

Ellen Nigro

Winterthur/University of Delaware Program in Art Conservation

Supervisors: Dr. Joyce Hill Stoner, Matthew Cushman, Richard Wolbers, Catherine Matsen, and Karen French

Technical Study and Treatment of a Late-Nineteenth-Century Thai Panel Painting

In the spring of 2016, a late-19th-century Thai painting, entitled *Buddha Descending from Tavatimsa* (WAM 35.263), arrived in the Winterthur paintings conservation studio from the Walters Art Museum. The staff at the Walters is treating and researching its collection of Southeast Asian paintings; *Buddha's Descent* became the subject of a technical study and treatment at the Winterthur/University of Delaware Program in Art Conservation (WUDPAC). During the course of the 2016-2017 academic year, the results of the technical study added to the knowledge base about Thai painting techniques, while the treatment provided a case study for alternative consolidation methods for matte and absorbent surfaces.



Figure 1: *Buddha Descending from Tavatimsa*, before treatment. Photo: Jim Schneck

This eye-catching piece is a large and colorful panel with gilded details, measuring nearly three feet tall by more than six feet long, but when it arrived in the studio, the painting was in desperate condition. The paint layer was severely lifted and actively flaking across most of the surface. It could not be placed upright and had to be laid flat on a table to avoid further loss. Sections of paint were fully detached and scrambled. Almost two-thirds of the painting had sustained flaking and lifting, loss, tidelines, stains, and an appreciable layer of dust.



Figure 2: Detail of the left half of *Buddha's Descent* as it arrived in the studio, taken from an oblique angle to emphasize cupped and flaking paint.

This painting depicts two scenes from the life of the Buddha in a continuous narrative. At the upper right, it shows *Teaching in Tavatimsa*, a scene where the enlightened Buddha is teaching to a host of deities and his deceased mother in heaven, and the *Descent from Tavatimsa*, where the Buddha returns to Earth on a triple ladder. At that moment, all the beings in heaven, hell, and earth are revealed to each other. These scenes are traditionally in the same composition, and are two of the twenty-nine episodes from the life of the Buddha (Hampe 1957). The teaching and descent narratives here are limited to the right third of the painting; the rest of the panel represents a palace scene (Ginsburg 2006/2007).

The Walters has two other large-scale nineteenth-century Thai panel paintings in its collection, WAM 35.261 and WAM 35.262 (Ginsburg 2006/2007). Now decontextualized, these paintings would have been part of a Buddhist temple and used to tell the stories important to the religion (Rujivacharakul, pers. comm., 2016). All three paintings, as well as several other smaller scale paintings on panel or unstretched fabric, were previously in the collection of Doris Duke, a philanthropist and collector of Islamic and Southeast Asian art. Duke's Southeast Asian acquisitions were moved to her New Jersey estate, Duke Farms, in 1972 from Honolulu. Much of the Thai collection was stored in the property's indoor tennis court, and during Hurricane Floyd

in 1999, the building and much of its contents sustained water damage (Sasaki 2015). It is probably there that the *Buddha's Descent* panel incurred much of the tidelines and flaking seen before treatment. After Duke's death in 1993, her Southeast Asian collection was dispersed across institutions in the United States and United Kingdom. Many of the Thai paintings were donated to the Walters, the Asian Art Museum, and the Victoria and Albert Museum (Ginsburg 2006/2007).

Technical analysis has been conducted on Thai paintings on supports other than wood. Manuscripts were studied by Eremin, et al. in two separate papers in 2008. Jennifer Giacciai did technical analysis on two banner paintings on cloth at the Walters Art Museum in 2008. Chompunut Prasartset also analyzed pigments in a wall painting in 1996. Eremin, et al. in 2008 made the first identification of copper citrate in Thai manuscripts (Examination of pigments... 2008). No literature has been discovered regarding Thai painting on wood panel to date. According to Eremin, et al. in the Harvard University Art Museum study, paintings on all traditional Thai supports seem to have palettes that change from the 17th to the 20th centuries. Her study identified emerald green, Prussian blue, synthetic ultramarine, chrome yellow, and zinc yellow only on paintings from the 19th and 20th centuries. Huang in 2006 suggested that indigo was primarily used in the 18th century, ultramarine and Prussian blue were used in the 19th century, while Prussian blue was exclusively used in the 20th century.

Binder analysis is nearly absent in English-language literature. Prasartset identified the binder of the mural painting in his study as simply “tempera.” A paper at the Asia Pacific Tropical Climate Conservation Art Research Network (APTCCARN) 2015 conference by Nichanan Thepsuparungsikul, et al. studied ground binders in Thai mural paintings, citing tamarind kernel glue as the binder in mural paintings since the reign of King Rama I, who reigned from 1782 – 1809.¹

Beyond the technical studies cited above, there seem to be minimal publications in English on Thai painting materials and techniques. Therefore, the literature review was expanded into non-scientific resources for information on Thai painting. Boisselier (1976) and Lyons (1963) briefly described the preparation of grounds for wall and panel paintings, as well as

¹As of August 2017, papers from the APTCCARN conferences are still unpublished and the author was unable to obtain a copy of this article. The abstract is available online.

brushes and application technique. Nicole Tse mentioned traditional binders in her 2008 dissertation. Art historical resources by Leksukhum (2000), Hampe (1957), and Boisselier (1976) were referenced for information on Thai iconography and history. Catalogues from the Walters Art Museum (Ginsburg 2005/2006) and the Doris Duke Collection (Tingley 2003) were also consulted for background on *Buddha's Descent* as well as general information on the history of the Doris Duke Collection. Shiho Sasaki's 2015 WAAC article on the treatment of Thai paintings in the Doris Duke Collection at the Asian Art Museum in San Francisco was also helpful in identifying similar objects in other collections.

According to the sources previously mentioned, the ground would likely be white chalk bound in tamarind seed extract. Preparatory drawings were typically done in red ochre. Traditionally, the paint would be bound in a tree gum called *ma-khwit*, which is a tree in the Rutaceae family (*Feronia elephantum rutaceae*) called the elephant apple, although different tree gums or animal sizes sometimes replace this (Tse 2008). Tse noted that banner paintings would be primed with a size of acacia, tamarind glue, or rice milk. Gold leaf is traditionally used and adhered with *mah düa*, a *ficus* tree in the Urticaceae family (*Ficus hispida urticaceae*) (Boisselier 1976 and Tse 2008). One study found that gold leaf size on one 19th-century Thai manuscript may be gutta percha (Eremin, et al., Materials and techniques... 2008). Specific recipes on the preparation of these binders and glues were not found.

Polarized light microscopy (PLM), cross-section microscopy with fluorochrome staining, x-ray fluorescence spectroscopy (XRF), Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, scanning electron microscopy-energy dispersive spectroscopy (SEM-EDS), x-ray powder diffraction spectroscopy (XRD), and gas chromatography-mass spectrometry (GC-MS) were all used to study the materials and techniques of the Walters's panel. Pigments and fillers identified in the panel include zinc white, calcite, synthetic ultramarine, vermilion, red lakes, carbon black, barium sulfate, emerald green, iron oxides, and lead white. The ground was identified as primarily calcium carbonate with barium sulfide, wurtzite (ZnS), and monimolite ($\text{Pb}_3(\text{SbO}_4)_2$) impurities. The pigments identified are consistent with what has been written on late 19th-century Thai painting practice on other supports. Binder analysis in GC-MS yielded a distribution of sugars suggesting the binder is a gum, although further research is needed to determine the source. The metal leaf on the panel is gold, while the metal leaf on the frame

appears to be a gold alloy. PR 49:1 (lithol red) was also identified as the red paint on the frame, suggesting it was made in the 20th century and added later. (Nigro 2017).²

In addition to technical analysis, close looking at the painting revealed some of the techniques the artists used in this piece. This rich composition was thinly painted in a graphic manner, featuring broad expanses of solid color with abstract birds, and stippled trees juxtaposed with finely painted details with gilded accents. Most of the composition appears to have been painted in discrete layers, with very little wet-into-wet blending. The support is composed of two horizontal wood panels, about 2.5 cm thick, which are abutted but not joined in the middle. They are thought to be a tropical hardwood, probably teak. Paint spillover in the join and a lack of residual glue suggest the panel was never fully joined.

The white ground was unevenly applied, loosely bound, and highly absorbent. It has a sandy, textured quality, and vegetable fibers and hairs are present throughout, which are especially visible in raking light. There are incisions in the ground outlining some compositional elements. The ground was also applied more thickly under most of the figures. In raking light, there is a visible difference between the thicker layer structure immediately around the figures and the background, creating a slight ridge. This preferential application suggests the composition was carefully planned before it was executed.

Although an ochre underpainting was not discovered on this painting with close looking, fine lines of a dry medium are visible in the temple complex architecture that follow the painted details. These lines have the appearance of graphite, but did not become clearer with infrared imaging. It appears that in this area, the green-gray wall color was painted first, then the details were outlined with the dry medium, and then the detail lines were painted on top.

Close looking was also important in understanding the qualities of the flaking while designing a consolidation protocol. The flaking seemed to be the most frequent and most extreme in areas where the paint and ground were heavily applied. This group displays significantly curled paint and ground where the stratigraphy is thicker, but stops almost exactly at the point where the structure becomes much thinner. The characteristics of the flaking also vary throughout; the flaking in the wall at the upper left has big, curled paint chips, but the

² The full technical study can be requested through the scientists in Winterthur Museum's Scientific Research and Analysis Laboratory (SRAL).

nearby rooftops display finer, smaller flakes. Sometimes the pattern followed contours of the compositional elements exactly, presumably where there was a sudden difference in the thickness.

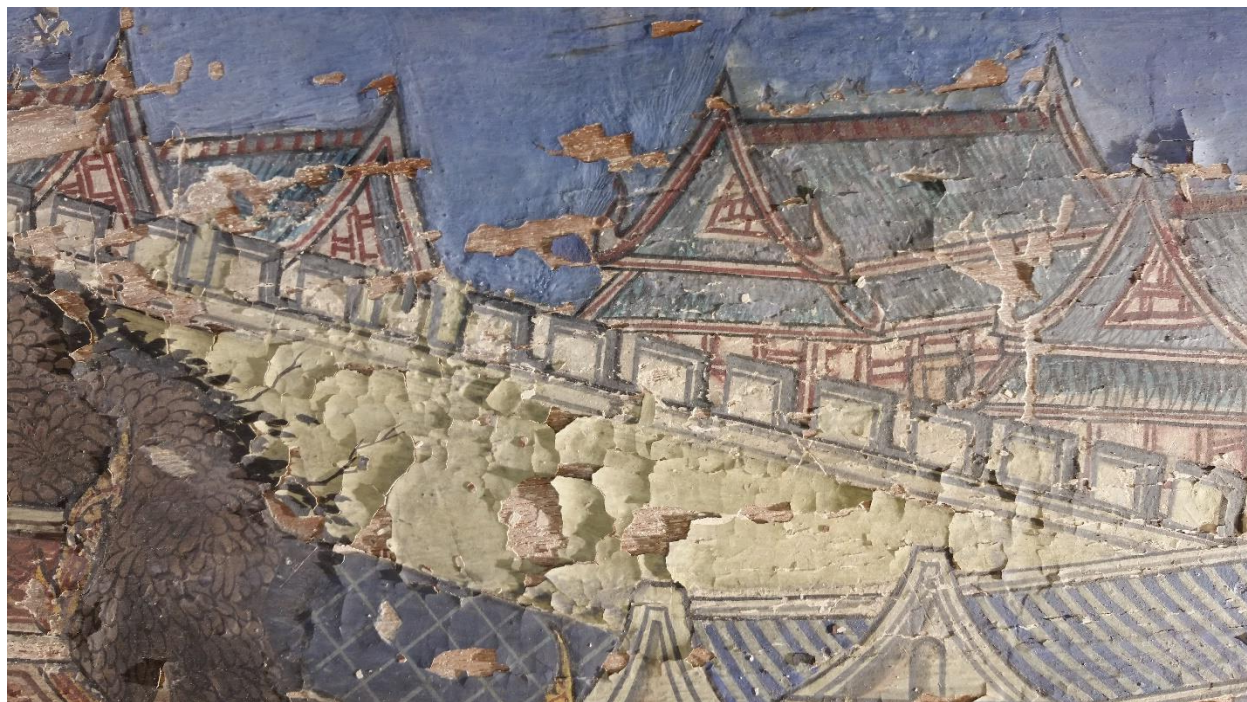


Figure 3: Detail of wall in upper left quadrant, raking light. The wall with a thicker stratigraphy shows large, severely curled flakes. The rooftops have relatively thin paint and ground buildup, and show finer flakes with less cupping. Photo: Ellen Nigro

The consolidation of this paint posed a rather difficult scenario. The paint is very matte and underbound, and the porosity and absorbency vary significantly throughout the piece. The flaking was primarily occurring between the ground and panel, and many of the flakes were thick, stiff, and curled, so the consolidant needed to have some strength. Although there is some underbound and powdery paint on the surface, this was represented in only a small fraction of the paint film. Last, but not least, the paint film is readily soluble in water and alcohols.

These solubility parameters immediately excluded many of the usual matte consolidants in paintings conservation like Klucel G, methylcellulose, or funori. The Asian Art Museum published a treatment protocol on their Thai panel paintings in which a gelatin-carageenan mixture was utilized as a consolidant, but that method also requires fully saturating the surface with the water-soluble adhesive (Sasaki 2015). However, water and alcohol testing on the Walters's panel caused immediate pickup of color and staining, so it was therefore essential to

avoid those solvents. So, if water and alcohol soluble adhesives had to be avoided, then the treatment needed to be limited to adhesives soluble in aliphatics, aromatics, and ketones, like BEVA 371, Paraloid B-72, and Aquazol. In solubility testing, aliphatics and aromatics proved to be slightly safer than acetone.

Consolidation tests at the left edge of the composition were successful with BEVA 371. The paint in this area is relatively thick, dense, and had formed the curled, stiff type of flakes. BEVA in combination with localized humidification through Gore-tex fabric emerged as the best option for consolidating these areas due to its solubility parameters and its strength, which was essential to holding the thick flakes in place

A soft brush was first used to dust away as much surface grime as possible and the loose flakes were rearranged so they were in their proper positions. There was a significant amount of dirt on the painting's surface, so this was an essential step to reduce the amount of grime that might get consolidated along with the paint. Then, a pipette or insulin needle with thin BEVA in petroleum benzine was used to feed in the adhesive under flakes, using large losses or lifting paint as an entry point. When there was enough adhesive in the area, the solvent was allowed to evaporate away. Next, the area was humidified through Gore-tex fabric, with a damp blotter on top, and sealed under Mylar and a weighted string for up to three hours. This slowly humidified the area without any direct contact with liquid water. After humidification, the flakes were leathery and pliable, and a heated tacking iron set to 60 °C could be used to reactivate the BEVA and relax the flakes back into plane. This worked well for the walled-in palace scene at the left of the composition because this area has much thicker and denser paint than the rest of the painting. The paint was effectively consolidated and if any BEVA remained on the surface, it could be removed with an 80:20 mixture of petroleum benzine to xylene applied with a small cotton swab.



Figure 4: Raking light detail of horse and rider consolidated with BEVA 371 in lower left quadrant. Photos: Ellen Nigro

However, BEVA was not successful for the rest of the painting, especially in the bright blue, ultramarine sky, where the introduction of BEVA into the paint structure caused immediate saturation and staining. Due to the porosity of the paint in the blue sky and water-damaged areas, the adhesive infused itself into the capillary structure of the paint, darkening the surface color. While some of the adhesive that moved up through the flakes could be removed from the surface, it did not return to an acceptable level.

The source of the darkening was a change in refractive index due to the penetration of adhesive into the paint layer, so in order to avoid the darkening, the adhesive should not penetrate up into the paint layer. One way to do this would be to have a more viscous adhesive. However, the consolidation protocol relied on the capillary forces under the flakes to draw the adhesive into the voids underneath, so good flow properties were still essential. Another way would be to mask the paint layer so an adhesive could still be injected under the flakes, have it flow into the voids, but not into the porous paint structure.

Richard Wolbers's lectures on cleaning water-sensitive surfaces were extremely helpful in developing an appropriate consolidation system for the other areas of the painting (Wolbers 2016). In particular, his lectures on using octamethylcyclotetrasiloxane, or D4, as a masking solvent for cleaning water-sensitive surfaces were the inspiration for the final consolidation

system. The polarity of siloxane solvents is even lower than aliphatic hydrocarbons, and it is immiscible with water, making it a very effective, temporary mask for blocking aqueous cleaning solutions out of paint films (Technical Data Sheet 2012). D4 has a particularly slow evaporation rate, which is helpful for working on a surface for several minutes at a time before it fully volatilizes.

Initially, D4 was used as a solvent to simply flood the pore structure of the paint flakes while BEVA was injected underneath. This reduced the capillary forces within the flake and the draw of adhesive into the structure, but still allowing the BEVA to flow into the voids under the flakes. This was successful to a certain degree by lowering the amount of BEVA that could flow up into the paint layer, but there was still a bit of darkening on the surface. D4 and BEVA's solvents (mineral spirits, xylene, and toluene) are actually miscible, so the BEVA could slightly penetrate the paint flake as the solvents intermingled, causing the darkening observed in other tests. This process was less controllable than was appropriate, and this system did not fully utilize the properties of D4 in the process.

Upon the suggestion of Wolbers, adhesives in water, ethanol, and acetone were tested, in order to take advantage the D4's low polarity and miscibility properties to further hinder the adhesive penetration into the paint film. Ethanol and water are both immiscible with D4, while acetone is partially miscible with D4. Adhesives tested include Paraloid B-72 in acetone, Aquazol 200 in ethanol, Aquazol 500 in ethanol, and Lascaux Medium for Consolidation at concentrations that could easily flow through an insulin needle, typically 5-10% (w/v) consolidant in solvent. The Lascaux Medium for Consolidation was used at the concentration at which it was manufactured.

This process happened in several steps. First, the D4 was applied with a brush and allowed to soak into the pore structure, reducing the capillary forces within the paint. The adhesive was injected underneath the flake with an insulin needle and flowed into the voids. Where there were hairline cracks or tiny losses that were too small to accommodate the needle, the surface was fully saturated with D4, then the adhesive applied in "micro-drops" near the crack and allowed to wick in. The immiscibility of the D4 and the polar solvent would cause the two to repel each other, adding a second level of protection, especially during the "micro-drop" process where the adhesive might briefly come in contact with the paint surface. Next the D4 and

the adhesive dried overnight, and the adhesive remained under the flake instead of in it. Then the area could be humidified with a damp blotter through Gore-tex fabric for no more than one hour and tacked down. If the Aquazol was in the humidity chamber for too long, it would become too liquid, losing its tack and potentially flowing back up through the flake during the tacking down process.



Figure 5: Images illustrating part of the D4/Aquazol 500 consolidation process – applying D4 with a brush (left), an area properly saturated with D4 (center), injecting Aquazol 500 in acetone with an insulin needle (right). Photos: Julianna Ly (left and right) and Ellen Nigro (center)

Several variations of D4 masking with preparations of Aquazol 200 and 500 in ethanol and acetone, Paraloid B-72 in acetone, and Lascaux Medium for Consolidation in water were tested. 5-10% (w/v) Aquazol 500 in acetone was selected as the final adhesive. Although acetone is partially miscible in D4, the slight incompatibility between the two solvents gave the surface the protection it needed. Now the surface could be consolidated while still retaining the matte, chalky quality of the paint film. The 5-10% (w/v) Aquazol was finally selected because it became plastic, but not too plastic, during humidification, which accommodated the movement of the curled flakes during the tacking down process. Ethanol and water posed too much risk for marring the paint film if any drops of adhesive rested on the surface for too long during the process. This system required some finessing and careful manipulation, but the results were highly satisfying on this delicate surface.



Figure 5: Detail of Indra at the lower right in raking light, before consolidation (left), after application of D4 (center), and after consolidation (right). Photo: Ellen Nigro

The treatment of this painting is still underway, and will continue beyond the tideline reduction, and probably minimal filling and inpainting in consultation with the Walters's conservation and curatorial staff. The structural stability of the panel will also be fully assessed once the reverse of the panel can be viewed, and necessary stabilization will be carried out.

Using siloxane-based solvent as a temporary mask for consolidation has proven useful for more precise application of adhesive on this painting. Although this consolidation system required a bit practice to be used successfully, it proved to be a good solution for the complicated surface *Buddha's Descent* presented. The particulars of this consolidation system can be tailored for other surfaces by choosing an adhesive with different physical properties, changing the adhesive solvent, or the humidification system.

We hope that recording and publishing the observations made from close looking and technical analysis will add to the body of knowledge of Thai painting. The rich surfaces these paintings present deserve special attention and will surprise conservators and curators with unique details in both imagery and artistic techniques.

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