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# Conservation of the Chinese Temple Painting *The Paradise of Maitreya* from the Bishop White Gallery, Royal Ontario Museum

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*In 2005,* The Paradise of Maitreya*, a Chinese fresco-secco wall painting belonging to the Far Eastern Collection of the Royal Ontario Museum (ROM), and dating to the Yuan Dynasty (1271-1368), underwent extensive treatment to address both surface and structural problems. In the early 1930s, several years after its acquisition, the painting was mounted onto Masonite panels and installed on the north wall of the Bishop White Gallery by George Stout. The preparation of the painting fragments for mounting used a process developed by Stout and Gettens at the Fogg Art Museum. A description of this process that relied heavily on the use of polyvinyl acetate (PVA) resin will be outlined as well as a brief history of past treatments as these relate to the present condition of the wall painting and its current treatment. The treatment, carried out in 2005 involved surface cleaning and consolidation, but most specifically addressed the problem of cracking and general breakdown in the joint material between the Masonite panels. In order to address the instability in the joints, Plastazote® LD45, a closed-cell, cross-linked polyethylene foam, chosen for its flexibility and imperviousness to fluctuations in relative humidity, was used as a support for the fills between the Masonite panels.*

Le Paradis de Maitreya*, une fresque chinoise de type "a secco" datant de la dynastie des Yuan (1271 à 1368) et faisant partie de la collection d'Extrême-Orient du Musée royal de l'Ontario (ROM), a fait l'objet, en 2005, d'un traitement de grande envergure qui visait à répondre à des problèmes de surface et de structure. Au début des années 1930, quelques années après son acquisition, George Stout entreprit le montage de la fresque sur un support en Masonite et son installation sur le mur nord de la Galerie Mgr White. M. Stout suivit le même procédé qu'il avait développé au Fogg Art Museum avec M. Gettens pour préparer les fragments de fresque en vue de leur montage, lequel était basé largement sur l'utilisation de la résine acétate de polyvinyle (APV). L'historique des traitements qu'a reçus cette fresque est présentée puisqu'ils sont liés à l'état et au traitement actuels de la fresque. Le traitement, effectué en 2005, a comporté le nettoyage de la surface ainsi que la consolidation de la structure, et visait avant tout à résoudre le problème de fendillement et de dégradation des matériaux de jointement entre les panneaux Masonite sur lesquels la fresque avait été montée. Afin de remédier à l'instabilité des joints, du Plastazote LD45®, une mousse réticulée à cellules fermées faite de polyéthylène, a été utilisé comme support de remplissage entre les panneaux de Masonite.*

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## Introduction

*The Paradise of Maitreya*, a Chinese wall painting dating to the Yuan dynasty (1271-1368) and belonging to the Far Eastern Collection of the Royal Ontario Museum (ROM), underwent an extensive conservation treatment in the summer of 2005. This treatment coincided with a major renovation of ten galleries in the ROM, that began in 2003 and was completed by December 2005. This, the largest of the ROM's three Chinese temple paintings, measures approximately 5.8 metres x 11.8 metres in size and depicts "Maitreya, the Buddha of the future, giving a sermon in the company of his retinue".[1] This painting is flanked, in its present location on the north wall of the Bishop White Gallery, by two smaller Taoist wall paintings.

*The Paradise of Maitreya* arrived at the ROM in 1928 in approximately 69 fragments (see **Table 1** for a description of terms used in this text). These fragments were treated and assembled in 1933 by George Stout using a technique developed by himself and a colleague, R.J. Gettens, several years earlier at the Fogg Art Museum in Boston. This treatment involved stabilizing the crumbling paint surface with thinned out polyvinyl acetate resin (most probably Vinylite "A", either AYAF or AYAT, produced by Carbide and Union Chemicals)[2] followed by removal of the supporting clay and fine plaster layers behind the paint and adhesion of the exposed paint layer to prepared Masonite panels. Multiple fragments were joined together and adhered on a number of single panels, the latter being of different sizes and shapes corresponding to fragment size and shape and assembly patterns. The Masonite panels, 26 in number, most of these bearing the painted fragments, but a few acting as support for the blank "background" used to square up the painting, were mounted onto a wooden batten structure fixed to the display wall. Spaces in joints between panels varied from none (tightly butted joints) to up to 3.0 cm in width. Wider spaces were filled with Masonite shims and linen, then surfaced with a clay and polyvinyl acetate resin mixture. Once the procedure had been established, George Stout returned to the Fogg, leaving the remainder of the work to be carried out by the staff at the ROM. Correspondence with a member of the ROM staff,[3] within a few months of his return to the Fogg, indicates that Stout had anticipated that there would be some movement between the panels, mostly due to the drying and shrinkage of the fill material. Ongoing work to the fills as well as inpainting and reconstruction of some missing details (**Figure 1**) were done by ROM staff, and the work completed by 1938.

**Figure 1**. An early during treatment photograph taken of the painting sometime between 1933 and 1938 shows the fills at joints between panels and at gaps between fragments prior to inpainting. Some reconstructive painting has been carried out on background panels (halos). Photo: Courtesy of the Royal Ontario Museum, © ROM.

Over the years, the joints between Masonite panels have suffered from ongoing deterioration, with cracking to the fill material and planar deformation. In the early 1980s, conservation staff at the ROM, given only a short period of time to address this ongoing deterioration of the joints, carried out an interim treatment that consisted of filling the cracks with wax, balsa wood and linen. By 2003 these fills had also cracked and some of the joints had begun to bulge where they were not supported by battens.

**Table 1: Terminology used to describe the treatment.**[4]

| | |
|---|---|
| Fragment | a section of the original wall painting as cut up by the monks |
| Gap | the area left between fragments of the wall painting mounted to the same Masonite panel |
| Joint | where the Masonite panels meet in both the vertical and horizontal axes |
| Space | the void left between the Masonite panels, vertically and horizontally |
| Panel | Masonite board used as auxiliary support for one or more fragments of the wall painting |
| Reconstruction | the replacement, by inpainting, of lost or missing details of the wall painting |

In 2003, prior to a forthcoming major renovation at the ROM, and in anticipation of a treatment in 2005, the museum staff completed a condition report, sent paint samples for analysis, did surface cleaning tests, and applied protective paper facings to the painting.[5] A hoarding was then erected around the painting for protection during the renovation of the gallery. At that time, the painting demonstrated serious deterioration, and it became obvious to ROM staff that full conservation treatment was required. In June of 2005, a team of five conservators: Barry Briggs, Pawel Marek, Bonnie McLean, Roumen Kirinkov and Desislava Bobeva, under the direction of ROM Conservator Ewa Dziadowiec, was contracted to treat the painting. The scope of work initially included removal of the protective facing, cleaning away of surface dirt and residual polyvinyl acetate resin (this latter, from the 1933 mounting process), as well as consolidation of localized cleavage that had occurred between the applied fine plaster coat of the wall painting and Stout's fabric interleaf. It became apparent, however, that the major problem was the ongoing deterioration of the joint fills. These were failing due to a lack of support behind the vertical joints, vibration transmitted through the gallery wall from a nearby subway as well as from movement in the panels due to fluctuating humidity in the gallery space. The original 1933 fill materials, along with the 1983 wax and balsa wood fills would have to be removed and replaced. A new fill material and better support for the most unstable vertical joints was required. The new fill material for both vertical and horizontal joints that would accommodate movement while providing for a visually acceptable surface finish had to be found. As well, the entire treatment had to be completed within a short time frame in order to accommodate the re-opening of the Bishop

White Gallery in December, 2005.

**Description**

*Iconography*

This temple wall painting originally adorned one of the worshipping halls in Xinghua Si Temple, from the village of Xiaoning in southwestern Shanxi Province, China, and was painted by Zhu Haogu with the assistance of his pupil Zhang Boyuan.[6] This is an example of "painted decoration for architecture"[7] whose antecedents date back to as early as the 1st and 2nd centuries A.D. An inscription in the monastery suggests that the painting was executed in 1298.[1] **Figure 2** shows an overall view while **Figures 3a** and **3b** illustrate and describe parts of the iconography.[8] The painting:

> *"... depicts the future Buddha, Maitreya, giving a sermon in the company of his retinue - monks, bodhisattvas, and heavenly beings. The event shown was predicted by the historical Buddha, Shakyamuni: that Maitreya, who was then ruling in the Tushita heaven (the fourth of six heavens in the world of desire) as a bodhisattva, would be reborn as a human and attain Buddhahood. He would give three sermons to save people from suffering, and many would follow him. The two dignitaries depicted at his sides are undergoing tonsure, a Buddhist ritual signifying a willingness to join the monastic order. They are singled out for depiction because they set an example for tens of thousands of people."*[1]

*Technique*

Wall Preparation

Chinese temple paintings were executed on (dry) plastered walls forming "an aesthetic and religious background for the carved or molded figures of the deities."[9] The walls on which these paintings were applied were non-weight bearing brick walls of poor quality materials and often not well engineered.[6] The levelling for the painting was applied on top of the bricks. This levelling or surfacing was built of a series of layers, beginning with coarse loess clay combined with chopped millet stalks or bamboo splinters, then followed by layers of fine clay, sand, and chopped hemp.[10] A final coat of fine clay or kaolin was applied to produce a smooth surface for the application of paint. This surface could be painted, or further prepared by the application of a coat of lime wash that would provide an undercoating for the painting.[6]

Underdrawing and Outlining

From brush drawings, the design was transferred to the wall using a light carbon-based ink. These outlines were then reinforced in dark tones (black paint), the lines being "sure, strong, unbroken and of even width."[6] Mass tones were applied within the black outlines, the flesh tones of the female deities painted white over a ground coat of kaolin, and the males a creamy tan colour painted over a darker ground.[6]

Medium

These paintings are done in a fresco-secco technique. The medium is difficult to determine; as with many of these paintings, very little of the original medium remains.[11] Some traces of protein were detected during analysis carried out at the Canadian Conservation Institute (CCI).[12] Practices of the period suggest that these paintings were executed using tempera paint, possibly glue-based.[6]

Pigments

R.J. Gettens described Chinese wall painting techniques indicating that there were "… six simple colours used in their natural state combined with water and glue, namely: Carbon Black from soot, White Kaolin from clay, Red Ochre, Green Malachite, Blue Azurite, and Vermilion from cinnabar. In addition there were two pigments which required complex manufacturing processes, Red Lead and Lead White […]."[9] The presence of these pigments was confirmed through sample testing done in 1983 and again in 2003 by CCI.[12,13] In addition to those pigments identified as commonly found in Chinese temple paintings by R.J. Gettens, CCI analysis identified yellow and orange iron oxides for yellows. All pigments had been applied over a kaolin-base. Many of the pigments were found in association with PVA resin residues (from the treatment by George Stout), and a large number of oxalates were detected. Copper oxalate hydrates were detected in some of the blue and green paints, and are assumed to be conversion products of azurite and malachite.[12,13] Calcium oxalate hydrates were found in association with almost all of the other pigments, regardless of colour.[14] It remains unclear as to the trigger of the alteration processes in the case of the blue and green pigments or the source of the calcium oxalates, although various causes have been postulated, ranging from micro-biological activity, to surface treatments, or original constituents of the paint.[14]

**Removal of the Painting from its Original Location**

During a period of civil unrest in Shanxi province in the 1920s, the monks, in an attempt to save the painting, cut the wall into sections, crated and stored them.[9] Cut lines were determined in order to avoid disturbing main compositional elements, such as faces.[6] All main compositional elements were salvaged, but much of the background sky was missing as well as some areas within the composition. Losses at cut lines varied from a few centimetres up to 5 to 6 centimetres.[4] Once cut and pried free from the brick wall by the monks, each section was placed face down on two layers of dry springy reeds and then covered with layers of cotton wool. Above this was placed a second section, painted side up, which was covered with packing materials. This two-section package was then roped together and packed into a wooden box cushioned by flax or reed filling.[6] It is, presumably, in this condition that the wall painting fragments were received by the ROM in 1929, purchased from a syndicate of Chinese dealers by William Charles White (1873-1960), the Anglican Bishop of Henan Province from 1909 to 1934, and one of the founders of the ROM's world-renowned Chinese collection.

**Figure 2**. Overall view of *The Paradise of Maitreya*: Maitreya is represented in Buddha form in the centre of the composition, to his proper left is Manjusri, the bodhisattva who personifies Transcendent Wisdom, to his proper right is Samantabhadra, the bodhisattva who symbolizes Universal Goodness.[6] Dark square-shaped outlines are old fills and inpainting in gaps between fragments. Photo: B. Boyle, ROM, 1998. Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 3a**. To the proper left of Manjusri is one of the "earthly" scenes depicting the tonsure ceremony, symbolizing conversion to Buddhism. The male figure undergoing tonsure by a monk may be King Sankha or the Liang Dynasty Emperor Wu.[6] Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 3b**. A similar tonsure ceremony is performed to the proper right of Samantabhadra. Here a divine being performs the tonsure on a female figure who may either be the consort of King Sankha, Queen Syamavati, or the Northern Wei Dynasty Empress dowager Hu.[6] Photo: Courtesy of the Royal Ontario Museum, ©ROM.

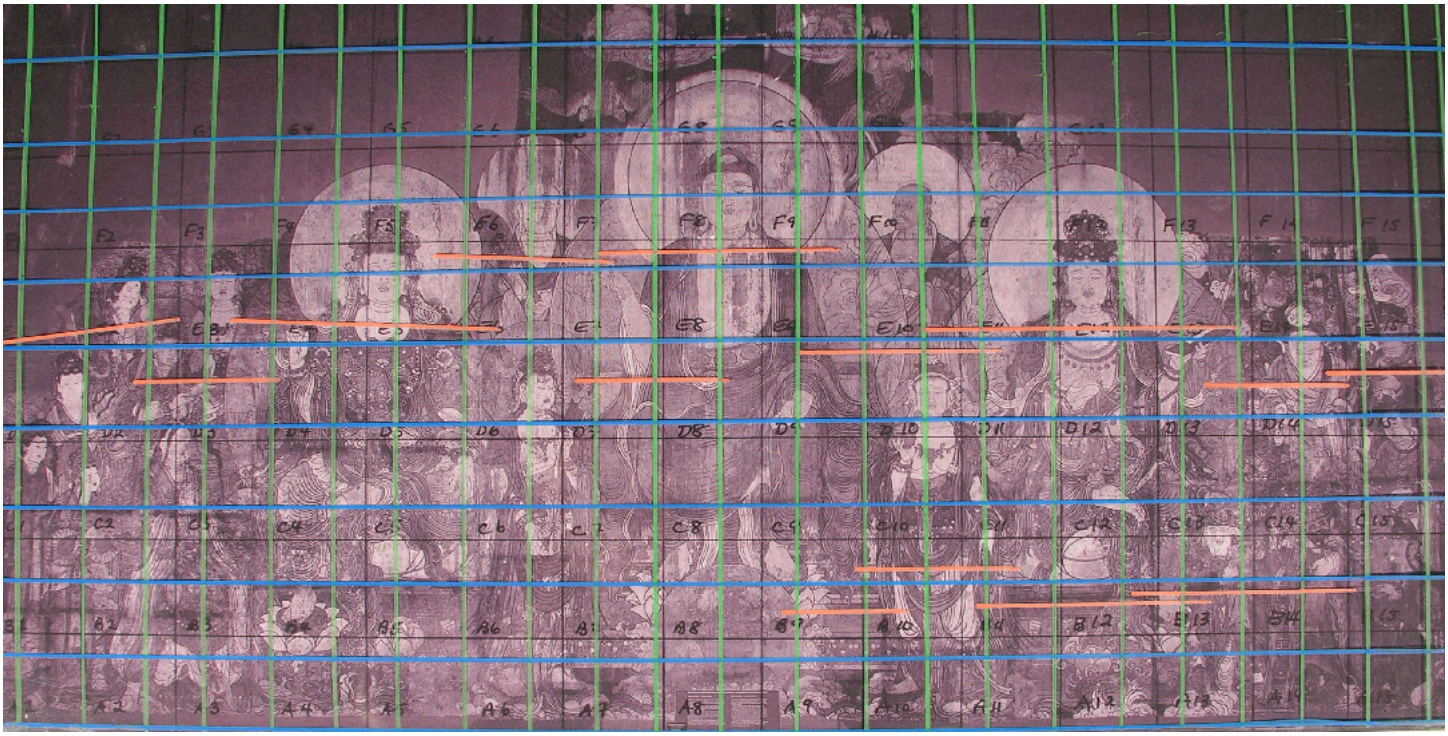

**Figure 4**. Layout of battens for the support of Masonite panels. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 5**. Schematic of panel arrangement. Masonite panels are screwed along their edges to the horizontal batten framework. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 6**. The twists of linen used by Stout as gap fillers are evident here in the joint between panels. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 7**. The underlying interleaf linen plus clay-PVA resin filler used by Stout are visible in the joint between two panels. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 8**. Grid pattern established for photography during 2003 was duplicated in order to establish documentation and working zones. Each square is roughly 80 cm x 80 cm. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 9**. Cleaning in progress: removal of dirt and PVA resin residues. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 10**. Ancient graffiti and inscriptions. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 11**. Blind cleavage, shown here using a marked mylar overlay, is located in sections D1 and D2 as delineated on the grid pattern in **Figure 8**. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 12**. Cracking and lifting of wax fills applied in space at joints between panels during the 1983 treatment. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

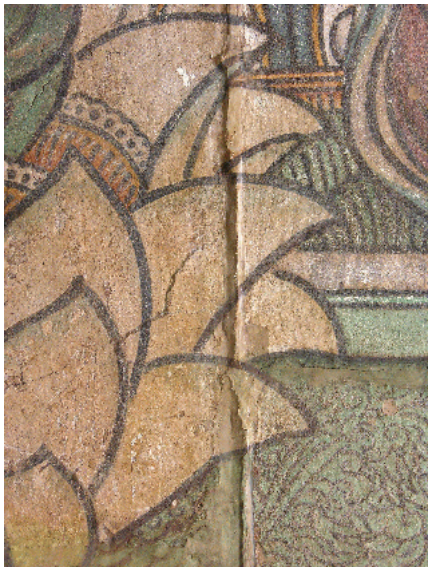

**Figure 13**. Cracking and lifting of original clay-PVA resin fill and 1983 wax fills at the joints between panels in the vertical axis. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 14**. Original clay-PVA resin fill removed along with 1983 wax repairs from the vertical joint (seen before treatment in **Figure 13**). Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 15**. Pieces of black Plastazote® LD45 are used to bridge the joints in the space between panels. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 16**. Two layers of Hollytex®, laminated with BEVA® 371 act as an interlayer between the Plastazote® LD45 bridge and surface fill materials. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

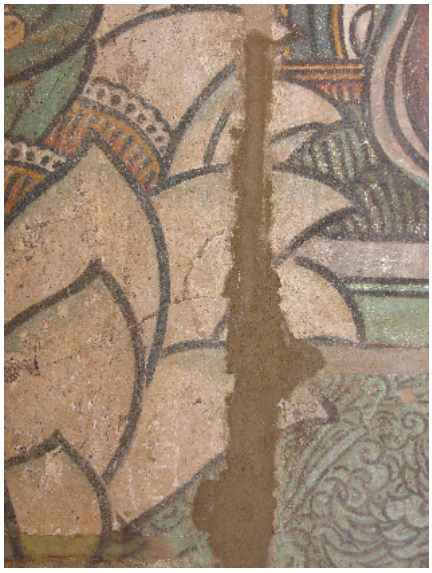

**Figure 17**. Tinted surface fill material made up of Polyfilla® toned with earth pigments, Jade® 403 and varying concentrations of Golden® Garnet Gel combined with Polyfilla®. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

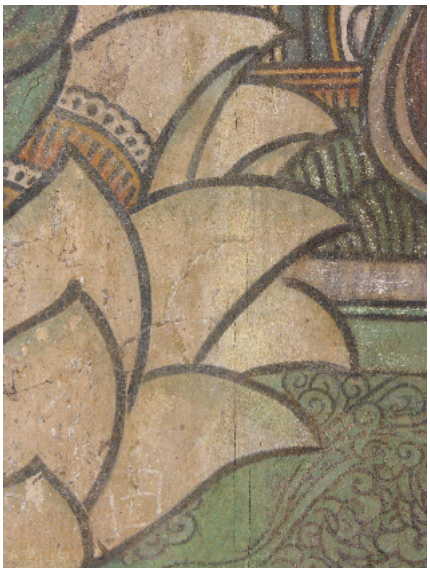

**Figure 18**. New fills at joints inpainted with dry pigment suspended in casein-borax medium. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 19**. Closed-cell cross-linked polyolefin foam T-Cell® EVA was inserted behind thinner panels to bring these into plane with a thicker, neighbouring panel. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 20**. Temporary toggle bolt with wood spanner inserted into the space between the panels. These wood spanners remained in place during the process of foam bridging and the application of the fill material. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 21**. A brass spanner inpainted to integrate with the adjacent composition. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

**Figure 22**. *The Paradise of Maitreya*, after the 2005 treatment. Photo: Courtesy of the Royal Ontario Museum, ©ROM.

## Treatments

### *Historical Restorations*

During the 2005 treatment, evidence of very early treatment(s), done while in situ in China, was found. Damaged areas of the painting had been removed, new ground applied and details completely repainted.[15] These repairs may have been precipitated by damage from an earthquake in the Shanxi province that occurred in 1303[11] or as a result of a general campaign of restoration of Chinese institutions undertaken during the reign of the Yongle Emperor (1403-1425).[16] These repairs and restorations have become an integral part of the history of the painting, as they were carried out while the painting was in its original setting and contain information about Chinese restoration techniques. These restorations were, therefore, left intact during the 2005 conservation treatment.

### *Twentieth-century Restoration Practices*

Paintings similar to *The Paradise of Maitreya* found their way into collections around the world in the early years of the 20th century. There appears to be a history of treatment[11,16-19] of painted wall fragments that involved, in many but not all cases, removal or thinning of the bulk of the original clay backing, mounting to a secondary support, cleaning, consolidation, and surface restoration. In many instances, these treatments were revisited half a century later as problems were encountered with flaking paint, delamination between the original layers and new support system or loss of fill material in the joints.

Treatment of Chinese wall painting sections or fragments was pioneered in North America by Rutherford J. Gettens and George Stout who applied treatment and mounting techniques developed at the Fogg Art Museum in Boston. An article published by Gettens and Stout in 1932[20] makes reference to their treatment technique. A number of authors indicate that the early interventions on their institution's particular temple paintings were either treatments carried out by Gettens and Stout[17,21] or inspired by their methods.[11] The methodology employed by Gettens and Stout rested largely on the use of the then new, synthetic polyvinyl acetate resin, Vinylite "A", which they used both as a bonding and a consolidating agent. Their treatment differed from the more traditional approach of backing the painted fragments with a plaster of Paris or other cementing agent prior to mounting on a secondary support, as described by Hanna, Lee and

Foster[16], this latter treatment carried out in the 1930s to the wall fragments in the British Museum. Gettens and Stout describe their rationale for using polyvinyl acetate (PVA) resin for the treatment of works of art, and specifically for the very powdery and matte Chinese wall paintings, in a 1935 article that appeared in *Technical Studies in the Field of Fine Art*:

> "In the transfer of these wall paintings it is a matter of fixing before applying a paper and cloth facing on a very friable surface without impairing the peculiar eggshell texture of the old tempera film. After the removal of the facing it is possible to clean the paint film with solvents so that there is no varnished or impregnated appearance, although there is still enough of the artificial resin film present to hold the pigment …"[22]

Not only was the PVA resin used as a consolidating agent, but as a bonding agent between the pared down original and the new mounting system:

> "When two surfaces to be joined are brushed with a 20% solution of polyvinyl acetate, the film allowed to dry a few minutes, and the two surfaces then joined by pressure, excellent adhesion is obtained."[22]

*Treatment of* The Paradise of Maitreya *by G. Stout in 1933*

In 1933 George Stout was hired by the ROM to carry out treatment of the fragments and to devise a method of permanent display for *The Paradise of Maitreya*. Although there are numerous old documents concerning this painting on file at the ROM, no actual treatment report by George Stout could be found. The following steps were pieced together from: the notes taken by William Todd[23], a ROM conservator and assistant to Stout during the 1933 treatment; a draft of an article written by Stout[24] in 1937; and the information collected during careful removal of the Stout fills during the 2005 treatment:[4]

1. Each fragment was superficially cleaned by dusting, mechanical removal of splattered mud and cautious sponging with a mixture of water and ethyl alcohol in equal parts. Stout notes that the clay and paint layers are extremely friable, crumbly and prone to cracking.[24]
2. The painted surface was impregnated with several applications of polyvinyl acetate resin, a 5% solution of Vinylite "A" diluted in: ethylene dichloride, one part; diacetone alcohol, two parts; and ethyl alcohol, four parts. Prior to and between subsequent coatings of PVA resin (five or six coatings), diacetone alcohol was brushed onto the surface of the painting and PVA resin layers to increase the penetration of the adhesive into the paint and underlying clay layers.
3. Once the PVA resin was dry (1 day), the pits and cracks were filled with a paste of clay and water. Broken pieces were set in place and the surface was adjusted to plane.
4. Several more coats of PVA resin (20%) were applied to the surface as a necessary protection prior to the application of a facing.
5. The surface of the now heavy layer of PVA resin was rubbed over lightly with a mixture of china clay and very weak rice paste in order to give a tooth to the aqueous adhesive used for facings.
6. A facing of two layers of Japanese rice paper and one layer of muslin was attached to the paint surface with an adhesive composed mainly of rice paste, fish glue, glycerin and corn syrup.
7. Once the facings had dried, and the paint layer was deemed secure, the fragment was turned face down and the clay support on which the image was painted was mechanically removed "as far as the plane of impregnation", revealing "an almost complete exposure of the paint film".[20] This was accomplished by cutting the bulk of the clay backing with a saw into small squares stopping within 1/8 inch (3.2 mm) of the painted face. The cut squares of clay were then removed with a bearing scraper. The remainder of the clay was scraped back until the layer of clay impregnated with PVA resin was reached, at which time, removal of the remainder of the clay was done using either a grinding machine (with light pressure) or carborundum stone.
8. Thin coatings of china clay bound in PVA resin were then applied to the verso to give the exposed back of the paint layer body and to fill in any inconsistencies. The resulting coating was less than one millimetre thick.
9. Using PVA resin as a bonding agent, a layer of stretched and sized linen was adhered to the back of the fragment. The linen was sized with first a 20% and then a 10% glue size and coated with 2 layers of PVA resin, 10%, then 25%. A thin layer of clay was then brushed onto the linen. Next, two coatings of PVA resin, 10% and 25%, were applied above the linen/clay layer and the faced paint layer set in place. The facings were now removed from the recto.
10. This composite was subsequently mounted to a piece of Masonite panel, once again using PVA resin (20%) as the adhesive, and the composite placed under pressure. Each Masonite panel was cut to a different size depending on the size and shape of the fragments that were to be mounted. Average panel size was 3.5 m in length and 1 m in width. The Masonite panels were mainly 1.12 cm thick, but several, in one location at top right, were 0.87 cm in thickness. The majority of the panels supported the paint fragments, but some additional panels were used to square up the painting and provide a monochromatic fill for the missing sections in the background. Each of the fragment supporting panels could house two or more fragments, and in some instances, up to seven fragments were fitted onto one panel.[4] A gap was left between these fragments to make up for any loss from the cutting process and to allow space for reconstruction of missing elements of the composition.
11. To equalize the strain on the Masonite panel, a layer of fabric was adhered to the verso of each panel.
12. When the new backing was completely dry, the facing was removed.
13. A support system of mahogany battens was attached to the gallery wall: the vertical battens attached directly to the wall, the horizontal battens then secured to the top side of the vertical battens (**Figure 4**). Battens were oriented vertically, 48 cm apart, and horizontally, 80 to 90 cm apart. Several diagonally oriented battens gave added support.[4] Since the Masonite panels were screwed to the horizontal battens only, the vertical joints were, in actual fact, unsupported. The Masonite panels were aligned and positioned in proper relation to each other (**Figure 5**). Brass screws were used to

fix the panels to the full length of the horizontal battens through the space left along edges. Some of the screws were driven through the paint layer itself. Additional panels were added to fill in the blank areas that remained in the top portion of the mural where the sky would have been, bringing the total number of panels to 25. When completed, the painting measured 5.79 m x 11.78 m.

14. Twists of linen, impregnated with PVA resin, were inserted into some of the joints between the Masonite panels as a filler where the space was 0.3 cm or greater (**Figure 6**). In some cases shims of Masonite were also used. Spaces in the joints between panels varied from none (tightly butted), to mid-size (0.3 cm), to large (1.5 to 3 cm).
15. Clay bound with PVA resin was applied across the joints to integrate the surface topography (**Figure 7**).

This treatment, based on the notes on file and evidence found during examination of the painting corresponds, in many respects, with previous documented treatments carried out or inspired by Stout and Gettens,[11,17,21] and to their publications on the subject.[20,22]

*Subsequent Treatments of "The Paradise of Maitreya"*

By the fall of 1933, Stout had returned to Boston. His correspondence with Ms. Greenaway, a staff member at the ROM, indicated that by December of that year the vertical joints had already opened up as the fill material began to shrink upon curing. This is something that Stout had anticipated and he wanted this process to continue "practically to its limit before the final joint filling and cleaning."[3]

William Todd completed the cleaning and removal of excess PVA resin by the fall of 1934 and treated blistering between paint layers in the figure group to the left using additional PVA resin.[25] Notes in the ROM files indicated that the building up of the joints and some of the reconstructive inpainting had been done by staff at the ROM and were essentially complete by 1938.[26] Some of the missing portions in the sky and background details had also been recreated by ROM staff: haloes were tinted in to correspond with the original, a fly whisk[26] was painted in to complete the composition, and areas of brown staining were toned down.[25]

In 1979, construction was to begin on the north wing of the ROM. The painting was faced with paper and starch paste and an "insulated cover" was put up around it for protection throughout the construction phase.[4] Although there is no specific mention in the documents as to the condition of the joints at that time, it is assumed that they had become unsightly and structurally unsound since in 1983 some remedial conservation treatment was carried out on the joints.

During the 1983 treatment phase, Elizabeth Phillimore and her team removed the facings, examined and treated the surface. Pigment samples were also analysed.[13] The ROM's two other Chinese temple paintings underwent restoration prior to the work on *Paradise of Maitreya*. The work on the two smaller Taoist paintings was described by Phillimore in a 1982 publication[10] and by Phillimore and Gordon in a 1984 publication.[21] Although the 1983 treatment of *The Paradise of Maitreya* was less extensive than that of the two Taoist paintings, the approach to the treatment of old cracked joint fillers was very similar. Phillimore and her team used beeswax and balsa wood shims to bridge the gaps between panels in the treatment carried out on the two Taoist paintings, and beeswax and balsa wood were used in the treatment of *The Paradise of Maitreya* to fill cracks and losses to the 1933 fill material. The new fills were coated with Rhoplex® 234 diluted with water and inpainted with Acryloid® B67 and powder pigments.[5]

In 2003, the ROM was to undergo a major renovation in which ten new galleries were to be prepared for the Far Eastern collection. *The Paradise of Maitreya*, located next to the construction site, was considered to be vulnerable to vibrations and dust from the nearby construction. A thorough examination of the painting was carried out at this time, photographs were taken, further paint samples were analyzed[12] and a condition report with treatment proposal was prepared. At this time, the painting was considered to require another cleaning, and had renewed problems with cracking at the joints. Plans were put in place to carry out a comprehensive treatment in 2005. In the interim, in order to protect the painting during the building renovation, paper facings were applied, this time with methyl cellulose, polyethylene sheets were hung overall, and a wooden hoarding installed.[5]

*2005 Conservation Treatment*

Surface Cleaning and Consolidation

With the end of the New Gallery Project in sight, the ROM set out to hire a team of conservators to treat the painting and to have it ready for the grand opening of the new galleries in December 2005. The team members, who were in place by June 2005, began with research into the history of the painting and locating condition reports and treatment documentation; examination of the paint surface and the joints[4]; research into joint replacement techniques and fill materials; and the purchase, collection and manufacture of tools, materials, and equipment required for the project. Safety training and personal protective equipment were required in order to access the construction site and for the team to work on the scaffold. The team also attended a training course to learn to operate the scissor lift that was required to reach the topmost portions of the painting when the scaffold was not in place (prior to erection of the scaffold and after the scaffold had been removed).

By July 2005, a two-storey scaffold had been erected and treatment began with the removal of the polyethylene sheeting and facing tissue. The facing was removed with a solution of ammonia in water (1-3%). This solution facilitated the removal of a layer of surface dirt along with the residual methyl cellulose. A string grid that duplicated the grid pattern applied to photographic documentation from 2003 was secured in place[4] (**Figure 8**) and each approximately 80 cm x 80 cm grid square assigned an alpha-numeric designation. This made tracking the progress of work much easier, and allowed for more precise documentation.

Examination and solvent testing of the paint surface revealed that PVA resin residue, discoloured overpaint and a substantial amount of grime embedded in the PVA resin layer remained even after cleaning with the ammonia and water. With curatorial input, the decision was made to carry out a complete surface cleaning of the painting to remove as much of the surface dirt, PVA resin residue and modern day inpainting/overpaints (those done since the painting entered the ROM collection). Testing indicated that cleaning with swabs using mixtures of acetone and/or ethanol was effective in removing dirt, surface PVA resin as well as inpaints and overpaints and would not compromise the PVA resin-impregnated paint layer (**Figure 9**).

Chinese symbols, either scratched into the surface or applied with black ink/paint, and appearing in areas of the painting accessible from the floor, were done while the painting still adorned the temple and are likely centuries old (**Figure 10**). No attempt was made to erase or reduce the "graffiti" as they have become part of the painting's history.

A full survey of the painting was carried out by sounding with finger tapping to identify areas of blind cleavage. These areas were found mostly on the west or left portion of the painting in grid squares "D1" and "D2" (**Figure 11**). Areas of delamination were treated with a 15% PVA AYAT (1:1 acetone/ethanol) solution using a syringe for application. Cleavage was found to have occurred between the linen support and the Masonite panel.

Once the painting surface was considered clean and stable, the treatment then focused on repair and restoration to the joints.

Repair, Structural Support, Filling, and Reconstruction

The joint fills (the fills inserted into the space between the Masonite panels that had been applied by Stout), especially those located in the vertical orientation where the edges of the panels were not secured to battens, were badly cracked and tented. The vertical edges of the Masonite panels were often out of plane one with the other, in some cases up to 0.5 cm. There was also cracking to fill material at the horizontal joints where some movement had obviously occurred. The wax fills, located in the vertical joints, and put in place during the 1983 conservation treatment, often over the clay-PVA resin fills were, like the earlier fills, also badly cracked and tented, with major out-of-plane deformation (**Figure 12**). All of these deformations resulted in very poor visual integration with the original texture of the painting and emphasized the cut contours of the panels.

After a thorough assessment of the joints, keeping in mind the conditions of the gallery, the decision was made to replace them all (vertical and horizontal) as their condition ranged from bad through to poor to fair (**Figure 13**). The fills between fragments of the painting on individual panels from the 1933 treatment were cracked, concave and very smooth in texture. The edges of these fills, in the gaps between the paint fragments, were often raised out of plane in relation to the rest of a fragment, causing a slight linear ridging. However, the gap fills were left as they were, as treatment of these areas was beyond the scope of this project.

All the 1983 wax fills from both vertical and horizontal joints were removed mechanically. Removal of the remaining clay-PVA resin fills from the joints between panels involved first softening with a solution of acetone and/or ethanol, then removing the softened mass mechanically, and final cleanup of the edges with solvent. Essentially, all the fill materials, such as the PVA resin impregnated fabric/clay composite, Masonite shims, balsa wood and wax were removed (**Figure 14**).When uncovered, any loose original brass screws attaching the panels to the battens were replaced with #6, 5/8 inch (1.6 cm) stainless steel Robertson screws.

From the beginning of the project, different materials and techniques were investigated to determine a viable solution for the repair, in-situ, of the joints between the Masonite panels. Because the time for treatment was limited, removal of the panels for more extensive treatment was never an option. Decisions concerning the treatment of this wall painting had to be considered more in terms of problems associated with composite panel paintings where provision must be made for the expansion and contraction of hygroscopic materials. What was required was a gap filler that would accommodate movement within the panels and that would absorb destructive vibration transmitted through the floor and wall. This filler would have to be sufficiently rigid in order to support a coating material while remaining compressible, inert, and compatible with both a PVA emulsion adhesive and BEVA® heat set adhesive. A number of products were investigated, some of which included Foam-Core® board and expanded polyethylene foam. Plastazote® LD45, a closed-cell polyethylene foam was selected, as it is inert, heat and chemical resistant, and has the requisite strength, rigidity, flexibility and elastic recovery after compression.[27]

Pieces of black Plastazote® LD45, 1.2 cm thick, were cut to fit all the joints between the Masonite panels and were adhered in place with Weldbond® PVA emulsion (**Figure 15**). Two layers of Hollytex®, laminated with BEVA® 371 film, were heat fused into place across the surface of the exposed Masonite panel and the foam (**Figure 16**). This provided a strong bridge with a smooth transition between the panels.

Once the Plastazote® and Hollytex® were secured in place, a layer of fill material, made up of Polyfilla® toned with earth pigments and mixed with a solution of Jade® 403 and de-ionized water (1:1), was applied to this surface. The use of the Jade® 403 was to give the fill material more flexibility. Once this layer was dry, a thin, tinted, texturized fill was spread above the Hollytex. This surface fill material was made up of Polyfilla® toned with earth pigments and mixed with a solution of Jade® 403 and deionized water (1:1) and then texturized with varying concentrations of Golden® Garnet Gel combined with Polyfilla® (**Figure 17**).

When completely dry, the fills were inpainted with dry pigment suspended in casein-borax medium. The casein formula remains reversible and was chosen for its milky, matte surface which replicates the original (**Figure 18**). No varnish layer was applied.

Level discrepancies caused by the two different thicknesses of the Masonite required a different approach. The thinner panels were loosened by removing the screws that fixed them to the horizontal mahogany battens. These panels were pulled forward, away from the supporting battens, in order to insert the appropriate thickness of a closed-cell cross-linked polyolefin foam T-Cell® EVA behind the panel in order to bring them into plane (**Figure 19**). The panels were then screwed back onto the mahogany battens.

Temporary toggle bolts, 24 in all, with wood spanners were inserted into the space between the panels and remained in place during the process of foam bridging and the application of the fill material (**Figure 20**). In six critical spots where the space in the joint was large (1.5 cm or larger), the temporary bolts were replaced with permanent toggle bolts that held brass spanners (2.5 cm x 4 cm) across the face of the joint. The permanent use of the spanners is important to the structural security of the painting and overrides any aesthetic considerations. The brass spanners were first spray-painted with white lacquer and then inpainted to integrate them with the adjacent composition (**Figure 21**).

## Conclusion and Future Challenges

The project was completed within the required time frame and the gallery opened to the public on December 26, 2005. The new fills are better integrated, both visually and texturally, and the overall appearance of the painting is more cohesive (**Figure 22**). The painting is still subject to the same environmental constraints (seasonal variance in humidity and ongoing vibration), however it is hoped that the flexible joint bridging with the Plastazote® will accommodate any small changes in the panel size and alignment. Within the first weeks after completion of the treatment, as anticipated, fissures began to appear in two of the new vertical fills overlying the Plastazote® located in the central portion of the mural at a point where the space between the panels is wider than two centimeters. These fissures are intermittent and are not contiguous with the joint line. The Plastazote® in these areas has undergone compression followed by decompression and has, as predicted, allowed for stress relief at the joints. Regular monitoring, both visual and environmental, is being carried out in the hopes of addressing problems at the joints as the new materials settle in and respond to the ambient conditions.

Of ongoing concern is the condition of the Masonite panels. Deterioration of the panels could have serious consequences for the future of the painting. Research into the longevity of Masonite panels would provide an insight into the long-term behaviour of this material and would allow for the informed monitoring and long term preservation of this important painting.

## Acknowledgments

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## Materials

BEVA® 371 (ethylene vinyl acetate copolymer) film: Carr McLean, 461 Horner Avenue, Toronto, Ontario, M8W 4X2, 1-800-268-2123, email: cmclean@carmclean.ca.

Brass spanners: manufactured by ROM preparators, Toronto, Ontario.

Casein-Borax Medium: 1 litre skim milk, 100 ml alcohol, 10 g Borax, Biocide: Thymol (one medium sized granule). These ingredients are combined together and allowed to sit for 24 hours before use. Recipe from Ewa Dziadowiec, Royal Ontario Museum.

Dry Pigments: Curry's Art Supply, 490 Yonge Street, Toronto, Ontario M46 1X5, 1-866-967-6666, website: www.currys.com; Kremer Pigments Inc. 228 Elizabeth Street, New York, New York 10012, 212-219-2394, fax 212-319-2395.

Golden® Garnet Gel (an acrylic polymer emulsion medium with texturizing additives): Curry's Art Supply, 490 Yonge Street, Toronto, Ontario M46 1X5, 1-866-967-6666, website: www.currys.com.

Hollytex® (non-woven, spun bonded polyester fabric): Carr McLean, 461 Horner Avenue, Toronto, Ontario, M8W 4X2, 1-800-268-2123, email: cmclean@carmclean.ca.

Jade® 403: Talas, 569 Broadway, New York, New York 10012, USA, 212-219-0770, email: info@talasonline.com.

LePage Polyfilla®: Canadian Tire Store, Yonge Street, Toronto, Ontario.

Plastazote® LD45: KristoFOAM Industires Inc., 160 Planchet Road, Concord, Ontario, L4K 2C7, 905-669-6616, email: chrisw@kristofaom.com.

Polyvinyl Acetate Resin (AYAT) 100% resin: Conservation Support Systems, 224W Pedragosa Street, Santa Barbara, CA 93101.

Robertson #6, 5/8" (1.6 cm) stainless steel screws: Canadian Tire Store, Yonge Street, Toronto, Ontario.

Solvents: Acetone, Ammonium Hydroxide, De-ionized Water, Denatured Ethanol. Fisher Scientific Limited, 1200 Denison Street, Unionville, Ontario, L3R 8G6, 416-479-8700, fax 416-479-9749, 1-800 263-3375.

T-Cell® EVA Foam: Rogers Corporation, High Performance Foams Div., 171 West St. Charles Rd., Carol Stream, IL. 60188-2081, Tel. 630-784-6200, www.rogerscorporation.com.

Toggle bolts: Canadian Tire, Yonge Street, Toronto, Ontario.

Weldbond® PVA emulsion: Canadian Tire Store, Yonge Street, Toronto, Ontario.

**References**


1. Ka Bo Tsang, "*The Paradise of Maitreya*: a Yuan Dynasty Mural from Shanxi Province," *Orientations, the Magazine for Collectors and Connoisseurs of Asian Art*, April 2006, pp. 60-65.

2. In the early history of "Vinylite" there were four series produced by Carbide and Union Chemicals Corporation (now Union Carbide): Series "A" resin is a polyvinyl acetate, series Q is polyvinyl chloride; series V is copolymerized vinyl chloride and series X is polyvinyl butyral. Union Carbide lists both Vinylite AYAF and AYAT in their polyvinyl acetate resin series—both having slightly different molecular weights—but both dissolved in either acetone or toluene. These could be bought as dry resins or in a predissolved syrup. References:
   Bunn, H.S., "Versatile Vinylite Resins," in: *Bakelite Review*, no. 4, January 1940, p. 3, <http://www.powerhousemuseum.com/collection/database/?irn=238241&search=australian+made+dolls&images=&c=1&s=>. Accessed January 15, 2008.
   Reed, Kay, "Vinyl Resins," in: *The Painter's Guide to Studio Methods and Materials* (Englewood Cliffs, New Jersey: Prentice-Hall Inc., 1983), <http://www.notesaccess.com/Materials/VinylResins.htm>. Accessed January 15, 2008.

3. Correspondence between Stout and Ms. Greenaway of the Royal Ontario Museum, January 3, 1934. Letters on file in the Far Eastern Library, Department of World Culture, Royal Ontario Museum.

4. Briggs, Barry, *Treatment Report Paradise of Maitreya*, January 11, 2006. Unpublished report on file at the Royal Ontario Museum.

5. *Bishop White Gallery Conservation Project: The Paradise of Maitreya Wall Painting (933.6.1) Phase One, May to July 2003*, Royal Ontario Museum, 2003. Unpublished Report.

6. *The Bishop White Gallery, Shansi Wall Paintings and Sculptures from the Chin and Yuan Dynasties*, Royal Ontario Museum Publication (Toronto: Charles J. Musson Ltd., 1969).

7. Jack, Lee-Anne, "Man on a Mission," *Rotunda, The Magazine of the Royal Ontario Museum*, vol. 38, Number 3, (Toronto: The Royal Ontario Museum, 2006) p. 34.

8. For a more detailed description of the subject matter in the painting see *The Bishop White Gallery, Shansi Wall Paintings and Sculptures from the Chin and Yuan Dynasties*, Royal Ontario Museum Publication (ref. 6). Descriptions provided in captions related to **Figures 1, 2** and **3** of this text are taken from this source.

9. White, William C., *Chinese Temple Frescoes: a Study of Three Wall Paintings of the Thirteenth Century* (Toronto: University of Toronto Press, 1940).

10. Phillimore, E., "Initial Report on the Treatment of Two 13th Century Chinese Wall paintings in the Royal Ontario Museum, Toronto," in: *Preprints of the 10th Annual Conference of the American Institute for Conservation*, Milwaukee, 26-30th May 1982, (Washington: American Institute for Conservation, 1982), pp. 150-159.

11. Twilley, J., and K. Garland, "Painting Materials and Deterioration Phenomena in a Yuan Dynasty Wall Painting", in: *Scientific Research on the Pictorial Arts of Asia*, Proceedings of the Second Forbes Symposium at the Freer Gallery of Art, Smithsonian Institution, Washington D.C., 2003, edited by Paul Jett, John Winter and Blythe McCarthy (London: Archetype Publications, 2005), pp. 109-119. According to the authors, the GC-MS carried out on the Yuan wall painting in the collection of the Nelson-Atkins Museum of Art, Kansas City, Missouri demonstrated that the paint layer contained "… a protein whose amino acid profile is consistent with that of an animal glue binder. The history of water damage and microbiological growth has probably reduced the media content substantially over the centuries." (p. 118).

12. Moffatt, E. and K. Helwig, "Analysis of Samples from *The Paradise of Maitreya*", *Canadian Conservation Institute Analytical Report*, ARS No. 4191, September 24, 2003. Unpublished Report.

13. Moffatt, E. and N. Adair, "The Lord of the Northern Dipper" and "*The Paradise of Maitreya*," *Canadian Conservation Institute Analytical Report*, ARS 2095, June 6, 1983. Unpublished Report.

14. Moffatt, E., N. Adair, and G. Young, "The Occurrence of Oxalates on Three Chinese Wall Paintings", in: *Applications of Science in Examination of Works of Art*, Proceedings of the Seminar, 7-9 September1983, edited by P.A. England and L. van Zelst (Boston: Museum of Fine Arts, 1985) pp. 234-238.

15. Personal communication with Ka Bo Tsang, Assistant Curator in the Department of World Cultures, ROM, June 2005.

16. Hanna, S., N. Lee, and G. Foster, "Three Bodhisattvas: The Conservation of a Fifteenth Century Chinese Wall Painting in the British Museum Collection," in: *Preprints for the UKIC 30th Anniversary Conference, Conservation Today*, London, 10-14 October, edited by Victoria Todd (London: UKIC, 1988) pp. 130-134.

17. Malenka, Sally and Beth A. Price, "A Chinese Wall Painting and a Palace Ceiling: Materials, Technique and Conservation", in: *Conservation of Ancient Sites on the Silk Road*, Proceedings of an International Conference on the Conservation of Grotto Sites, Getty Conservation Institute, the Dunhuang Academy, and the Chinese National Institute of Cultural Property, Dunhuang, Peoples' Republic of China, 3-8 October 1993, edited by Neville Agnew (Los Angeles: The Getty Conservation Institute, 1997) pp. 127-138.

18. Gordon, Eric, "Conservation Treatment of Two Ming Dynasty Temple Wall Paintings", in: *Conservation of Ancient Sites on the Silk Road*, Proceedings of an International Conference on the Conservation of Grotto Sites, Getty Conservation Institute, the Dunhuang Academy, and the Chinese National Institute of Cultural Property, Dunhuang, Peoples' Republic of China, 3-8 October 1993, edited by Neville Agnew (Los Angeles: The Getty Conservation Institute, 1997) pp. 112-119.

19. Luk, C., I. Neuman, J. Martin, Berry C. Kuniej, and J. Greenfield, "The Treatment of Two Chinese Wall Painting Fragments", in: *Conservation of Ancient Sites on the Silk Road*, Proceedings of an International Conference on the Conservation of Grotto Sites, Getty Conservation Institute, the Dunhuang Academy, and the Chinese National Institute of Cultural Property, Dunhuang, Peoples' Republic of China, 3-8 October 1993, edited by Neville Agnew (Los Angeles: The Getty Conservation Institute, 1997) pp. 95-104.

20. Stout, George L. and Rutherford J. Gettens, "Transport des Fresques Orientales sur de Nouveaux Supports," *Mouseion*, XVII-XVIII (1932), pp. 107-112. Stout and Gettens describe, very briefly, the materials used in Chinese wall paintings, and go on to say that traditional treatments that use "cement- or cement-like materials" for the backing and cellulose acetate for protective coatings are not appropriate for the very friable and humidity sensitive wall paintings. The Fogg Art Museum undertook an experimental treatment of one section of a Chinese wall painting 85 cm x 57 cm in size, dating from either the Ming or Qing period. The painted surface was coated with "polymerized PVA"- Vinylite "A" (from Carbide and Union Chemicals Corporation, N.Y.) 5 g of the dry resin being dissolved in 100 ml mixture of toluene, ethyl alcohol, ethylene dichloride and cellosolve acetate. Next, major losses were filled using a mixture that combined sand and clay. This was then followed by a second coating of PVA resin, but this time at a 20% concentration. These coatings, applied both by spraying and brushing, acted as consolidants for the powdery paint and as protection against both the facings (paper and muslin) and the water-based facing adhesive. Two coatings of powdered kaolin were applied to the PVA resin surface and fixed into this layer by softening the PVA resin by exposure to cellosolve acetate. This was done to provide a "roughened" surface that would ensure the adhesion of the rabbit skin glue that was used to attach two layers of paper and a washed muslin facing. Once paper and muslin facings were in place, the painted fragment was turned over and the original clay back reduced in thickness to 1 mm. The back was then coated with the Vinylite "A" (likely a 20% solution - see reference 19). Any inconsistencies in the back were filled in with a wash of clay mixed into the PVA resin. A final layer of PVA resin was brushed above this and allowed to dry. The backing was then installed in one operation: a layer of fabric plus a 7 mm thick sheet composed of Portland cement and asbestos fibers were adhered to the fragment verso using the same, 20% solution of PVA resin. The backing was allowed to set, under weights, for a period of 48 hours. Facings were then removed from the painting with warm water, and excess PVA resin cleared using toluene and ethyl alcohol.

21. Gordon, Eric and Elizabeth Phillimore, "The Treatment of Two Thirteenth-century Chinese Wall Paintings in the Collection of the Royal Ontario Museum", in: *Preprints, 7th Triennial Meeting, ICOM Committee for Conservation*, vol. 2, Copenhagen, 10-14 September 1984, edited by Diana de Froment (Paris: ICOM Committee for Conservation, 1984), pp. 12-14.

22. Gettens, Rutherford J., "Polymerized Vinyl Acetate and Related Compounds in the Restoration of Objects of Art", in: *Technical Studies in the Field of Fine Art*, vol. 4 (New York: Garland Publishing, 1935), pp. 15-27.

23. Todd, William, *Notes on Mounting of Buddhist Wall Paintings*, (Toronto: Royal Ontario Museum, 1933). Unpublished Report.

24. Stout, George, draft of an article "The Assembly of Transferred Fragments of Chinese Wall Painting," sent by G. Stout to Miss Greenaway, a staff member at the ROM, January 16, 1937. On file in the Far Eastern Library, Department of World Culture, Royal Ontario Museum.

25. Correspondence between William Todd and George Stout, January 25th, 1937. Letters on file in the Far Eastern Library, Department of World Culture, Royal Ontario Museum.

26. Phillimore, E., (Head of Conservation, Royal Ontario Museum), interview notes with Stella Gould, December, 1979. Notes on file in the Far Eastern Library, Department of World Culture, Royal Ontario Museum indicate that Stella Gould was involved in the work of integration of joints in 1938.

27. Conservation quality Plastazote LD-45 is an inert, high

density, closed cell, cross-linked polyethylene foam with a density of 45 kg/m$^3$. The product is used by conservators as a padding material where cushioning is required. It is available in 3 mm, 12 mm and 30 mm thicknesses and comes in both black and white.