yellowed with a satin sheen. This, combined with a network of overpaint covering most of the sky and some of the foreground, created a darkened, and in some areas opaque film over the surface of the work. This level of interference, and the ageing of the added materials meant that the painting was completely disfigured and unable to be viewed in its intended condition.

The task at hand, was hence to determine the possibility of removing varnish and overpaints (while being able to differentiate between these and alterations made by Streeton), and whether or not there was sufficient original surface to recover, the extent of damage to the paint film being obscured by the surface additions.

IDENTIFICATION OF THE VARNISH

The solubility characteristics of the varnish were to pose a cleaning challenge, the coating not responding to any conventional solvents tested. Analysis of the coating was conducted using photoacoustic and transmission FTIR microspectroscopy. Results from both techniques were agreeable, with an oil-based polyurethane being the most likely match (arrived at through comparison of reference spectra with the test spectra).

Oil-modified polyurethanes are prepared by alcoholising a drying oil (such as linseed oil) with a polyhydroxy compound such as glycerol. Free hydroxy groups then react with a diisocyanate. The resulting product is therefore composed of unsaturated hydrocarbon chains linked by urethane groups. This material is remarkably hard, tough and moisture and chemically resistant. (Surface Coatings, pp116). Examples of use include gym floors, industrial and concrete floors, marine finishes, and in chemically resistant paints for metals.

STRUCTURE USING CROSS SECTIONS

Samples were taken for cross sectioning from several areas around the edges. The number of varnish and overpaint layers are inconsistent throughout. The overpaint sits in between varnish layers. The varnish layers do not fluoresce the same, due either to different ageing processes or to there being different materials present.

CLEANING STRATEGY

Extensive solubility testing was now required to determine whether the coatings could be removed, whether they would need to be removed in stages layer by layer, and whether the overpaint could be removed at all. The stability of the original paint film was also an issue. It was clear from microscopic examination that the paint surface was distressed and abraded and faint scratch marks were visible in certain directions suggesting the use of pumice or sand paper. The painting had also most likely undergone a previous clean as very dark resinous residue was visible in paint recesses. It was obvious that the paint film had suffered a high level of interference and it was unknown to what extent previous cleaning solvents and procedures had leached and damaged it.

It was clear that, due to the chemical structure of the urethane or urethane oil, that a cleaning system would require both a polar and an aromatic component to affect the coating. As mentioned, solvents alone were not adequate. It appeared that due to the nature of the polyurethane, the severe ageing of the coating, and the subsequent cross linking involved, the contact time of the solvents with the varnish needed to be increased. In this way, it was hoped

to avoid the need to use undesirably potent solvents. A solvent gel appeared to be the answer.

SOLVENT GELS AND SOLUBILITY TESTING

Two gels tested were found to be successful in removing the coatings. Both contained both aromatic and polar components, the first an acetone / xylene mix, the other an ethanol / xylene mix. The ethanol / xylene gel appeared a safer option for the paint film, hence detailed testing with this gel was commenced. Tests were carried out around the rebate edge and later further into the paint film. It was found that the amount of time the gel was left on the surface was absolutely critical, and also directly dependent on the thickness of the coatings in that area and the amount of overpaint present. The sky area appeared to behave consistently, largely due to the fact that the sky had been abraded or scrubbed and had only remnants of brush work intact. It was therefore a fairly smooth surface with layers of varnish of even thickness throughout. Contact time for the gels were varied from 1 minute to 7 minutes, the most successful time for the sky area being 3 minutes. The gel was then wiped off with a dry swab and cleared with Stoddard solvent. This treatment appeared to remove upper layers of varnish, while leaving a softened film of overpaint and undervarnish. This could then be removed using 20% ethanol in white spirits v/v, recovering a paint film which was unharmed by the process.

The foreground areas tested posed a more challenging approach, for a number of reasons. The paint film appeared more sensitive to the cleaning materials, particularly the clearing solvents. When the same procedure as used for the sky was employed here, (i.e. leaving the gel on for 3 minutes, clearing the gel with Stoddard, and then any overpaint with 20% ethanol in white spirits), a dry and sometimes blanched surface was left. With excessive use of the 20% ethanol in white spirits, the tops of original brush stroke ridges would be removed in isolated areas. By leaving the gel on for only 2 minutes, the upper varnish softened enough to be able to be removed mechanically with a swab stick. This reduced any possible contact of the gel with the paint layer. It was also found that by clearing the gel with Stoddard immediately, but then allowing time for the paint surface to dry again between this and the use of the 20% ethanol in white spirits, that the paint did not blanch as much, nor risk being solubilised. Another reason the foreground presented

more of a challenge was because the paint layer is still quite textured here, unlike the sky. As a result the varnish varies in thickness quite a lot from thinner over high points in the paint layer to extremely thick in recessed areas. As mentioned, the working efficiency of the gel is directly dependent on the thickness of the varnish, hence does not work as evenly in these areas. However, the varnish is generally softened enough in thicker areas to be removed mechanically with a pick or swab stick.

CLEANING

It was decided to commence cleaning, the proposal being to clean the sky completely of all varnish and overpaint, as the original paint in this area was stable enough and the procedure relatively uncomplicated. The foreground would need to be cleaned slightly more selectively, probably less completely, and following a procedure more taylored to each localised work area.

The cleaning of the sky was commenced using the following procedure;

The painting was set up under the binocular stereomicroscope, and all stages of the process carried out and monitored carefully under magnification. The gel (recipe on overhead) was applied with a sable brush and quickly spread over a small area (2 x 2cm maximum). Only a small area could be done at a time so that the gel was on the entire area for the same amount of time. A fine brush was used to push the gel to the very edge of the last cleaned area. Obviously it was critical not to get any gel at all on the original paint. A photographer's timer with alarm was used each time to ensure an accurate 3 minute period for the gel to be left on. The gel was quickly wiped off with a dry swab and the area cleared immediately with Stoddard solvent. This was chosen to clear the gel components (Carbopol and Ethomeen C25) for its aromatic character. Most of the varnish would be rubbed off with this swab. Softened overpaint, softened undervarnish and often residues of the yellow varnish would remain on the surface. The area was left for several minutes and 20% ethanol in white spirits v/v was then used to remove the remaining overpaint and varnishes. Softened residues of the upper varnish layer would often need to be removed with a swab stick or fine pick.

During the time the gel was on the surface, it was possible to see the polyurethane slowly swell until it was quite wrinkled and delaminating from its substrate. The edge left by the clean was extremely sharp, due to the specificity of the gel. It was also possible to see how thick the varnish was and the extent to which it and the overpaint were obscuring the original paint. It is interesting to note that in areas with overpaint completely covering the original, the varnish didn't swell as quickly and after 3 minutes was softened but still had to be mostly mechanically removed. This could not be predicted and so it wasn't safe to leave the gel on for longer periods. However, generally 3 minutes worked beautifully. As cleaning from the top to the horizon progressed, a subtle change in colour from pale aqua to deep mauve became apparent. This transition was not visible at all under the surface coatings, and the colours themselves were a revelation.

The recovery of the moon was an important stage in cleaning, considering its shifted position and phase. The area where the full moon used to be (as seen in the x-ray) was covered in much overpaint and was lumpy to touch. It was unclear how much damage might be revealed in this area. Fortunately, disruption here was negligible, and it became obvious that it was indeed Streeton who had made this alteration. The crescent moon was also obscured with clumsy overpaint and it was unclear how much of the original remained. Again, the surface that was revealed was slightly abraded, but otherwise intact and the moon itself delicately rendered.

The foreground area is still undergoing testing due to the complex nature of its problems. Although the paint layer appears stable during the entire procedure when observed through the microscope, the appearance on drying is bloomed or blanched. It is difficult to discern whether this is occurring in residual varnish material or in the upper part of the paint layer itself. The fact that it wasn't occurring in the sky, using exactly the same procedure, suggests the paint layer is being affected. As mentioned, by leaving the gel on for only 2 minutes, wiping off with a dry swab, clearing immediately with Stoddard, *but then allowing to dry* before removing overpaint with 20% ethanol in white spirits appears to give the paint layer time to stabilise and much less blanching is observed. This procedure will need to be followed for certain areas in the foreground. Tests do not reveal a consistent pattern or relationship here.

CONCLUSION

As seen in the slides, a painting which was previously so disfigured as to be considered lost is being recovered. Colours and deft brushwork so much more characteristic of Arthur Streeton are being revealed. An ethereal atmosphere is developing. The unpredictable nature of what is being revealed and the radical change taking place makes the task exciting. Curators and others are seeing the painting closer to what it originally would have been for the first time and must review their perceptions and documentation. Restoration will be required, although will be less than first thought. Some inpainting of the most severe drying craquelure and a low key varnish may be all that is required to give an appropriate finish to the newly unveiled paint surface.

JO SHEA
AFV PAINTINGS CONSERVATOR
NATIONAL GALLERY OF VICTORIA

Solvent gel recipe used for cleaning Arthur Streeton's
Evening With Bathers

This is an adaption by Jo Shea of an original recipe
of Richard Wolbers

2 gms carbopol 934
10 ml ethomeen C25
15 ml deionized water
50 ml xylene
90 ml ethanol

THE ARTIST AND THE CONSERVATOR: THE BEGINNING OF A DIALOGUE AT THE QUEEN VICTORIA MUSEUM AND ART GALLERY

Therese Mulford

Abstract

The Queen Victoria Museum and Artt Gallery is well-known for its colonial paintings. However, few practicing artists in Tasmania, saw the conservator as a resource to be used for information regarding materials and methods of construction for contemporary work. The trickling of a few enquiries led to an endeavour to involve contemporary artists so that a dialogue could begin. Much is left to be accomplished.

" Artists vary in their attitude toward the historical importance of the work they produce.....I think of the life of a work as correlated to my own. Each thing made is part of a larger activity that includes writing, speaking, teaching, and exhibiting. The most I would ask is that all my work be fully available, and in good condition, during this short span, and I balance the deleterious effects of time, handling, and exhibiting against this need. If there is anything left at the end of 50 years of greasy fingers, bumpy roads, and leaky studios, I can only see it as a bonus, and thank my friends, the conservators, for it." Liz Magor, Toronto artist.

As conservators, we have a three-fold responsibility: to the work, to the artist, to the public. How a conservator balances this three-fold responsibility is not specific or pre-determined. At the Museum, I am rather isolated from the public, working off-site, primarily on 19th century paintings. At the start of my time at the Museum, a few enquiries by practicing artists trickled through and made me realise that there was a responsibility to these artists as well as to the works of artists who were no longer living.

The first step in becoming more relevant was to begin gathering information concerning practising Tasmanian artists' materials and techniques while those artists were still alive. To obtain this information, artists were approached by means of a questionnaire which was based on one used by the National Gallery of Australia (Attachment 1). The artists involved regarded the gathering of this information as important but did need encouragement and cajoling to fill out the form.

As a result of this first questionnaire, other issues evolved, such as the suitability of the language in the questionnaire and the questionnaire itself. The questionnaire was not appropriate for artists of long standing who had changed their methods and

materials . Therefore, another was developed that would cope better with the phases or stages of an artist (Attachment 2).

One artist, Paul Boam, suggested that photography of the studio and materials would provide more information than the questionnaire particularly in relation to working methods. This suggestion was followed through and resulted in a more meaningful dialogue occurring and more information being exchanged. (See illustrations) Twenty-nine artists were photographed. Many artists provided records of their previous studios. Some wrote about their relationship to their studios and their materials (Attachment 3). Interestingly, the artists in the north of Tasmania tended to be female whereas the artists in the south tended to be male. This may be possibly due to the supportive and mentor role Bea Maddock plays in the north.

Some artists worked in a small room creating big paintings; others worked in their lounges, others had purpose-built studio, others had leantos or sheds which are very chilly in the winter.

Several things emerged as a result of this exchange. Many artists were concerned about the appropriate fixative to use for their drawings. Others were oiling their paintings because it 'fed' them. Many were interested in sources of supply because materials were difficult to obtain. Northern artists often travelled to Hobart for supplies. Those who could afford it or who were very committed to specific materials would travel to Melbourne. This difficulty in obtaining materials did influence the mediums which artists used. Some changed or adjusted their framing practices as a result of dicussions. The most common framing device was to nail a slim frame to the stretcher which denied future keying.

Increasingly, it became obvious that collecting information about artists' materials was not enough. The artist's intention, the concept of the work, the reason for selecting construction methods and materials are all intertwined.

A day-long workshop " Materials Awareness For Painters ", designed specifically for painters, both students and practitioners, eventuated 1993. This was a collaborative venture between the Museum and the Tasmanian School of Art at Launceston. The aim was to increase awareness of the conservation implications of various painting practices.

Paul Bishop, Paintings Lecturer from the University, started off the day by focussing on making or creating work. I discussed some philosophical concerns concerning a dialogue between the artist and conservator. Isolating materials and techniques outside the work placed them out of context and there is a danger in that.

A history of methods of constuction was presented so that the existing methods could be put into perspective.

A boolklet was produced with this information and materials such as modern tube colour and viscosity, encaustic, oil mediums, and grounds. Bea Maddock made her encaustic formulations available. Discussion about construction made it evident that most artists did not think in systems. Some traditional methods and materials were used but not all. The romantic appeal of linen was prevalent; some artists sized their canvasses but then used acrylic grounds.

Three artists, Bea Maddock, David Marsden, and Kit Hiller, presented their working methods and painting philosophy. Each artist differed. Kit Hiller worked in water colours with a model, being careful in the selection of paper, paint quality and brushes. Bea Maddock worked in a highly considered manner, doing trials and tests before embarking on her large scale works. David Marsden worked more intuitively, or as he refers to it in an ' agrarian ' manner, using what was at hand at the time. Some of his work uses weathered and deteriorated elements. This made for a stimulating discussion about the role of the conservator in such situations. Bea said she had to work in a structured and considered manner to control the animal in her which was very amusing because she presents as a person with inner calm. When referring to David's agrarian analogy, she said she would plough a small part of the field before deciding how to do the whole field. David said he'd plough the field at one go and then see what happenned.

What is the relavance of this to conservators? Artists want to use good quality materials and are happy to receive advice and help in their selection. However, we do not have all the answers. Understanding the context and methods in which artists work is important in selecting the appropriate treatment methods. Simply identifying materials is not enough. It was stimulating to be part of art in the making.

The McMichael Collection of Canadian Art Museum appears to have an active policy to desseminate information to the public regarding the technical aspects of contemporary artists' work. It is undertaking technical studies of Canadian artists. The work of one artist have been systematically studied, the reults tabulated so that trends in materials, technique and condition of work can be identified. This information is then gathered to produce didactic program of an artist. Living artists are interviewed. I will be doing several months of professional development at this institution in the later part of this year. Hopefully the experience will reveal new approaches that may be applicable to continue the dialogue that has begun at the Queen Victoria Museum.

Attachment 1
First Questionnaire

based on the form used by the National Gallery of Australia
includes the questions only: the original form had spaces for answers

Artist's Name
Date of Birth
1. How long have you been working?
2. Have you always used the same materials?
If not, which materials have you ceased using?
3. Materials most often used in your current (last 2 years) work? (We would appreciate as much detail in the information you can supply, such as, type and brand name of paints and varnishes, brushes, etc).
4. What influences your choice of materials? (Availability, cost, appeal of the medium, studio stock, other)
5. What medium do you consider to be the most important in your work? (for instance, oil paintings or/and prints or/and mixed media or all)
6. What surfaces do you paint on regularly?
7. Problems associated with specific materials:
8. Technique, including tools and equipment used
9. How do you care and clean your brushes?
10. Do you use varnish mixed in your paints or as a final coating?
If so what type and brand name?
11.General comments

Attachment 2
Second Questionnaire

includes questions only; the original form had spaces for answers

Artist
Date of Birth

Groupings of Works
Time Frame

Brief description of image concerns for the grouping

Frame type (artist manufactured, commercially manufactured)

Auxiliary support (stretcher/strainer)
artist constructed, commercial, types of corner joints, bevel on the front face

Painting Support (fabric type, weave, heavy/fine; rigid support, wood type)

Ground/size layer (artist prepared, commercially prepared)

Image Materials (paint type, brand, artist prepared, commercially prepared, other encorporated material)

Application technique and special considerations (tools used, reasons for selecting media)

Surface Coatings (type, brand names, manner of application)

Technical difficulties encountered with this grouping/ special considerations in handling

Other comments relating to this group

Attachment 3
Karin Lettau notes

My relationship to studio:

a space I embrace
a space I deny
a space I fill
a space I empty
a space which places and displaces
a space which closes (the view) and opens (another)
a space which threatens
a space which nurtures and protects
a space which is a place to be, to which I have come to from which I depart

it is made and remade
it is my one and only-
seemingly private but the world is watching somewhere where meaning does not prevail.
K.L.
Karin Lettau

My relationship to materials

they are to be used and abused
they seem to carry experience
" a crop"
they are (as well) the experience
they offer resistance and discord
they create time frames
they are like the composed
they *order things?* I desire as well as they realism (as opposed to pure paintng)
where/when do they shift from being tactile to being transparent?
K.L.

my relationship to studio

a space I embrace
a space I deny
a space I fill
a space I empty
a space which places and
displaces me
a space which closes (the views)
and opens (another)
a space which threatens
a space which nurtures and
protects
a space which is a place
to be, to which I have
come to from which
I depart
it is made and remade
it is my life and they—
seemingly private but the
world is watching
somehow these meanings
does not prevail

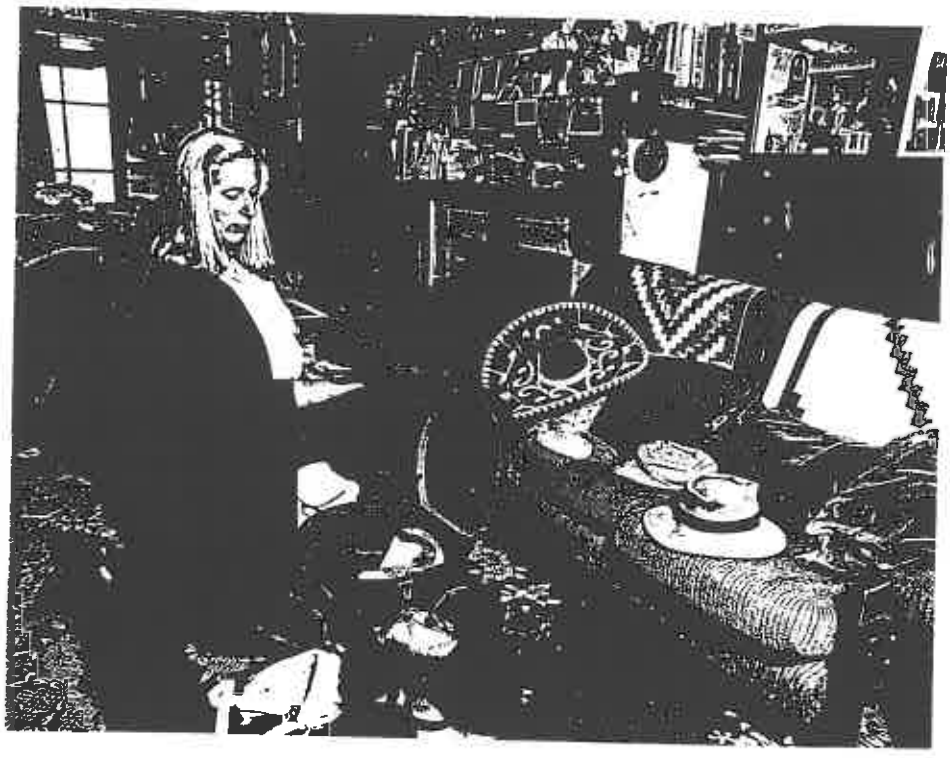
K.L.

my relationship to materials

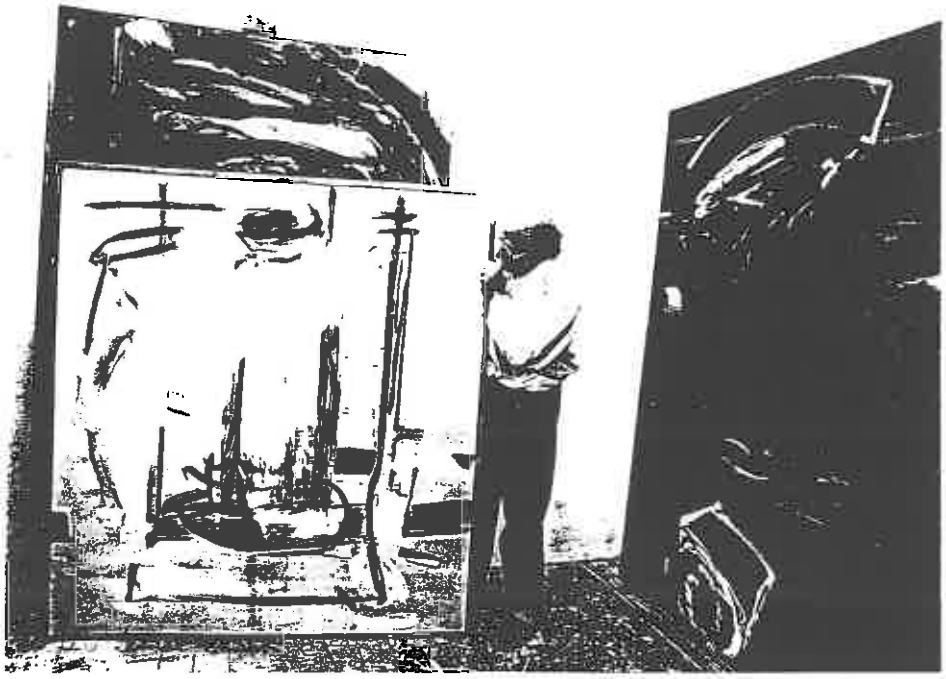
they are to be used and
abused
they serve to carry experience
"drops"
They are (as well) the experience
they offer resistance and discov
they create time frames
they are like me. composed
their ordinariness / density as
well as they're realism (as
opposed to pure painting)
when / when do they shift
from being tactile to
being transparent?

K.L

1. Kit Hiller's Studio



2. Kit Hiller with some of the many hats that she uses in her self-portraits

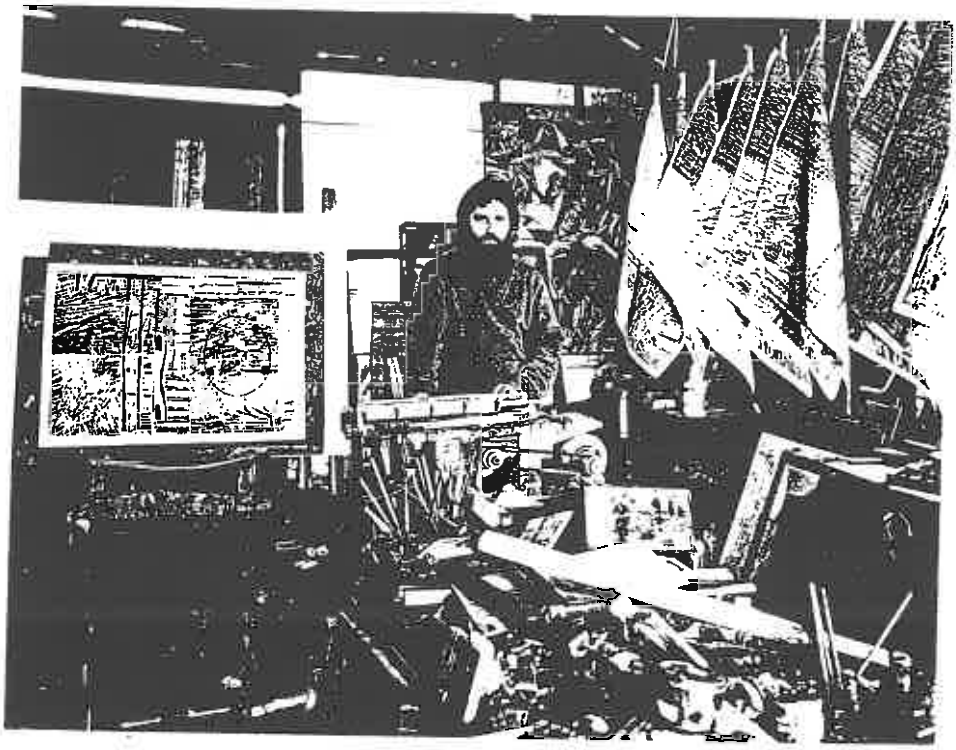


3.Anton Holzner in his studio with his recent works

4. The outlook of Anton 's exhibition space

5. Bea Maddock showing the block printing letters she collects

6. Bea Maddock in her store room



7. David Masden in his studio with recent prints

8. Karen Lettau in her studio

The Ordeals and Benefits of Developing a Five Year Plan for Painting Conservation

Therese Mulford

Abstract

The Queen Victoria Museum and Art Gallery is partially funded by the City of Launceston. In an effort to provide the ratepayers with a better service compatible with the Vision and objectives for the city, each department was required to put forward a five year plan.

The City of Launceston is partially responsible for the financing of the Queen Victoria Museum and Art Gallery. The City Council has been restructuring itself into a corporate body with a Mission statement and strategic plan. Each department was requested to put forward a five-year plan so that budget projections could be anticipated and the rate level for the City determined.

The prospect of writing such a document was daunting at first. Everyone knew that the engineers and the road/sewer program were the most successful in arguing for increases and improvements to their budgets and programs. Because the aldermen were familiar with their method of presentation, it was decided to adopt their format and adapt it to the needs of painting conservation. Information on the Delta Plan was also available, therefore the two concepts were merged.

The engineers used three categories in their presentation:

1. Correcting Immediate Problems
2. Maintaining Existing Standards
3. New Projects

The Delta Plan for the Preservation of the Cultural Heritage outlines criteria to establish conservation choices and priorities. In summary, these are:

1 Priority is first given to the ***backlogs of registrations*** of the collections; without registration, no realistic management and conservation plans could be drawn up.

2. ***Preventative conservation*** is then given priority, that is, the improvement of the environment of the buildings which house the collections.

3. ***Active conservation*** is limited to the most important categories of objects. Less important objects are protected by preventative conservation measures.

Category levels for active conservation include:

- *Category B: Objects that are important because of their presentation value, provenance, and ensembles.*
- *Category C: Objects which round off the collection or add to overall significance .*
- *Category D: Left-overs which should never have entered the collection in the first place.*

The Queen Victoria Museum's painting collection had been registered; it is a small collection of some 500 works. Active conservation was based on three categories: high , medium and low, very similar to the Delta Plan's A, B, and C. Category D, de-registration, was not considered at this stage.

In order to establish the needs of the collection, a stocktake and examination of the collection was completed. Of these, 70% had frames. A data base of all the paintings in the collection was completed. Fields used in the data base included:

Artist
Work
Condition report
Hours Painting (conservation hours required to complete the painting)
Materials Painting (cost of materials required to complete the conservation of the painting)
Hours Frame (conservation hours required to complete the frame)
Materials frame (cost of materials required to complete the conservation of the frame)
Conservation Priority
H(S): High Storage Priority
H:High
M:Medium
L: Low
Curatorial priority (High, medium, low)
Significance (Historico-cultural)(High, medium, low)
Final Priority: year in which work is expected to be done

After examination, each work was allocated a high, medium or low priority in three areas: conservation, curatorial and historico-cultural significance.

Historico-cultural significance, not monetary value, was the key factor in priority allocation because it reflects the importance of objects related to all strands of the community. Curatorial priorities often coincide with significance but diverge at times where exhibition and/or research needs require works of lessor significance.

The time and cost of treating the paintings and frames estimated. Estimation was considered "*very general* " given that detailed condition reports have not been completed for most of the collection. Allocated "Hours" were based on treatments, not on research or analysis of samples. A year's treatment work was regarded as 900 hours or half of the one full -time conservator's work-load. The remaining 900 hours are allocated to operational duties (training, training of support staff, incoming/outgoing exhibitions, ordering and maintenance of equipment, public enquiries, emergency treatments, general administration) and professional duties (professional development, research, analysis, report writing, involvement with local, state, national and international professional groups). At the time, 50% was considered a little low for allocation to hands-on conservation, that is, a higher percentage was thought necessary by some departments in the Museum. This percentage was in fact too high. In retrospect, a figure closer to 40% would be more realistic in the Queen Victoria Museum situation.

The five year plan included the following outline. Specific paintings were allocated to each section.

1. Correct Existing Problems

. *Emphasis on Preventative Conservation*

. *Condition Reporting* only 15% paintings have been condition reported

. *Storage Improvement,* the dilemma is that storage not a conservation responsibility

. *Replacement of Inappropriate Frames on Key Works*

. *Establish and Develop Safety Equipmentand Conservation Facilities*

2. Maintain Existing Standards

. *Preventive Program of Frame Build-ups and Backing Boards*

. *Continue Treating Works and Frames as Integral Units*

3. Undertake New Projects

. *Move conservation facility closer to the main museum site*

The time consuming activity of reviewing the entire collection and writing the report resulted in funding for a part-time technical assistant for frames, funding for a major project which had been unsuccessfully sought in the previous five years, and a clearer idea of where the department was heading.

ADVANCES IN LINING

Julie O'Connor

This paper provided a general overview of the materials and methods used in conservation lining practice. It dealt with a wide range of materials and methods including previous and current lining methods, interferences to the lining process, lining materials and lining supports.

The paper was a precis of much larger paper which was presented to a student seminar at The University of Canberra in 1994. A copy of the paper is available from the author.

THE ANALYSIS AND TREATMENT OF A CHINESE SCROLL PAINTING

The work which is the focus of this talk was brought to the attention of the Paper Conservation Department at the Auckland Art Gallery by a corporate client. It was described by them as being a Tibetan Than-ka painting of unknown age and in need of urgent repair. The painting had been bought by the present owners who had subsequently had it re-framed and then displayed in the main office area of their headquarters in Central Auckland. The work had obviously been extensively and crudely restored in the past, but the main cause for concern was the large horizontal tear which had developed several centimetres in from the top edge of the work, and continued some way down the left hand side. We guessed that this splitting was perhaps related to the re-framing of the work, maybe a strip lining, and that extreme environmental conditions within the air conditioned office space were significantly contributing to it's advance. We subsequently took readings of temperature and relative humidity on several occasions and found that the relative humidity hovered consistently around the low 30's. As the owners wished to return the work to this environment and to retain the framing, after conservation, it was an initial priority to try and find a more sympathetic way for the work to be displayed. Our first suggestions therefore revolved around a perspex enclosure creating a micro-climate around the whole

As a paintings conservator, I became involved in this project on the basis that the work was a Tibetan Than-ka. These are complex hanging scrolls involving a wide range of fabrics, however the painted image area at least does have some similarities to Western paintings, being usually on linen or cotton with a gesso ground. The materials and painting techniques used for Tibetan Than-kas follow a strong tradition, with a limited and distinctive range of pigments having been used to define a symbolic religious imagery.

The painting under examination had obviously at one time been rolled up and may have been removed from a surrounding fabric border, however its method of manufacture did not seem to correspond to the than-ka tradition. Instead of a ground over a fabric support this painting had a fairly open weave gauze laid over a paper support. The paint, depending upon the ratio pigment to medium,

either sank into the interstices of the weave coating the paper or overlay them. While it may be a votive image the figures bear more resemblance to Chinese representations of Buddhist deities than to Tibetan.

The two inscription panels were later confirmed as being in Classical Chinese, unfortunately the translation, by the Chinese department at Auckland University, is still in preparation and couldn't be ready in time for this paper.

The first stage of the treatment of the object involved removing it from the solid support in the frame, establishing a clearer idea of its structure, and hence, the possible reasons for the development of the tear. The edges of the painting were found to be lightly glued with a starch based adhesive to the gold painted fabric surround, while a tissue strip lining held the painting more firmly over a width of about two centimetres all the way round. The painting was released from these mechanically and lifted away from the secondary support. This revealed the extensive use of plywood, PVA, and rusty nails to build up the frame, none of which exactly fall into Feller's Class One range of materials. More importantly it showed that the painting had already received a lining and that the tearing closely corresponded to the gaps that had been left between the lining tissue and the strip lining. The stress of contraction at low R.H. was obviously being concentrated at this weak spot and the original materials were not strong enough to resist the tension, in addition the strip lining tissue is excessively strong.

With the original paper support now exposed, analysis was carried out on both the support materials, the lining materials and the pigments. The aim was two fold, firstly it was hoped that some information might be gained that would help us locate and to roughly date the painting, and secondly would alert us to whether there was anything present which might make our proposed treatment of lining removal and replacement difficult.

The analysis of pigments and fibres was restricted to optical microscopy and, were feasible, micro-chemical testing. For most of the materials found this was more than adequate, however it does mean that absolute confirmations cannot be given and that the question of the media has had to rely on

documentary sources.

As there has been no real previous attempts at the practical analysis of paintings within the Auckland Art Gallery Conservation Department there is consequently no history of co-operation with outside institutions such as the University science departments, the DSIR etc. Therefore, although access to SEM/EDX and GC/MS facilities would be nice the commercial cost, around $350 per analysis, is prohibitive. Hopefully in the future we can interest someone in the area to at least give us a better rate.

The fibres in the support materials were examined in various stained states. A general stain, Toluidene Blue was used to highlight structural features, this can be permanently mounted in a mounting medium. Two temporary stains, Phloroglucinol and Hertzberg stain were used to indicate chemical properties of the fibres. Neither of these can be preserved permanently, both were tested against known samples prior to use.

The original support paper remained clear with Phloroglucinol, indicating that little or no lignin was present. Some fibres stained red/brown with Hertzberg indicating bast fibres, others stained blue showing them to have been chemically processed. Microscopically it was clearly apparent that mechanical processing had been used as well as chemical processing. Many of the fibres have a chopped appearance with a wide variety of fibre lengths being present, there is poor fibrillation and much debris.

The main components were bamboo and soft wood wood pulp. Bamboo is shown with the flat ribbon fibres, the thin, needle like fibres and the parenchymal cells.

The lining tissue showed evidence of a more thorough mechanical processing, the lignin content is far higher than in the original paper. Microscopically the fibres are much shorter with few longer, unprocessed fibres. The paper has a much greater woodpulp content, although the bast fibre does again seem to be bamboo. This indicates a poorer quality and far weaker paper than that used originally. The materials and high degree of processing that both of these papers have undergone is consistent with known Chinese examples, bamboo having

been used in China for paper making since the 12th-13th centuries.

The strip lining tissue had some lignin in the shorter processed wood-pulp fibres, the red/brown Hetzberg showing bast fibres.
Overall there was a greater proportion of longer fibres. These are very long with exaggerated cross striations. The fact that they are pointed and thin and have a cuticle characterises them as Paper Mulberry a material used by both the Chinese and Japanese. The wood pulp inclusion is again a soft wood

Samples were taken of the original fabric on the painting and from areas of repair. The fibres are smooth and pointed showing no signs of beating or chopping and have clearly been spun. The new fibres show the same characteristics as the old but are simply longer due to the lack of age related degradation, fracturing, fragmentation etc. In comparison with known examples the material would appear to be silk. The use of a fine silk cloth over paper to support an image has been practised since the 14th century in China.

The lightness with which the pigments were bound, the ease with which samples could be dispersed with water and the ample evidence of previous flaking would all seem to indicate that the original medium used on the painting was probably the traditional animal skin glue, the best grades coming from donkey skins, The paint that remained was in good condition with little active flaking taking place. There was evidence of previous consolidation with what appeared to be PVA. It may be that the previous wet lining had also had a consolidating effect re-activating the original medium to some extent, evidence of this comes in the amount of dirt which has been absorbed into the paint layer. The very rough re-touchings had been executed in a non-water soluble paint which looked like acrylic although no tests were caried out to see whether this was the case.

The pigments found were to play a critical part in the direction which the treatment took. Of the traditional Chinese pigments identified the red was dry process Vermilion, a colour with an ancient history in Far Eastern painting. The white was a finely ground lead white containing small amounts of lime or chalk white, again a pigment often found on Chinese works. The blue was Smalt,

a cobalt glass, thought perhaps to have been used in China long before it was 'invented' in Europe. The pink was a mixture of red lead and lead white. The red lead was interesting as it was much coarser than modern grades, showing fibrous particles similar to the dry process vermilion. Gold had also been used but little now remains intact.

Of the areas which were assumed to be black, few actually were black but were instead a dark blue. This blue was, from previous information, expected to be indigo, however based on microscopic evidence and micro-chemical testing it would appear to be Prussian blue. This blue has been used in copious amounts on its own and in mixtures. The few areas of black found were a carbon black, probably the lamp black which is the main constituent of Chinese ink sticks. The browns were largely composed of an unidentified organic brown, the shadow areas within them being a mixture of a red lake, perhaps carmine which has been previously reported on Chinese works, and Prussian Blue. It may be that the brown particles observed are faded and discoloured lake pigments, or they could be bituminous in origin as this has also been reported on Chinese works from earliest times.

This leaves the large areas of green unaccounted for. Again, from previous research, it was expected that this would be malachite either the natural or manufactured basic copper carbonate pigment that is found extensively throughout the history of Far Eastern Art, having been identified on Tibetan, Japanese, Chinese works etc. dating from at least the 7th century A.D. The typical pattern of accelerated degradation seen on the back of the lining tissue indicated that this probably was a copper pigment. Copper (II) ions have a catalytic action in the oxidative degradation of the cellulose components of the paper in combination with excessive sunlight and moisture. Microscopically the pigment was identified as being Emerald Green however, copper aceto-arsenate. Arsenic was confirmed as being present by several separate micro-chemical tests and by comparison against known samples.

Although there has been some previous research published into more recent Chinese artifacts such as 19th. century wallpapers and export watercolours there seems to be very little systematic analytical data available on artists palettes than were perhaps other than non-traditional. In terms of dates

therefore, it is assumed that the Emerald Green and Prussian Blue were imported from Europe. This means that the painting of at least the green portions must post-date 1820 when Emerald Green was first manufactured. The fundemental part which Prussian Blue plays in the rest means that the earliest possible date can be no sooner than 1704 the date of the invention of Prussian Blue.

In terms of the treatment of the work the presence of an arsenic bearing pigment meant a radical re-think. Following conventional paper conservation methods the lining tissue would have been removed using reasonable amounts of moisture and re-lined with, to painting conservation eyes, a quite thin and wet wheat starch paste. As Emerald Green, in a damp and especially acidic atmosphere, releases toxic arsine gas excess moisture had to be avoided. Tests at removing the degraded lining tissue with simple mechanical action proved negative as did using the Steam jet pencil with minimal moisture. It was decided, as the work did not fit in the fume cupboard and we do not have a mobile extraction unit, that for the sake of safety we would leave the lining tissue in place.

For the re-lining, synthetic adhesives such as Beva 371 were rejected as being unsympathetic to the existing structure, difficult to reverse and for adding a further problem in terms of reaction to environmental conditions. A solvent activated lining using Plextol B500 was considered, however it instead provided the impetus to use a re-activated starch paste lining. In principal this follows exactly the same lines as the synthetic adhesive lining. Instead of Plextol as the adhesive and toluene as the solvent, this process uses wheat starch paste as the adhesive and water a the solvent. The process provides and easily reversible, strong lining that would allow an absolute minimum of moisture to penetrate into the structure of the work. It would however provide sufficient moisture to allow the tear to be relaxed and re-aligned on the table.

In conclusion, if ever there was a treatment that might highlight the value of research and analysis for me this could be it. In the light of the pigments found on this work the idea of creating an enclosure around this painting, which I mentioned at the beginning, has taken on a greater significance than

purely maintaining a micro-climate. Although, given the conditions in the office, the painting is unlikely ever to get damp, the lightly bound Emerald Green, to say nothing of the lead and mercury also present, still poses a danger to people coming into contact with it in the busy work place in which it hangs. Perhaps the time has come to issue a health warning with all suspect scrolls, and who said that art is no longer dangerous.

DAVID WISE
AUCKLAND CITY ART GALLERY
MARCH 1995

Post-conference note

Since the Lorne gathering further analysis on the Emerald Green has revealed the presence of a copper chloride formation. I am hoping to do some work on the possibility that Emerald Green undergoes a decomposition along the lines of Malachite forming Posjnakite/ Atacamite.

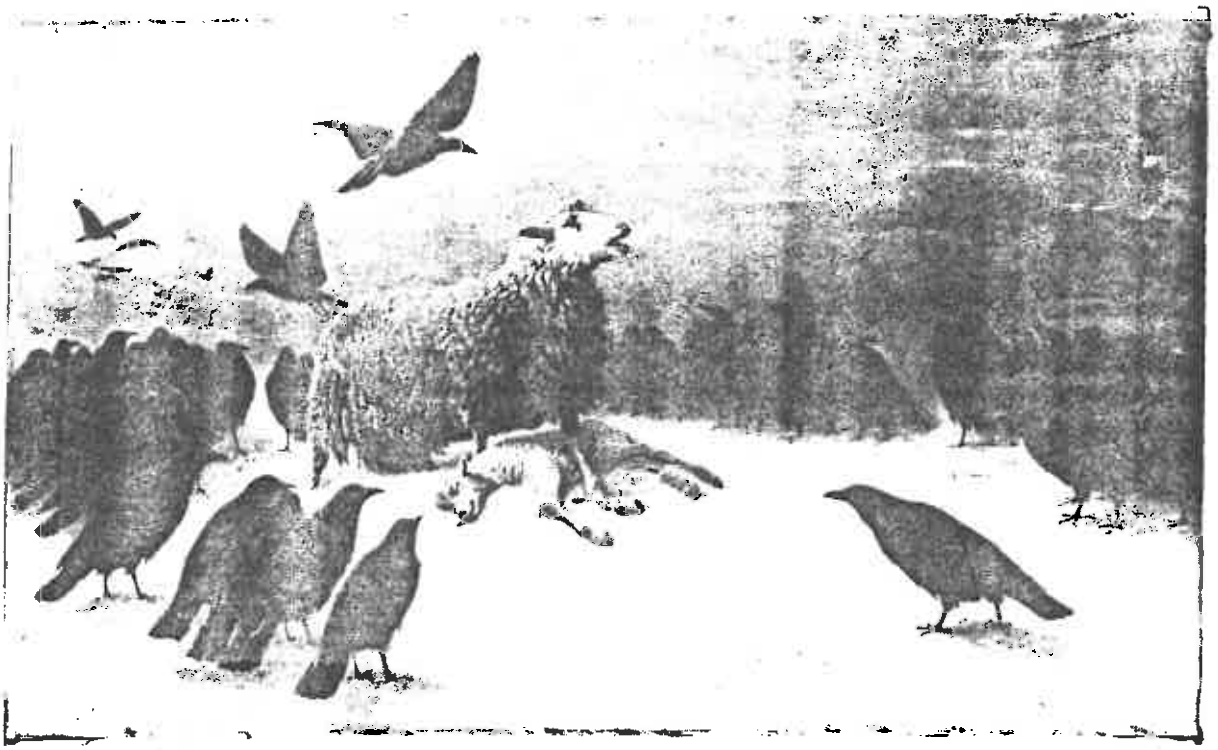
THE "FRICTION" LINING OF A LARGE VICTORIAN PAINTING

Linda Waters Conservator, Paintings Project, National Gallery of Victoria

"Anguish" by Augustus Frederick Schenck was requested for the forthcoming exhibition of French 19th century painting at the National Gallery of Victoria.

It is a large oil on canvas, measuring approximately five by eight and a half feet, and was probably painted shortly before it was exhibited at the Salon in 1878 . I t was acquired by the National Gallery in 1880 and was always on view in the old gallery building. It was a painting that and was well known and well loved. In fact, in 1906, a letter written to The Argus (The Age) by Mr Isaac Whitehead of Williamstown prompted a public vote to be taken of the twelve best pictures in the Gallery. "Anguish " came fifth. Its' importance as a picture is also demonstrated by its splendid frame which adds another two feet in each dimension.

The subject matter is extremely compelling, and engages the viewer emotionally and almost physically as there is a space in the centre foreground in which the viewer stands: when the painting is viewed at the right height the onlooker seems to become part of the circle of crows and a witness to the slaughter of the lamb.



After treatment photograph of "Anguish" by Augustus Schenck

The painting had not been shown in the new gallery, which was opened in 1968, and was sitting neglected with many other Victorian works, in the "graveyard "outside Conservation (racks for extremely large pictures that are difficult to store elsewhere in the building). In short, it had two large tears which probably occurred during transit between the old and the new gallery buildings. It was also very dirty, and the canvas was slack and very brittle. Not surprisingly, the frame also needed some attention.

There was also a series of creases in the support, curious as examination of the tacking edges showed that the canvas had not been removed from the stretcher after being painted by the artist. It appeared that the creases were actually from the commercially primed canvas having been rolled before being attached to the stretcher. Proof was found when the stretcher was removed during the treatment: a colourmans' label was found on the inside of the central brace,

denoting that the stretcher was sent to Schenck at Ecouen the small village in northern France where he lived. It was likely that the canvas, also supplied by the colourman Colin, was sent rolled on the stretcher, hence the creasing. Further evidence that the stretcher was probably assembled by the artist is seen in the pairs of numbers wr the joints, which indicate the way the stretcher was to go together.

There was a thin layer of varnish over the whole painting, plus a heavy selective application on the birds and animals seen in UV fluorescence. This at first looked like the result of selective cleaning of discoloured varnish form the snow, but a closer look proved that to be incorrect.

The nature of the tears indicated the brittle nature of the canvas and the need for it to be lined. And of course, the nature of the lining influences the type of tear repair to be done. Ultimately it was decided to loose line the painting.

The tears were firstly consolidated with 5% gelatin, and relaxed using moist blotters and weight. They were then mended using sutures rather than a patch as the painting was not to be fully lined: sutures covered less canvas than a patch and would be less likely to cause differential localised expansion and contraction. The potential rigidity of sutures was also considered more appropriate for the brittle canvas than a patch which would be relatively more pliable. For the same reason it was decided to use an epoxy resin rather than a PVA or similar adhesive to mend the tears due to its rigidity being more compatible with the stiff degraded canvas in this instance. Araldite HY 106 which has a curing time of 24 hours was chosen for its stability and good aging characteristics. Trials to determine how best to use the adhesive were undertaken and the following method devised.

The canvas around the tears was firstly coated with 3% methyl cellulose to reduce the absorption of the adhesive and allowed to dry. Polyester threads dipped in the epoxy were used , rather than sutures of the epoxy alone, as they were easier manage. The Araldite was mixed and left to cure for around three hours, when it became a workable consistency, then individual plies of polyester thread were pulled through the adhesive, blotted lightly and placed on the canvas. They were covered with silicon-release Mylar and weighted for 24 hours. As they were very easily displaced, the ends were lightly tacked in place with the heated spatula before the weight was applied.

Whilst investigating lining options and waiting for the materials to arrive, the painting was surface-cleaned using saliva. As surface cleaning progressed it was found that moisture was imbibed to some extent by the paint in the sky, making it appear slightly lighter, and turning the paint film "rubbery". The paint in the areas of snow and animals was unaffected. These phenomena disappeared when the moisture evaporated. This suggests that the paint in the sky alone may contain a hydrophilic substance, possibly alkaline in nature and possibly causing the softening of the paint film when moisture is present due to a rise in pH. Deionised water affected the paint film less than saliva, though removed far less dirt. Petroleum spirits did not affect the paint in the sky in the same way, but removed very little if any dirt. Various erasers were tried, but again had little effect, so it was decided to clean the sky with a short application of deionised water dried immediately with another swab.

The matter was not investigated further - cross sections were taken but staining and identification of materials was not pursued. One clue to this problem may be in the texture of the sky which suggested continuous wet in wet painting from one end of the picture to the other. Perhaps there was an additive used to able the paint to stay wet enough for the sky to be painted in one.

Lining was complicated by the sensitivity of the paint to low temperature (60 -61°C) so various options were investigated. A pressure sensitive lining such as Fabrisil would have been ideal in this situation, but is no longer available. Beva or EVA film was also considered as a lining adhesive with canvas or polyester fabric as a support. Test were undertaken to reduce the melting point of the film by pre-swelling it with solvent prior to using heat. A reasonable bond could be achieved at 45 - 50° C using Stoddards solvent to swell the film, however it was felt that it would be difficult to achieve an even result over a canvas of this size. In addition, the paintings laboratory does not have a fume extraction system, and the amount solvent vapour from the treatment would be unacceptable. It may have been possible to use cold lining methods but a large air-flow table is needed, and again the process is complicated by the scale of the painting.

A loose lining using a strongly napped fabric to provide a mechanical or friction bond to support the canvas seemed to be the best option given the nature of the paint film and other considerations. Materials similar to the substrate to which Goretex is attached were investigated., and a brushed polyester felt used as an industrial filtering material was found to be suitable, though not particularly strong, and not large enough to be used in one piece. However, when it was brushed to further raise the nap, held against the back of the painting and gently burnished into place, it could not be drawn sideways because of the strong intermeshing of the brushed polyester fibres and the canvas. In this way it provided a extra support for the canvas . A stiff polyamide mesh (Nybolt) used for sieving flour on an industrial scale was found to be a suitable backing for the polyester felt. The mesh was used, despite being nylon, as it was of a suitable stiffness and weave. It would not be exposed to light or UV, being on the reverse of the stretcher and behind a backing board ,so would not be prone to the factors which initiate deterioration.

The Nybolt mesh was joined with a long horizontal overlap using a strip of EVA film. An outline of the face of the stretcher was drawn onto the mesh, and EVA film and brushed polyester cut to this shape. The EVA film was tacked into place on the mesh using a heated spatula, the brushed polyester in two pieces with a central vertical join, was laid on top, and the whole ensemble heated to around 70° C on the hot table under vacuum to adhere the polyester felt and the mesh toghether.

The painting was removed from its stretcher and the tacking edges were left upright, to be strip-lined with Stabiltex and EVA film. Fomecor was used behind to support the upright edge whilst using the heated spatula. It was felt that the adhesive could be used on the tacking edges as there was marginal, if any, overlap with the temperature sensitive paint film.

The loose lining was attached to the stretcher: the brushed felt was on the face of the stretcher only, so did not add bulk to the sides or corners plus it fitted the perimeter well ,as the shape of the stretcher has been traced onto the felt beforehand. The mesh extended around the stretcher and was stapled through cotton tape to the reverse. The ensemble was laid down onto the painting which was face down on the table, and the painting was then reattached to the stretcher with copper tacks and blotter washers. The mesh and felt loose lining was elastic enough to allow the painting to be keyed out to increase the tension: this was done, then the lining was "burnished" with a large soft cloth pad to create a good mechanical bond with the original canvas.

The tears were filled with a mixture of 5% Mowiol and chalk, and inpainted with Maimeri restorers colours with watercolour washes over the top. The yellowed varnish was quite distracting in areas where it was thick, such as under the ewes chin, so was overpainted locally with a blue watercolour wash (with the addition of ox gall) to counter the yellow discolouration.

The treatment may not have been the optimum solution for the structural problems of the painting, but when everything was taken into account, a successful lining system providing extra mechanical support for the canvas with minimal interference had been devised.

Suppliers

Polyester needle felt:	AR Simpson Holdings Pty Ltd, 8 Trenerry Crescent, Abbotsford, Vic 3067 ph: (03) 419 6055
Nybolt monofilament polyamide mesh:	Ure Pacific, Unit 37, 65-67 Canterbury Road, Montrose, Vic 3765 ph: (03) 728 6644

A STRUCTURAL TREATMENT OF LUDWIG BECKER'S "PORTRAIT OF JOHN HODGSON"

Carrie Thomas and Sharon Towns, The Victorian Centre for the Conservation of Cultural Material Inc. (V.C.C.C.M.)

Introduction

John Hodgson was the Lord Mayor of Melbourne from 1853 to 1954. His portrait by Ludwig Becker (1802 - 1861) is the earliest of a series of mayoral portraits treated at the V.C.C.C.M. during 1993 and 1994.

When the painting arrived at the laboratory a number of aesthetic and structural problems were evident:

- The surface coating was milky and uneven, with extensive sunken patches
- Passages of the image had been severely abraded during a previous varnish removal
- Repairs and abrasions had been broadly overpainted during several previous treatments
- Of particular concern was that the stretcher inadequately supported the canvas, which in turn was weakened and degraded, and exhibited quilting on the reverse as a result of the cupped craquelure of the paint film.

According to City of Melbourne records, the painting was last treated in 1976. It was probably during this treatment that the plywood corner reinforcements were added to the stretcher joints, and five patches applied with wax resin adhesive to repair six tears. Mysteriously two of the patches were placed where no tears existed. The tacking margins had been cut away at the corners, probably during reframing in the 1970's.

The most interesting and problematic aspect of the painting structure was the seamed canvas. The canvas was commercially primed, and bears a colourman's stamp near the bottom member. However, the piece of canvas available to the artist was apparently inadequate to his needs, as it was joined with a vertical seam about 8.5 centimetres from the right edge (as viewed from the front) to create the present format. The seam was hand sewn, using a thick thread and a coarse back stitch. The canvas exhibited some planar distortion adjacent to the seam, apparently as a result of pressure from the back by the stretcher members pushing the bulky seam material forward.

The aesthetic and structural problems of the generally embrittled canvas, the distortions caused by the cupping paint film, the multiple tears, the distortions caused by the wax resin patches, and the trimmed and weakened tacking margins all suggested that a lining may have been called for. However, as the seam in the support precluded any kind of conventional lining, other painting conservators were canvassed for ideas via a mail-out, and many stimulating suggestions resulted.

Ideas basically fell into two groups, with some overlap:

- Supporting the canvas with adhered material: This could have been in the form of an overall adhered lining applied in two pieces the same size as the original two pieces of canvas, each piece following the original fabric by passing over the stitches at the seam. It would have been applied by hand to accommodate the seam. Also suggested was a strip lining with two extra strips applied to the two pieces of seamed fabric over the stitching.

  One suggestion we considered involved re-stitching through the adhered material using the original stitch holes to reinforce the original canvas at the site of the seam.

- Hard supports of various materials: Honeycomb board was a popular suggestion, with a groove cut in the face which was to go against the back of the canvas to accommodate the seam. Suggestions included non-adhered and adhered variations, the latter to be removable by delaminating and peeling away the honeycomb board.

  A couple of suggestions involved using Needled felt[1] as a non-attached secondary support, an idea which we eventually incorporated into the final structure. (Needled felt is a polyester felt-like material used in air-conditioning filters, which has a strong nap that can grip and support the back of a canvas, resulting in a relatively strong shear strength for a non-adhered bond).

The treatment

The uppermost synthetic coating was removed, some old natural resin residue reduced, and the more soluble retouching removed. The old patches and as much of the old adhesive as possible were removed, and the tears repaired with polyvinyl acetate emulsion/Japanese paper fills and Beva/Stabiltex sutures. The painting was removed from the stretcher and strip lined with EVA film and polyester screen printing fabric.

A new secondary support was constructed, involving a composite of the ideas received from other conservators, and some of our own.

We were particularly concerned with the seam as a weak point in the structure of the painting. Any structural treatment needed to address this, without transferring the stress to adjacent areas, which would have set up additional craquelure patterns. For this reason we wanted some kind of support which provided a continuous plane to the back of the painting. We were wary that an adhered lining, while strengthening the canvas generally, would transfer greater stress to the fabric holding the stitches. The idea of sewing through original stitch holes to hold the lining fabric along the stitch line was attractive, but we were cautious of excessive manipulation of the area.

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[1] Needled felt: A.R. Simpson Holdings Pty. Ltd., Trenerry Crescent, Abbotsford, Victoria 3067. Telephone (03) 9419.6055.

Or, Unit 1/12 York Road, Ingleburn, N.S.W. 2565. Telephone (02) 829.2122, Facsimile (02) 605.6145.

We therefore tried to design a structure which would grip the seam, minimising movement at this point, while supporting the entire reverse surface evenly. We decided against pre-treatment of the quilted distortions because without an adhered lining we were not sure of permanently removing the distortions. After some deliberation we decided that we favoured a less interventive approach which would maintain an acceptable degree of age patination.

We liked the idea of honeycomb board, since it is light weight and rigid. However it was prohibitively expensive, and in any case we were unable to identify a supplier who could deliver in the time available. We therefore experimented with laminating a number of alternative materials, making them up of standard sized pieces, 10cm square, to compare weight and strength.

The following combinations were tested:

1.	Fomecor and Supercor	16.3gm
2.	Fomecor and Double Multi-use Board	22.1gm
3.	Fomecor and 2 x Single Wall Multi-use	23.3gm
4.	Double Multi-use Board and Supercor	25.1gm
5.	2 x Supercor and Fomecor	26.7gm
6.	Supercor 2 x Single Wall Multi-use	26.8gm

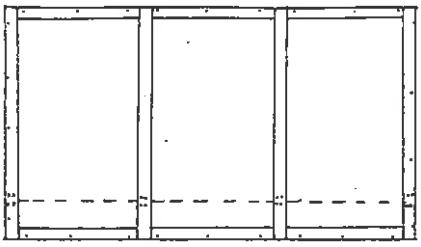
We chose (1.) Supercor/Fomecor sandwich, which was the lightest by far, and seemed sufficiently rigid.

The full size laminate piece was made up by first roughing the surface of the Supercor, and adhering the Fomecor to it with polyvinylacetate based emulsion adhesive. The laminate was weighted between felts for several days to dry.

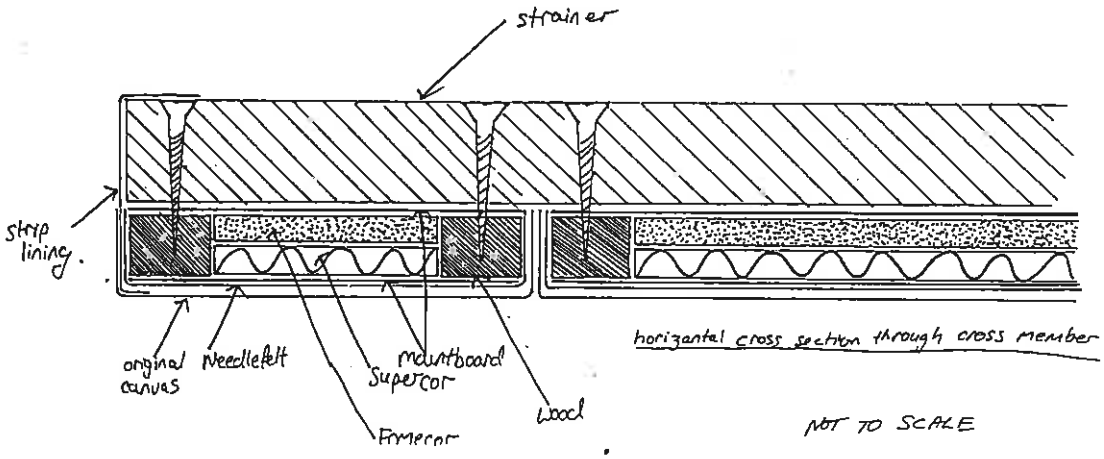
Paper templates were cut to the exact shape of the canvas on each side of the seam. Mount board pieces were cut to these exact shapes, battens of red cedar, which is light weight and flexible, were adhered to the borders of the mount board pieces with hot melt adhesive. These timber pieces were to give a hard edge to stretch the painting over when placing in on the new support, and also to screw the new stretcher to. Pieces of the laminate were cut to fit inside the timber battens, and glued in place. A second piece of matt board was glued to the other side.

We now had two pieces of our made-up board, corresponding to the shapes of the canvas areas on either side of the seam, but very slightly smaller to allow for the Needled felt which was next adhered to each piece, again using PVAc emulsion adhesive.

Meanwhile, a new strainer had been ordered, the same overall dimensions as the original stretcher. The fabric of the seam, which was originally curled over, was straightened up using moisture and clamps. The new support was ready for assembly (see diagram).



from above, showing fixing of strainer to panels.



The two Needled felt covered pieces were put in place on the back of the painting. The strainer was placed on top. With the two pieces of laminate pushed firmly together to hold the seam tightly, the strainer was screwed to the boards around all edges and along both sides of the seam. After turning the partially secured painting and support structure face up using another board for support, the final step was simply to stretch and staple the painting to the new strainer, using a cloth pad to massage the painting smooth over the new support.

Finally, we attached clear instructions to the reverse, explaining how to dismantle the unit in the future.

Conclusion

We found this an interesting project, and the presence of the seam forced us to re-think the structural requirements of the work. We especially wish to thank all those who so generously gave us their time and ideas.

Carrie Thomas
Sharon Towns

Problems posed by lining a large contemporary acrylic painting onto a solid support.
by Judy Dunlop.

I want to discuss a complex project I was involved in in 1993. A large acrylic contemporary painting on fine canvas required lining or supporting in some way before being suspended in a ceiling. The problems encountered were caused by the combination of traditional and modern materials used in the work, which were compounded by the large scale of the work.

A modern acrylic painting was commissioned for the ceiling of the master bedroom in a 19th century mansion in Melbourne.

The space for the painting measured 4.24m by 1.5m. When inspecting the site I noticed air conditioning cooling tanks directly above the space intended for the painting. There were also roof trusses to help with winching the painting up and tying it into position, as well as a trap door to gain access from the roof.

The painting arrived from Canberra rolled onto a 250mm tube, interleafed with fine calico and two layers of bubble pack. There were "pimples" caused by small particles of grit trapped between the layers, creases caused by the calico and a general quilted effect caused by the bubble pack. Obviously these unwanted impressions had been transmitted very easily, as the painting had been carefully packed.

The picture was painted on lightweight canvas. It is a highly detailed work delicately painted in many fine layers of Matisse professional acrylics, using Atelier binding medium. Before commencing the painting, the artist had coated the front and reverse with the same Atelier binding medium to make the paint easier to apply. The painting was finally brush varnished with "Liquitex glass medium and varnish" diluted 1:2 with water.

The artist was most forthcoming about the materials she used and has been concerned about their compatibility. She had consulted the Canberra Galleries before starting the project. Unfortunately there were flaws in her procedures. The artist chose an oil primed canvas because her tests showed that an oil primed canvas caused less cracking than the acrylic primed canvas. I was concerned about the acrylic paint sheering away from the oil priming in future. Here we have a mismatch of materials.

Due to her meticulous approach I assumed she had prepared the canvas herself. When I realised it was a commercially prepared canvas from Art Stretchers Co. in Melbourne I was able to question them on their method of preparation; first of all a liberal coating of size is applied to prevent the oil priming rotting the canvas. While their acrylic primer is applied directly onto the canvas: They were also concerned about the long term effects of acrylic paint on oil primed canvas.

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Here is a diagram of the layers so far showing hygroscopic canvas and size encased on the front by oil priming and an acrylic binding medium and on the reverse by an acrylic binding by medium, followed on the front be many thin layers of acrylic paint with an acrylic varnish diluted in water.

For the moment I assumed the canvas and size layers were safely sealed in by the acrylic binding medium on the front and reverse. My moisture tests on samples of materials used, sent by the artist, had confirmed this.

Rather inappropriately for the scale of the work, the artist had used the finest Belgian linen canvas. This was because she usually worked on a small scale on the smooth surface of masonite and she didn't want the coarse weave of a heavier canvas interfering with the intricacies of her design.

If the canvas was stretched onto a wooden or metal stretcher, as originally envisioned by the artist, I was concerned the light weight canvas would not be strong enough to support the paint layers, especially as it was to be placed in a ceiling.

So I was looking for a large, strong, lightweight support for the painting with no joins, which would transfer disfiguring impressions through the paint layers. A solid support would also be preferable to prevent future damage from above, should the water tanks overflow for instance.

Various honeycombed supports were investigated but either their weight or joining system proved to be a problem on this scale. Due to the urgent timeline involved for completing the job I handed over this part of the problem to R. Hodgson, who was conserving some furniture for the same client.

He discovered a Melbourne firm that makes the walls for refrigerated trucks from fibre glass and polyurethane foam, a fibreglass sandwich encasing 25mm thick polyurethane foam was custom made to his specifications. Within the panel it has fibreglass struts 300mm between faces.

The board was sanded and cut exactly to size outside. Five aluminium brackets were adhered to the reverse of the board with an industrial acrylic adhesive, Bostik M890. Stainless steel cables would then be used to lift the painting to the ceiling and tie it to the roof trusses. The board would then be screwed into position and the edges on the front covered with moulding to match the rest of the ceiling. The board was given a trial fitting before I proceeded with the lining of the painting to it. The total weight of the canvas and board is not more than 65kg.

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To keep the work as flat and as taut as possible, I had faced the edges of the painting with starch paste and tissue; the facing was attached to widths of wet kraft paper with PVA adhesive and attached to a loom in the "Dutch loom method" of prestretching (1). It was also useful to be able to view both sides of the work at once, especially when applying adhesive.

As the room was cold and damp it did not stretch out much. Once the temperature was raised to 22o C, and the relative humidity lowered to 55%rh the prestretching improved. The condensation gathering on the surface of the painting also disappeared. For weeks however, the site manager would not take my complaints about the cold and damp seriously!. Finally it was discovered the central heating had broken down in the room I was working in! I was then able to buy a dimplex and be reimbursed for it!.

I had decided on a two stage lining process for easier reversibility in the future. I was also anxious to give the painting more support with a compatible material as opposed to the smooth surface of the board. This led me to line the fibre glass board with a layer of fine Belgian linen canvas to match the original nap-bonded to the board with Beva 371, a heatseal synthetic adhesive.

A lining canvas was prepared on another loom. Two thin coats of Beva 371 were sprayed onto the canvas and the sanded surface of the board. It was nap-bonded with irons and cooled with weights. The bond was tested all over by pulling the canvas with tweezers. This part of the process was successful.

The next stage of the process was to line the painting to the canvas covered board without using heat or solvents which would affect the Beva 371 bond and the acrylic layers. (2)

The Lascaux Restauro range of acrylic adhesives appeared to be the solution as they could be used cold or by reactivation with xylene and contacting. Unfortunately the product information was obviously a bad translation and it was difficult to tell quite how the adhesive would behave, except that it was perfect for every job!. (3) 498HV was recommended for linings and marouflages and had been used by ICS on a mural in a church in Sydney. They had used the reactivation method. (4).

Despite ordering well in advance, the correct adhesive did not arrive until the evening before I was due to line the painting with a team of helpers. Fortunately however my front room where I ran tests the evening before, was as cold and damp as the room in the mansion where I was working. Acrylic adhesives I discovered behave very differently in the cold and damp and just will not dry. By the morning the moisture content in the adhesive had seeped through the layers of my test pieces to the size and canvas causing them to swell. The paint had delaminated on one sample and become unstable on two others. My plan had been to allow the adhesive to set/dry in a vacuum envelope.

.../4

When the room was warm and dry, the adhesive dried very differently and really quickly, but I did not feel confident enough now to use it; nor could I use it by the reactivation method as xylene can soften acrylics (2) and could also affect the Beva 371 bond.

I prepared a sample board at this stage using a variety of materials as adhesives. I also consulted conservators, scientists and paint experts all over the world about the solution to this problem. I would like to thank everyone I approached for their time and invaluable advice.

My investigations led me to pressure sensitive adhesives. I looked at silicones which unfortunately have free solvents and at flexible epoxies, whereby the ingredients are absorbed in the setting process. However, epoxies seemed too irreversible.

The safest and easiest to use on such a large scale appeared to be a contact acrylic laminating adhesive made by 3M in roll form. The Tate Gallery has run tests on this material with a view to lining modern works. It is reversible by removing mechanically and lasts forever according to the manufacturers. Tests showed the 3M contact adhesive bonded better to an acrylic surface than to raw canvas. The canvas covered board was therefore brush coated with 498HV diluted 2:1 with water; when dry a 2nd coat of undiluted 498HV was screened onto the lining canvas and onto the reverse of the original painting, taking care to remove any small lumps in the mixture as it dried. Both surfaces to be sealed were now coated with an inert acrylic coating.

3Ms Scotch no. 9471, 900mm wide and 0.13mm thick was laid onto the board and burnished thoroughly to ensure good adhesion and to remove any air bubbles. The joining seams were merged together, not overlapped. As it was to be suspended in the ceiling and I was worried about the strength of such a thin layer to support the painting, I took the advice of the manufacturers and laid down a second layer burnishing thoroughly again to remove air pockets and to merge the two layers.

The painting was then cut from its loom and trimmed to the size of the board, which was not quite square. Half the painting was clamped into position on the board using Fomecor between the clamps and the painting to prevent marking the surface of the painting and to prevent everything slipping askew. The other half of the painting was rolled on to its 250mm tube. It was gradually unrolled 300mm at a time and carefully smoothed into position with cotton gloved hands, working from the middle outwards to prevent creases or unrolling askew. I had a team of three others to help me and the whole process went smoothly with no unforseen problems. It appeared and still does, to be a complete success. The painting was covered with melinex, fomecor and custom wood boards to cure for 72 hours, to achieve its maximum bond strength (manufacturers recommendation). It was then photographed, hoisted into position and fixed by tying and

screwing into position. I have not seen it since the architects devised the best lighting for it but according to them it looks wonderful and the clients are very pleased.

This unusual project posed some very interesting problems which I hope I have solved satisfactorily in rather a unique and unorthodox way.

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Acknowledgments:

I would like to thank the following for their time and helpful advice:

Robyn Sloggett of IPAC, Sharon Towns of VCCCM, Cathy Lillico of ICS, Oscar de la Tycki of Melbourne University Chemistry Department and most especially Alan Phenix of the Courtauld Institute, London, without whose enthusiasm I could not have completed the job.

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Removing an Oil Painting on Paper from an Aluminium Honeycomb Panel

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Abstract- This paper describes the problems encountered in treating a partially delaminated aluminium honeycomb support panel without endangering the fragile oil painting on paper adhered to one of the aluminium skins. The treatment of this work was designed to stabilise the support system and return the painting to a visually and structurally more acceptable state while maintaining the benefits of a solid support.

1. Introduction

Mounting paintings on solid support panels was proposed as a solution to the stabilisation of severely cleaved paintings as far back as the late 1950's[1]. Since that time various solid support systems have been developed to stabilise paintings with paint cleavage, heavy paint films and paintings with large tears. One such system utilises the physical characteristics of aluminium honeycomb skins and an aluminium honeycomb core to stabilise problematic works. In 1982 an oil painting on paper in the collection of the National Archives of Canada was conserved and mounted onto an aluminium honeycomb panel. The painting *The Horse Shoe Falls, Niagara Falls, Ontario* was executed by Sir James Erskine of Torrie (1772-1825) who may have been in Canada with a British military expedition. Erskine's view is the first known depiction from below the falls and is dated c. 1784. The painting returned to the conservation laboratory in 1985 for a detailed inspection prior to travel and loan. At that time inherent problems with the aluminium honeycomb panel were identified and a treatment needed to be devised which would not only stabilise the panel but return the painting support system to a more historically correct state.

2. Condition and treatment of painting in 1982

According to the condition report of 1982 the painting was executed on paper which was adhered to an auxiliary fabric support[2]. The painting was stretched onto an expandable wood stretcher with two cross bars and half lap corner joints. There were two significant inscriptions present on the verso, one was written directly on the auxiliary fabric support in the upper right corner and the other was a type written label adhered to the centre of the horizontal cross bar. Both inscriptions provided details on the artist, view and approximate date of the work.

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[1]Mecklenburg, M.F. and J. Webster. (1977). Aluminium honeycomb supports: their fabrication and use in painting conservation. Studies in Conservation (22): 177-189.
[2]Treatment report 81-OP-48 (1982). National Archives of Canada. Ottawa.

The paper support was described in the condition report of 1982 as ...'very brittle and totally incapable of supporting the design layer'[3]. Two corners of the paper were missing, there was buckling and there were numerous tears. There were paint losses associated with the tears and layers of dirt and discoloured varnish were also identified.

The 1982 treatment involved removing the dirt and discoloured varnish from the surface, facing the painting and removing it from the stretcher. The auxiliary fabric was removed, tears were repaired and the painting was lined onto one layer of polyester fabric with a polyvinyl acetate mixture consisting of equal parts of AYAA and AYAC (Union Carbide). The painting was then mounted with heat onto an aluminium support honeycomb panel with the same polyvinyl acetate mixture mentioned above. The aluminium honeycomb panel had presumably been assembled in the laboratory at the National Archives of Canada as a cost saving measure. Losses were filled, and inpainting was undertaken with AYAC resin and dry pigment. The painting was varnished with Acryloid B-72. The original stretcher was attached to the back of the painting with brackets and the two inscriptions were backed with paper and mounted directly to the back aluminium skin.

3. Condition and treatment of painting in 1985

3.1 Examination

In 1985 the painting was examined in the conservation laboratory. The painting itself was in a stable condition with only a few minor distortions in the paper support. The most serious problem discovered during the examination was large areas of separation between the aluminium skins and the honeycomb core (**Figure 1**). These separations may have been caused by several factors:

1. An expansion of the wood edge strips which forced the skins to separate from the inner core.

2. Improper technique in preparing the panel such as insufficient de-greasing of the aluminium surfaces or improper preparation and use of the bonding adhesive.

3. Insufficient heat and pressure during bonding of the skins to the aluminium core.

Although the painting was well secured to the upper aluminium skin, the instability of the support system was a major concern if the painting was to travel. Several treatment options were put forward to the archivists and collections manager of the National Archives of Canada.

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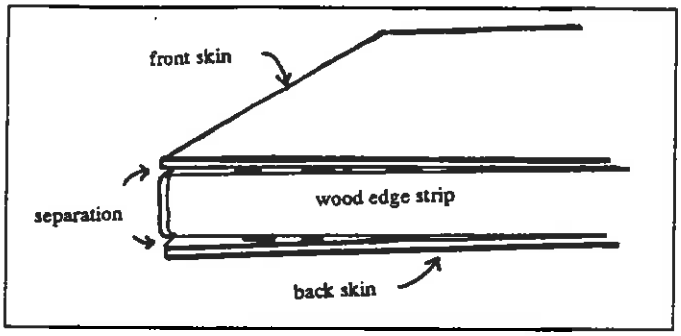
[3] see footnote 2

Figure 1 Example areas of bond failure.



Option 1
Remove the aluminium back skin and honeycomb core leaving the painting with its polyester support still attached to the top skin. Mount the painting including the top aluminium skin to a suitable fabric and stretch the whole over the original stretcher.

Option 2
Remove the painting with its polyester backing from the aluminium top skin by applying heat through the entire panel from the back and gently lifting the polyester. Since this option required heat it would likely soften the bond between the polyester support and the fragile paper as well. Pulling the polyester away from the aluminium panel could also introduce distortions into the paper and it was felt to be a risky option on such a delicate work.

Option 3
Inject epoxy into the gaps and re-adhere the panel. Since the required pressure for such a procedure could not be safely applied to the delicate paper surface this option was the most unsuitable of the three options. Injection of an adhesive without pressure would not allow the raised corners of the skins to be flattened and the system would remain unstable.

Option 1 was selected because it would remove the unstable components of the panel and allow the painting to be re-mounted onto the original stretcher.

3.2 Treatment

The painting was placed face down onto a padded surface and lightly secured with padded clamps. The back aluminium skin was rolled away from the honeycomb core and in the centre it was scored with a knife and peeled away in small sections (the skin was more firmly adhered near the centre). The inner honeycomb was carefully chiselled from the top skin. It was apparent during this stage of the treatment that in vast areas there was little to no adhesion of the honeycomb core to the top skin. In these areas the honeycomb simply lifted from the skin without the use of a chisel. Once the core had been removed, the skin was lightly sanded to provide some tooth for the fabric support.

A medium weight Ulster linen was selected as the support material onto which the skin and painting was to be adhered. Following testing, an adhesive was selected which would provide sufficient strength to hold the canvas to the aluminium skin but which would not stain the canvas. Jade 403 (Talas) was selected as the adhesive. It provided the best bond and no staining of the linen. Jade 403 was spread thinly and evenly over the Ulster linen with a stiff card, keeping within the marked size of the aluminium panel. The painting was placed over the coated linen and placed face up on a vacuum table. It was placed under gentle pressure (3-5" Hg) for 7 hours. Once the adhesive was sufficiently dry, the painting was removed from the vacuum table.

The painting was attached to the original stretcher with stainless steel staples and the linen edges were trimmed and turned over onto the back of the stretcher and secured. Once the painting was attached to the stretcher, the small raised ledge created by the aluminium skin was evened with strips of linen fabric coated with Jade 403. This would prevent accidental lifting of the corners during handling of the painting. The edges were also sharp and could cause injury to someone handling the painting or cause damage to other works. Keys were secured into their slots with clear silicone sealant.

The label, which had previously been positioned on the cross bar of the stretcher was encapsulated in Mylar and adhered in its original position on the stretcher with double-sided tape (3M). The other label was also attached in its original position in the upper right corner and covered with a sheet of protective Mylar film.

A sheet of Plexiglas was selected as a transparent, protective backing for the painting. It was selected over more common backing boards because it would allow researchers to study the stretcher and labels without excessive handling of the work and it would provide protection against vibration of the painting during transportation.

4. Conclusions

The approach to the conservation treatment of this painting in 1985 was determined by the history of the work, documentary evidence of its condition upon arrival at the National Archives of Canada and consultation with archivists. The benefits of utilising elements of the existing solid support system for the painting were carefully considered and a treatment was devised which took the safety of the painting into account. The painting was removed from a defective support system and returned to a visually and historically more accurate state.

Acknowledgments

I would like to thank staff at the National Archives of Canada, in particular Gilbert Gignac, for assistance in developing this treatment approach.

Heat - Friend and Foe: The treatment of two paintings affected by heat and the utilisation of heat to treat a panel painting.

Kathryn Ferguson, Canberra Paintings Conservation Service.

Introduction:
Three paintingsexamined had unusual forms of deterioration. The treatment of each was adapted specifically for the type of deterioration noted.

First Painting (Reversed image on perspex)
The first painting was an Arthur Boyd painting titled "Figure in a landscape with windmill." - an oil in reverse on perspex painted during the 1950's. The owner first got in touch when they noted damage to the paint media in the top left quadrant. This was the only area where the paint was cleaving away from the perspex support. When the painting was examined at the clients home they commented that the afternoon light would strike the painting in the TLQ only. It was presumed that the effect of light and or heat component of the sunlight had contributed to this deterioration. There was an unusual opaque stain visible in that region when the painting was viewed in raking light. The approach to the treatment of the painting was unusual in that the image was reversed and painted directly onto the inner surface of the perspex which functioned as a support. The outer surface of the perspex, visible to the viewer, was the glazing. Boyd had framed the perspex support with side spacers acting as moulding sections and secured a primed plywood backing board behind the visible image to give it depth. The plywood backing board had been secured onto the side moulding sections of the frame with numerous long staples. The removal of the staples was both time consuming and difficult, and an attempt was made to minimise jarring and flexing of the perspex support. Once the backing board had been removed the damaged area could be examined in detail. Although cracking and cleavage of the paint media had occurred, no losses appeared evident. Due to the smooth unprimed nature of the perspex and the flexibility of the curled paint media it could be gently pressed down. Consolidation of the paint was carried out using 2.5% w/v Paraloid B72 in acetone (prepared from a 5% stock) to minimise potential pooling of the consolidant or discolourations being evident from the front, either from the perspex "blooming" or the paint media "staining". Due to the fast evaporating nature of the acetone, a fine brush was loaded with the diluted Paraloid B72, a finger used to hold the specific cleaved paint fragment down, and the brush used to gently anchor it at one or two points. Once the fragment was anchored, more consolidant was run along the crack lines to join it to an adjacent fragment. This was continued until all of the fragments were laid down. An overall consolidation along the crack lines was carried out. Final inpainting using Liquitex acrylic paint media along the crack lines on the paint surface was carried out to reduce the dark cracking lines visible from the front (where the cracks had originally become visible).

Second Painting (Mixed media contemporary)
The second painting was by Beverly Batt, titled "Smoke and Dream" painted in 1976 with mixed oil and wax media on a cotton duck support. The owners noted that during hot weather dark "waxy" dribbles were becoming evident running down the central part of the image. The owners said that the painting had not been displayed close to

sources of heat or near direct strong light or sunlight. Since the dribbles were raised and above the image surface and very tacky, mechanical reduction and removal seemed the initial option. A septum elevator was angled to gently work along the dribble removing the excess- ultimately working down to the surface as close as possible without disrupting the soft mixed media image. Gentle swabbing using 60:40 petroleum spirits (BP 100-130^{o})/ ethanol (absolute) with cotton swabs to reduce the remaining dribbles with care being taken not to go outside the dribble margin (to avoid differential cleaning or discolourations when compared with the surrounding media). Pastel (Art Spectrum) was then stippled along the dribble margins using a lightly dampened (60:40 P.S./EtOH) cotton swab to even out the dribble margin visually and to absorb any excess tackiness from the minimal dribble residues. Due to the obvious effect of gravity, and the unstable nature of the contemporary mixed media, the owners were advised to avoid excessive warm conditions and to rotate the painting regularly (every 3 months). (They were quite happy to hang their painting in different orientations- as they had already been hanging it sideways!). Perspex glazing had been considered, however, the clients were happy to leave the painting to see if further deterioration occurred.

Third Painting (17th Century cradled panel painting)

The last painting was a 17th Century panel painting titled "Portrait of the first Marquis of Winchester" by Benson (?). The panel support had been cradled during the early 20th Century (1930's), and the painting had been restored during the 1970's. No previous treatment documentation had been given to the owners. Previous matte inpainting was evident in the head, beard and hand and thick varnish surrounded the figure, with selective previous varnish removal of the face, beard, hand and second medallion. The wooden panel consisted of a single piece of unevenly hand planed panel with the grain in the vertical orientation. The back of the panel had been pared down at regular intervals to accommodate the cradling members or braces, which ran in both the vertical and horizontal directions. A plug or inset in a cradle member or brace was visible in the bottom left quadrant on the back.

The owners brought the panel for examination after noting vertical sections of cleaved paint running the full length of the panel, specifically down the inner right hand edge and to a lesser extent down the inner left edge and centre bottom region. The cleaved panel and paint in those regions indicated lateral shrinkage of the panel due to the cradling process.

Due to my lack of exposure to 17th Century panel paintings I contacted Trevor Hoyne at the National Gallery, Canberra to discuss the condition of and treatment approach for the panel painting. The main consideration was that the cradling process was irreversible any attempt to remove the cradling could cause further damage. The treatment then had to be centred around stabilising the cleaved areas of paint and support and housing the panel to minimise further deterioration. It was suggested by Trevor Hoyne to use fish glue for the treatment as it would enable me to have time to work the glue underneath the cleaved support/paint and be able to gently adhere it down. A 3% w/v fish glue (sturgeon) was made up in distilled water (boiled covered for about 8 hours and filtered through Stabiltex and stored at 4^{o}C prior to using). A double beaker was used to keep the 3% fish glue stock warm and liquid (it gelled at room temperature), and it was applied with a fine brush. Direct heat from a heated spatula through a dry thick blotter was used after applying the glue underneath the cleaved support/paint to assist the fish glue to disperse before a light weight on silicon

release film was used while another application was carried out. In minor areas of cleavage the heat through the blotter was sufficient to adhere the cleaved areas down. Small losses were infilled using Liquitex acrylic gesso and inpainted using 10% Paraloid B67 in Petroleum Spirits (BP 100-130^{o}) and dry pigments. The panel was housed back into the frame using UV Plexiglass XT glazing with spacers to buffer the surface from the environment.

Acknowledgments:
Thank you to Trevor Hoyne, National Gallery of Australia for advise regarding the condition and treatment of the panel painting and to the Paintings Conservation staff for providing a sample of fish glue.

RECENT WORK AT ARTLAB

Helen Weidenhofer

In this paper a number of interesting problems were raised based on an examination of recent work which has been undertaken at Artlab. The restoration of a painted frieze in a private home and the removal of a 1970's acrylic painting from the wall of Adelaide gaol.

The paper focussed on issues raised by limitations of cost and use, and discussed these issues in light of the AICCM Code of Ethics, and the problems raised for conservators who were required to show strict adherence to the Code.

A METHOD OF COSTING THE CONSERVATION COMPONENT OF A PAINTING EXHIBITION

Catherine Earley
Conservator for Exhibitions, National Gallery Of Victoria

Conservators working both privately and in institutions have, of necessity, to be practised at costing treatments and materials. This paper illustrates a 'ready reckoner' that I use at the National Gallery of Victoria (NGV) and that may be adapted for use by others.

As exhibition budgets get tighter it has become important for the Conservation Department of the NGV to calculate and formally submit conservation costs for every exhibition. Calculations using the ready reckoner explained below have resulted in cost estimates that have proved to be fairly realistic and often a lot higher than projected costs as suggested by non conservation personnel.

This greater degree of accuracy has been achieved by identifying tasks involved in the preparation of a work for exhibition, and costing the predicted time taken and materials used in these specific tasks.

THE RECKONER

Costing Materials:

Page 1 of the reckoner (see appendix) lists materials and times involved in various tasks, and how to calculate the amount of each required. Page 2 is a list of costs for these.

The costs on page 2 must be filled in by individual users as they will be idiosyncratic to each, differing from supplier to supplier and from consumer to consumer. To give some idea of costs involved, I have included the prices the NGV pays for these materials. We do not buy in bulk and incur no discounts other than a tax exemption.

Pages 1 and 2 could also include any additional material such as overheads including rent, electricity, tax, work cover etc. and their cost loading for each job as required. At the NGV these costs are covered elsewhere.

Costing Tasks:

Page 3 is included to illustrate how I present final costing estimates for basic tasks we have found are required in the preparation of a work for exhibition. Costs for further, optional, procedures are also included. Adjusting for the size of the works, I use this page of estimates to cost an exhibition. Final costing figures are rounded up to the nearest whole number and are never offered as anything but an estimate. While this is offered as a usable format, the actual figures shown here are only relevant to the NGV as they are based on the prices we pay for items and the time we take to perform tasks.
The calculations are based on a sample painting of 1 metre x 3/4 of a metre (the average size of a Hugh Ramsay painting which is where all this started).

Tasks: breakdown of costs

The break down of these cost estimates on page 3 are supplied on pages 4 and 5. Additional expenses should be added to totals as required.

For every exhibition we have a basic condition reporting cost that applies to every work. It can be one of three costs depending on whether it is in:

Category 1) a work from another institution where every thing is prepared and it is just a matter of condition reporting in and out. In this case it is merely a cost for time.

Category 2a) a privately owned work or NGV work in a travelling exhibition requiring compilation of a condition report as well as condition reporting in and out.

Category 2b) a private work or NGV work not travelling but requiring compilation of a condition report (usually done more informally and stored on my computer) and condition reporting in and out.

Looking at the break down of costs for these categories (on pages 4-5) a levy of 1 hour is also charged per work. In an exhibition there are a lot of hours generally spent on organisation for e.g. letters to lenders for permission to treat works, phone calls and attendance at meetings etc. Calculated from past exhibitions, this has come out to around 1 hour per work. Materials are also covered in this cost. For example 2 AA batteries in my Maglite have to be replaced after a solid day of condition reporting.

Every item in an exhibition has to incur one cost (from category 1 or 2)

Then we have a list of costs for *additional* but not mandatory tasks (categories 3-6). Category 3 costs the addition of backing boards either loose in a soft pack, screwed to a frame or stretcher, or fitted with a profile to the back of a frame.

Our profiling/spacer timber (because it's kiln dried and has no knots) is by far the most expensive item in these categories. Our TAs are looking at cheaper timber alternatives to bring the overall cost down. Not costed here, we have started to use a narrow U shaped plastic extrusion, screwed to the stretcher of large unframed contemporary works, and which the backing board slots into. This is a much cheaper alternative to wood and keeps the profile of an unframed work very shallow. It does not answer if a frame has to be built up at the back to protect a protruding work however.

In category 4 I have calculated the cost of glazing a work and in category 5, minor touch-ups to frames and paint layers. Category 6 is an inhouse estimate for swapping glass for perspex before travel. Rough ball park figures are given for new frames, as supplied by our framer and by a commercial framer in Melbourne.

Conservation treatments are object specific and the true cost is variable dependant on the actual condition of each work. It is not possible to estimate these costs in advance.

If curators choose works which do not require treatment, or have the treatment carried out at the owner's expense, then theoretically that leaves only the accidentally damaged in transit works to be borne unexpectedly.

<u>To predict the cost of an exhibition:</u>

First, the materials listed on page 2 have to be costed at the prices that the form user has to pay.

To cost an individual painting at a *specific* size, a page similar to the layout of page 6 can be filled in using pages 1 and 2 for calculating amounts. Materials required for various procedures (add others as required) are listed in column 1, the amount of each item required, in column 2 against those procedures/materials, and their prices in column 3. A total of column 3 will give you the cost of preparing the painting. This enables costs to be tailored to a specific work.

An *average* size for the whole exhibition can be used to work out costs and this cost then multiplied by the number of works involved. As the costs are *estimates*, this method provides an adequate working figure.

Working from a print-out of all the known items in an exhibition listing owners, dimensions and materials, I divide the works into 2 categories

1) works from institutions that I know will only require condition reporting in and out. These are costed accordingly.

2) all the other works - from private lenders, corporations and Regional Galleries. These incur the more expensive condition reporting cost involving the compilation of reports. In addition, all those on canvas (if the exhibition is travelling) incur a cost for backing boards. Works on panel will incur a cost for perspex also.

The total of these costs is submitted as an estimate to the budget committee.

As the contents of an exhibition often remain fluid well after budgets are set, costs for reframing, processing late inclusions, minor treatment of some non-institutional works etc. will be likely to occur to stretch the budget a bit. By estimating on a worst case scenario then and finding that some works in category 2 do not require preparation for instance, these costs can be accommodated. I also have a modest budget to draw from and there is always the trick of getting some other department to frank a particular task.
Finally, as an idea of the estimated costs involved in preparing works for exhibition I looked up some of the estimates for exhibitions held in the last 6 months. Most of these merely represent condition reporting as, although some originated at the NGV, none were travelling shows.

The Gleeson Exhibition $2,800.00
Renoir $1,800.00
Mike Parr $1,400.00
Fairweather $2,400.00
Arthur Boyd $2,500.00
and
Phillips Fox $1,300.00

TO ESTIMATE MATERIALS AND TIME NEEDED

(Based on dimensions H100.00 x W 75.00)

TRAVELLING CONDITION REPORT

ITEM	CALCULATION
Photograph	1 B/W 8"x10" per painting
Mylar Overlay	1
Double Sided Tape	14cm x 2 (photo to paper, Mylar over)
Paper	x3 (1 for photo, 1 for report, 1 forcheck sheet)
Time	1/4 hr

REFIT

ITEM	CALCULATION
Glazing	Same dimensions as painting
Fome-cor	Add 2.5cm to both dimensions of the painting, to go beyond the work to the frame area for anchoring (av. fig.: may need to be bigger to bridge wider gap)
Profile	Add 1.0cm to both dimensions of backing board
Spacers	Same length as painting dimensions (2xH + 2xW) + paint
Felt	Same length as painting dimensions (2xH + 2xW)
Mirror Plates	2 per 50cm length of profile
Hangers	2 per work (2 hole nickel plated)
Screws 12mm(backing board) 20mm(mirror plates) 30mm(profile) 1/2"(hangers)	 4 per 50cm length of Fome-cor 4 per 50cm length of profile 3 per 50cm length of profile 4 per painting
Cup Washers no.6 no.8	2 per mirror plate, 1 per backing board screw 4 per painting (hangers)
Time	3 hours per painting

REHOUSE IN FRAME

ITEM	CALCULATION
Time (glazed)	1/2 hour includes cleaning glazing/vacuuming rebate
Time (unglazed)	1/4 hour

PAINT LAYER REPAIR Object specific. Usually small infill/inpaint: 1/4 hour.

FRAME REPAIR Object specific. Usually small inpaint: 1/4 hour.

NEW FRAME

ITEM	CALCULATION
Simple wooden	Same dimensions as painting
Time	1 hour
Gilded compo.	Same dimensions as painting
Time	Months (Framer)

PAPERWORK/MATERIALS LEVY

1 hr: Includes meetings, initial inspections, letters to lenders, pens, batteries etc.

COST OF MATERIALS AND TIME

Refit:

ITEM	COST	COST [NGV*]
Fome-cor	$ per 2400x1200mm	$14.00 per 2400x1200mm
Profile	$ per 50cm	$3.00 per 50cm
Felt	$ per 50cm	$0.59 per 50cm
Perspex (3mm)	$ per 2440 x1200mm	$75.00 per 2440 x 1200mm
O.C.Glass (3mm)	$ per 1800x1220mm	$228.40 per 1800x1220mm
Spacer (25mm Sugar Pine)	$ per m	$6.00 per m
Mirror Plates	$ per 500	$59.00 per 500 (12c each)
Hangers		Supplied by installation
Screws (12mm)	$ per 1000	$48.69 per 1000 (5c each)
(20mm)	$ per 1000	$54.03 per 1000 (6c each)
(30mm)	$ per 1000	$66.03 per 1000 (7c each)
(1/2")		Supplied by installation
Cup Washers (no. 6)	$ per 1000	$12.61 per 1000 (2c each)
(no. 8)		Supplied by installation

Frame (includes time):

ITEM	COST	COST [NGV*]
Blackwood L-section (FINI)	$	$150.00
Gilded compo on wood	$	$4,000.00 +
L section (TA cut down spacer)	$	$33.00

Forms

ITEM		COST [NGV*]
8" x 10" B/W Photograph	$	$5.00 (true cost to public approx. $30.00)
Mylar overlay	$ per sheet	$00.40 per sheet
Double sided tape	$ per m	$8.85 per 33 m
Paper	$ per 500 sheets	$8.95 per 500 sheets (2c each)

Time:

ITEM	COST	COST [NGV*]
Per hour	$	$12.27 (TA) $17.00 (CR)

*(tax exempt and as per orders 1994)

Cost of conservation labour and materials for exhibitions

- Based on painting size **H100.00 x W 75.00 cm**
- (x) categories itemised on attached sheets
- Totals rounded up to nearest whole number

BASIC CONDITION REPORTING COST APPLIES TO EVERY WORK

(1.) INSTITUTIONAL WORKS Est. $26.00 per work
Condition report in and out and general paperwork/materials levy.
Assumes work and travelling condition report prepared by lending institution.

(2a.) PRIVATE AND NGV WORKS (TRAVELLING) Est. $45.00 per work
Initial inspection, compilation of travelling condition report, condition report in and out and general paperwork/materials levy. Includes below cost B&W 8"x10" photograph.

(2b.) PRIVATE AND NGV WORKS (INHOUSE) Est.$40.00 per work
Initial inspection, compilation of an inhouse condition report without photograph, condition report in and out of exhibition and a general paper work/materials levy.

ADDITIONAL PREPARATION COSTS:

(3a.) Est. $8.00 per work
Backing board. Temporary for transport. Fome-cor cut to size but not attached.

(3b.) Est. $13.00 per work (typical of large contemporary pictures)
Backing board. Fome-cor backing board, attached.

(3c.) Est. $76.00 per work (typical of traditional framed pictures)
Backing board. Fome-cor backing board attached with profile.

(4a.) Est. $79.00 per work
Glazing with perspex. Felted rebate, spacers.

(4b.) Est. $115.00 per work
Glazing with perspex. Felted rebate, spacers, profile, backing board.

(5.) Est. $19.00 per work
Minor touch ups to frame / painting.

(6.) Est. $31.00 per work
Replacing glass with perspex on NGV works.

NEW FRAME:
Simple wooden moulding (spacer cut down by TA) Est. $33.00
Simple wooden moulding (Blackwood L-section from Fini) Est. $150.00
Gilded, compo moulding: Est. $4,000.00 +

TREATMENT:
Object specific. Requires examination to determine true cost.

BREAK DOWN OF COSTS FROM PAGE 3.

CATEGORY (1.)	AMOUNT	COST [NGV]
condition report in/out	1/2 hr (CR)	$9.00
paper work/materials levy	1 hr	$17.00 (CR)
EST. Total		**$26.00**

CATEGORY (2a.)	AMOUNT	COST [NGV]
initial examination	1/2 hr (CR)	$9.00
condition report in/out	1/2 hr (CR)	$9.00
paper work/materials levy	1 hr (CR)	$17.00
travelling condition report	-1 8x10" B/W photograph -1 mylar overlay -tape (28 cm) -3 forms -1/4 hr (CR)	$5.00 $00.40 $00.08 $00.06 $4.25
EST. Total		**$44.79**

CATEGORY (2b.)	AMOUNT	COST [NGV]
initial examination	1/2 hr (CR2)	$09.00
condition report in/out	1/2 hr (CR2)	$09.00
paper work/materials levy	1 hr (CR2)	$17.00
inhouse condition report	-2 forms -1/4 hr (CR2)	$00.04 $04.25
EST. Total		**$39.29**

CATEGORY (3a.)	AMOUNT	COST [NGV]
Fome-cor	1/3 sheet	$5.00
time	1/4 hr (TA)	$3.00
EST. Total		**$8.00**

CATEGORY (3b.)	AMOUNT	COST [NGV]
Fome-cor	1/3 sheet	$05.00
12mm screws (backing board)	28	$01.40
No.6 cup washers	28	$00.56
time	1/2 hr (TA)	$06.00
EST. Total		**$12.96**

CATEGORY (3c.)	AMOUNT	COST [NGV]
Fome-cor	1/3 sheet	$05.00
profile	364.0 cm	$21.84
felt	350.0 cm	$04.13
mirror plates	15	$01.80
12mm screws (backing board)	28	$1.40
20mm screws (mirror plates)	30	$1.80
30mm screws (profile)	22	$1.54
no.6 cup washers	(28+30) 58	$1.16
time	3 hr (TA)	$ 36.75
EST. Total		**$75.42**

CATEGORY (4a.)	AMOUNT	COST [NGV]
perspex (3mm)	1/3 sheet	$25.00
felt	350.0 cm	$4.13
mirror plates	15	$1.80
20mm screws (mirror plates)	30	$1.80
no. 6 cup washers	30	$0.60
spacers	350cm	$21.00
time	2 hr (TA)	$24.54
EST. Total		**$78.87**

CATEGORY (4b.)	AMOUNT	COST [NGV]
pespex (3mm)	1/3 sheet	$25.00
profile	364.0cm	$21.84
felt	350.0cm	$4.13
mirror plates	15	$1.80
20mm screws (mirror plates)	30	$1.80
30mm screws (profile)	22	$1.54
no. 6 cup washers	30	$$0.60
spacers	350.0cm	$21.00
time	3 hr (TA)	$36.75
EST. Total		**$114.46**

CATEGORY (5.)	AMOUNT	COST [NGV]
minor frame repair	materials	$0.20
time	1/2 hr (CR2)	$9.00
minor paint repair	materials	$0.20
time	1/2 hr (CR2)	$9.00
EST. Total		**$18.40**

CATEGORY (6.)	AMOUNT	COST [NGV]
perspex	1/3 sheet	$25.00
time	1/2 hr (TA)	$6.00
EST. Total		**$31.00**

ARTIST:
TITLE:
DIMENSIONS:

Refit:

ITEM	AMOUNT	COST
Fome-cor		$
Profile		$
Felt		$
Perspex (3mm)		$
O.C.Glass (3mm)		$
Spacer (25mm Sugar Pine)		$
Mirror Plates		$
Hangers		$
Screws (12mm)		$
(20mm)		$
(30mm)		$
(1/2")		$
Cup Washers (no. 6)		$
(no.8)		$
Time		$
Total		

Forms

ITEM	AMOUNT	COST
8" x 10" B/W Photograph		$
Mylar overlay		$
Double sided tape		$
Paper		$
Time		$
Total		$

Frames

ITEM	AMOUNT	COST
Gilded Compo on wood		$
L section (routed spacer)		$
Blackwood L-section (Fini)		$
Time		$
Total		

Other

ITEM	AMOUNT	COST
		$
		$
		$
		$
Total		

EST. TOTAL $

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REVIEW OF SOME PAPERS GIVEN AT THE COLLOQUIUM "VARNISHES - AUTHENTICITY AND PERMANENCE" HELD AT THE NATIONAL GALLERY OF CANADA, SEPTEMBER, 1994

The challenge to find a synthetic varnish with the working and optical properties of a natural resin, but with much better stability has been the subject of research from as early as 1930.

Perhaps we need to ask why were varnishes used? Was it for protection? If so would not any varnish do. However, it is more widely accepted that the artist applies the varnish to provide a particular effect, whether it be the saturation of the paint film to enrich the colour or provide an illusion of transparency, or to provide a surface texture for a given effect. Except for a very limited period in the use of varnishes as surface coatings on paintings, varnishes were applied as a clear colourless transparent film.

It has been established that aging of natural resin varnishes produces a yellowed, less transparent film with increasing insolubility, and it is the yellowing factor which has introduced the conservator to the paintings cycle. At each point of intervention the paint film is susceptible to damage or the introduction of elements that may hasten its deterioration. Those who presented papers at the Canadian Conservation Institute Colloquium "Varnishes: Authenticity and Permanence" Sept. 1994 sought to understand the nature of varnishes and their processes of deterioration, both natural and synthetic, and attempted to formulate varnishes (providing a wide range of optical effects) that were both stable and able to preserve the artists intent whilst reducing the need for intervention in the cycle.

According to Rene de la Rie, National Gallery of Art, Washington, there is evidence that paintings have had varnish removed from as early as the 17th century,

and as varnish is probably one of the most unstable components that artists have used, this is not surprising. The traditionally used natural resin varnishes yellowed and with age become increasingly difficult to redissolve. This century, with the introduction of synthetic resin varnishes, conservators sought to produce a varnish that did not yellow or crack, that remained transparent and could be easily removed with solvents that least effected the paint film. The new synthetic varnishes were thought initially to have fulfilled their expectations, but in practice they also have problems with yellowing and insolubility.

The degradation process takes place in a number of ways; free radical initiated oxidation, and from photochemically initiated oxidation. There is a large surface to volume ratio in the varnish film and with no pigment or other substance present that absorbs UV light or inhibits oxidation, the paint film deteriorates unchecked. Cross linking of the molecular structure occurs rendering them insoluble.

A great deal of research has been conducted over the years to understand the degradation process and it is acknowledged that it can be slowed down by the reduction of exposure to UV radiation, the reduction of intensity of light and, or by the addition of chemical stabilisers to the varnish solution. For example, anti oxidants, where radical scavengers convert unstable components into more stable components. Heat stabilisers reduce the effect of thermal degradation, and UV absorbers absorb the UV and thereby protect what lies below in the structure.

Whilst the synthetic varnishes appeared to have performed well in terms of reduced rate of yellowing and greater stability, many conservators found them difficult to handle and found their optical properties failed to imitate the effect of natural resin varnishes. This led to experimentation with the light stabiliser TINUVIN 292 and the UV absorber TINUVIN 328. In

Dammar, 4 - 5% TINUVIN 292 + 3% TINUVIN 328, has produced a quite stable varnish. Natural Dammar alone is very unstable, and mastic even less stable. Mastic was found to be less responsive to inhibitors and therefore could not achieve the same degree of stability as Dammar.

Because the low molecular weight synthetic resins have the ability to produce similar optical effects to the natural resins, they were selected for experimentation with stabilisers. Laropal K80 - Ketone, MS2A - chemically reduced Ketone, Regalrez 1094, hydrogenated hydrocarbon Arkon P90 - hydrogenated hydrocarbon Laropal A - aldehyde, were compared with Dammar with stabilisers. The criteria sought was a varnish film that did not yellow or crack and would stay soluble in the same solvent that was used in its delivery. It should have a relatively high refractive index and be soluble in low aromatic hydrocarbons since highly polar solvents are more likely to cause leaching to the paint film during the cleaning process.

After artificial aging in a weatherometer, using a xenon light source with constant output, 30°C at 40% RH, with similar spectral distribution to daylight and with the use of filters to assimilate indoor conditions, the removability performance was rated without stabilisers, from greatest difficulty to dissolve, to the least degree of difficulty to dissolve in low aromatic hydrocarbons: Dammar, MS2A, Laropal K80, Arkon P90, Regalrez 1095, Laropal A - Aldehyde. With the addition of 3% wv Tinuvin 292 the order was: Dammar, Laropal K80, MS2A, Arkon P90, Regalrez 1095, Laropal A-Aldehyde.

Polymeric additives have been added to the resins to alter their handling and optical properties. KRATON G 1657 (Shell) is a styrene ethylene butylene-styrene block copolymer, which is compatible with the hydrogenated hydrocarbon resins and Elvacite 2044 (Dupont) is compatible with the aldehyde resins.

These additives make the varnished more flexible, increases the viscosity and improves the flow. Initially, the major criticism of Regalrez 1094 was that it was too glossy and its long working time made it difficult to manipulate. Different solvents with different rates of evaporation were experimented with in conjunction with these resins. Jill Whitten reported on some research carried out by her in the Scientific Research Dept. at the National Gallery of Art, Washington. The hydrogenated hydrocarbon resins dissolve best in aliphatic hydrocarbon solvents such as Shellsol TD which has an initial boiling point at 172^{O} and also in aromatic hydrocarbons. The aldehyde resins are soluble in low aromatic hydrocarbon solvents like White Spirit with initial boiling point at 160^{O}C (The papers presented by Rene de la Rie and Jill Whitton would be available through the Scientific Research Dept., National Gallery of Art, Washington DC FAX: (202) 842 6886. Paper titles: "An Overview of Research on Picture Varnishes"; "Synthetic Low-Molecular-Weight Varnishes"; "Stabilized Dammar Varnish").

With the addition of 3 - 5% KRATON G 1657 25% in Shellsol TS28, Regalrez 1094 has been successfully sprayed and brushed. The surface can then be buffed with various materials to give different finishes. Regalrez 1094 has been used with great success to reconstitute a degraded varnish where it is not intended to remove the lower layer, but possible to safely remove the Regalrez at a later date.

An issue of great importance is the relatively short shelf life of varnishes with additives. It is recommended that varnishes should not be kept for more than 3 weeks.

Another issue raised within the framework of the Colloquium by Anne Ruggles was pigment migration in varnishes, where the solvent delivery of the varnish sets up solvent sensitive migrated pigment particles indicating that the timing between completion of the

cleaning process and the application of the new varnish may be crucial.

Alan Phenix expressed the need for either a broader range of varnishes to provide a range of optical effects or ways of modifying a particular varnish to give that range. He also expressed concern that there was still wide range use of Ketone varnishes in spite of evidence of the limitations of the varnish with regard to stability.

Stephen Hackney and Alan Phenix both expressed some reservations about Paraloid B72 which has shown to require higher polarity solvents to redissolve after 60 to 70 years, perhaps due to cross linking, though yellowing does not seem to be an issue. B72 seems to remain flexible, displays little tendency to crack, has resistance to moisture exchange which does not appear to change upon aging. It is however a poor conductor, storing electric charge, attracting dirt by its static charge. Giving an example of a painting varnished with B72 in 1964 which was recently surface cleaned, it was noted that there was no evidence of blanching or bloom, the film had remained transparent and could be surface cleaned safely with good results.

Stefan Michalski indicated that thickness of the varnish film plays a major role in evaluation of yellowing. The thicker the film, the lower the level of acceptability of yellowing. There was also some question whether TINUVIN 292 would have as remarkable results at low lighting levels (below 200 lux) as it does at high levels. When Dammar has UV filtration, the yellowness factor is not effective at high light levels. Without UV filtration the effect of yellowing levels off after a number of years probably due to the auto bleaching mechanism. However the UV filtration factor is important to the reversibility of the varnish film.

The question was raised whether it was really beneficial to add UV absorbers to the varnish if the painting was to be displayed in a museum environment where UV had been excluded from the light source. The answer was essentially "no", however it was advised that if conditions were not strictly controlled, then anti oxidants as thermal stabilisers and UV absorbers as additive to the varnish are good risk management. With the conclusions of the preceding IIC Conference on Preventive Conservation still ringing in our ears, proposing that it was impossible to control conditions to the parameters set by the profession, it seemed a very positive idea to include these additives as a preventive measure.

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