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PAINTINGS

The three Ps in a sustainable practice: Persistence, patience, and perseverance

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Abstract
In 1989, painting conservators at the Smithsonian American Art Museum were confronted by the vandalism of Morris Louis' *Beta Upsilon*, a masterwork painting from his Unfurled series (1960–61). Composed of colored bands of paint flowing inward from the edges on an unprimed canvas, the work was found defaced with penciled graffiti on the raw canvas that mimicked the unfurling lines of colors on both sides. The guilty party was never apprehended, but the damage left the artwork visually disfigured and un-exhibitable. The painting was removed from view after preliminary tests revealed that no treatment available could remove the graffiti without causing harm to the raw canvas. Despite the urgency felt to treat the artwork, conservators advocated for a more cautious approach to finding the right solution. Persistence over three decades, patience through experimentation and research, and perseverance through challenges resulted in the design of a laser system to remove the graffiti without damaging the canvas.

HISTORICAL CONTEXT

In February of 1989, the vandalism of a masterwork by Morris Louis in the gallery of the Smithsonian American Art Museum (SAAM) forced the permanent removal of the painting *Beta Upsilon* (Figure 1) from display for over three decades until an adequate treatment to remove the graffiti without damaging the raw canvas could be identified.

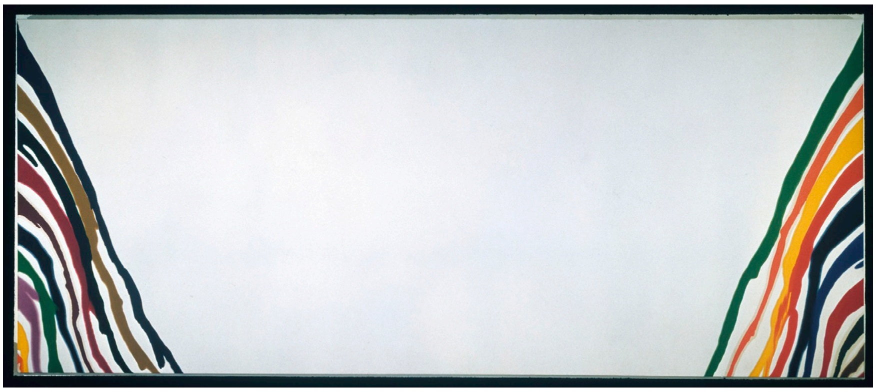

Figure 1. Morris Louis, *Beta Upsilon*, 1960, Magma on canvas, 102 1⁄2 × 243 1⁄2 in. (260.4 × 618.5 cm), Smithsonian American Art Museum, Vincent Melzac Collection purchase through the Smithsonian Institution Collections Acquisition Program, 1980.5.6

Morris Louis (USA, 1912–1962) is considered a founder of the Washington Color School, an affiliated group of Washington, DC artists that included Kenneth Nolan, Gene Davis, Alma Thomas, Sam Gilliam, and Anne Truit. Using innovative techniques that expanded on Abstract Expressionist experiments with color and paint application, the Washington Color School artists used color to create and delineate simple geometric forms. Many of the artists used a soak stain technique whereby thinned acrylic paint was applied in methods that saturated the raw canvas, causing it to blend into the canvas rather than just sit on the surface.

Between 1954 and 1962, Louis painted over 600 works, encompassing five major stylistic periods: The Veil and Floral series show bold pours, overlapping pools of color, and relatively little exposed fabric, while the Pillar, Unfurled, and Stripe series exhibit greater control over paint application onto the unprimed canvas, featuring pure color juxtaposed with vast expanses of exposed raw fabric. Louis' *Beta Upsilon* was created during the Unfurled period (1960–61) and is the second largest of the oversized paintings created in that period.

Astonishingly, Louis created most of his paintings in a twelve by fourteen-foot studio on the first floor of his home in Washington, DC. He was intensely private about his working methods and never permitted others to watch him work, not even his closest acquaintances. Incredibly, he was often not even able to view most of his paintings in their entirety until they were completed and dried. Louis is reported to have exclusively used Magna paint and cotton duct canvases for his paintings from 1954 onward (Watherston 1974). To this day, little is known of his working methods or how he achieved the control and application of the paint in such a confined studio space.

Beta Upsilon was created by Louis in his studio in 1960. Measuring over 20 feet in length, the canvas has rivulets of colored bands cascading inward from both edges, with an expansive field of exposed raw canvas in the center. Over 20 individual colors make up the manipulated bands of paint that flow inwards from each edge. The paint bands stain the raw canvas, with halos of absorbed medium soaked outwards into islands of raw canvas sandwiched between each color band. The canvas is a heavyweight plain weave cotton duct, left unprimed. At the time of the vandalism, the painting was displayed tensioned onto a multi-membered wooden, expansion-bolt stretcher with a simple strip frame.

On the morning of February 8, 1989, the painting was found graffitied with two penciled lines drawn directly onto the raw canvas (Hawkins 1989). Each line measured over 32 inches (ca. 80 cm) in length and mimicked the undulating colors in singular downward strokes (Figure 2). The drawing medium could not be tested without damaging the textile; however, examinations and spot testing suggested it was a carbon-based material with a clay medium.[1]

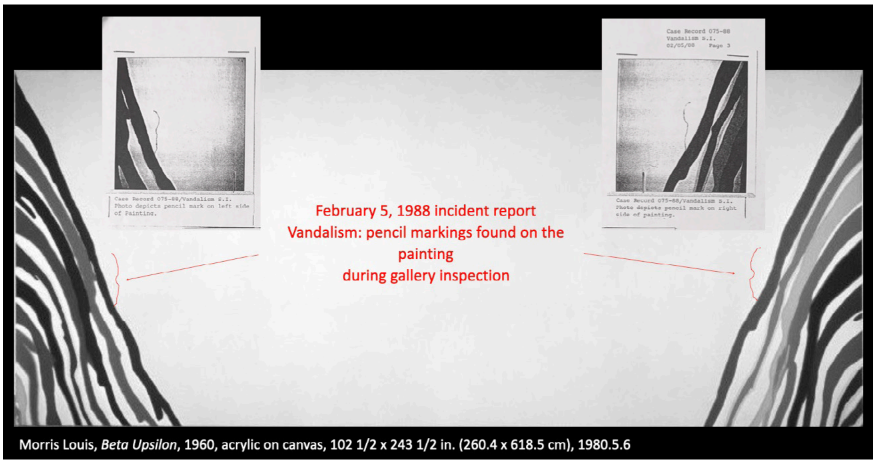

Figure 2. Digital recreation from incident report with scanned polaroid pictures taken in 1989 overlaid onto an image of the painting. Polaroid photos were used to document the graffiti lines drawn on the painting's left and right sides, as indicated by the corresponding arrows and annotated lines on the black-and-white digital image

Initial spot tests carried out by conservators in the gallery revealed that removing the graffiti was going to be challenging, as mechanical methods such as dry erasure were damaging the fibers of the raw canvas, causing a nap or disrupting the pristine surface of the textile. The use of cleaning solutions or solvents, even when judiciously applied by swab, caused additional staining, or drove the material deeper into the fiber matrix.

A sense of urgency to remove the graffiti dominated the early days of treatment tests, yet it was increasingly clear that all tests were ineffectual, and that the artwork needed to be de-installed and placed into rolled storage until an adequate solution could be found to remove the disfiguring marks without causing damage to the textile.

PERSISTENCE THROUGH METHODOLOGY

Conservators worked alongside scientists from the Smithsonian's Conservation Analytical Lab,[2] selected experts from within the field, and curators to inform and advise museum leadership throughout the early response period to effectively set realistic expectations regarding the treatment of this vandalized masterwork. The initial challenges were to address the misguided perception that the treatment was a straightforward process of removing pencil marks from fabric (when in fact nothing about the treatment was simple) and the fact that further harm could be caused if traditional mechanical or solution-based treatments were used. Protecting the artwork from urgent yet well-intended demands for immediate action required advocacy and persistence. Using informed communications supported by documented tests and clear methodology, conservators effectively championed the opportunity to find a solution to remove the pencil marks from the raw canvas without being rushed into performing a hastened risky treatment that would put the painting back on view expeditiously, but with potentially damaging long-term results.

Providing documented evidence to support the decision, using research data and analysis of tested treatments, was critical to influencing the decision processes. Scientists and conservators created numerous canvas mock-ups and tested a vast number of known and recommended treatment protocols and methodologies before considering them for testing on the actual painting (Ballard 1989). Experimental methodology included,[3] but was not limited to:

- Mechanical dry removal with compensative inpainting
- Dry cleaning alone
- Wet cleaning with localized suction
- Laser cleaning

A consulting team of experts was assembled to make recommendations and provide feedback on each of the methods used as well as a review of the results after testing (Ballard 1989). Consideration was also given to the effects of the treatments over time, as the raw canvas aged, including the potential impact that each method would have on future treatments of the canvas if a more effective and material-sympathetic treatment became available (Ibid.). The results of all the tests performed were favorable toward waiting for science to find a solution to the problem, as all of the methods explored either caused further harm to the textile or would create even greater challenges for the future treatment of the area, including the possibility of irreparable differences over time between the area targeted for localized cleaning and the surrounding areas.

The recommended course of a suspended treatment in favor of scientific research was not favored at first, but after several months without successful results or conclusive methodology, museum leadership acknowledged the recommendations provided by the museum conservators in unison with the collegial support from scientists and curators as well as the collective consultations from experts on the advisory team.

PATIENCE THROUGH PRACTICE

Over the next three decades, SAAM conservators patiently researched and pursued solutions to remove the marks from the raw canvas, seeking the most judicious, aesthetically sympathetic, and scientifically proven methods to remove the graffiti while protecting the canvas. Key to the ultimate success of the project has been the open dialogues and collaborative research with experts within and outside of the Smithsonian, along with collaborations with colleagues from other conservation disciplines as this was a textile as much as a painting conservation treatment. Conservators also attended numerous conferences and study days that focused on the treatment of color field artists, as well as remaining vigilant for the news of burgeoning research and treatments performed by colleagues. The combined dedicated efforts of the conservators would span over two generations of staff and included a constant vigilance of collegial dialogues, educational outreach, and investigations championed by the museum staff, interns, and fellows in both conservation and curatorial departments.

In the decades that followed, laser ablation treatments were increasingly highlighted in conservation work, and in 1995 the first *LACONA: Laser in the Conservation of Artworks* biennial international conference highlighted the advances in laser technology and its effectiveness in removing unwanted materials from sensitive surfaces. The advantages of laser cleaning are clearly desirable for treating modern paintings that are easily harmed by traditional conservation practices used in manual or immersion cleaning (Anglos et al. 1997). In 2006, research presented at the *Modern Paints Uncovered* symposium (Learner et al. 2006) on the use of a laser to treat an Ad Reinhardt painting was encouraging, although it focused on treating a painted surface rather than a raw canvas (Stringari et al. 2004, Stringari et al. 2006). Laser treatment was initially considered, but at that early time the technology was still under development and was harmful to the fibers, as the wavelengths and laser parameters available often dehydrated the fabrics, causing irreversible damage such as stinging or burning.

Investigations into new treatments for raw canvas included the use of agar gels, as demonstrated in the treatment of the discolored canvas of Morris Louis' *Untitled (Floral)*, held as a non-accessioned work at the Museum of Fine Arts, Houston (Skelton et al. 2016, Diamond et al. 2019). Although typographically applied gels appeared promising, testing on mock-ups proved ineffectual as the gel applied to the surface failed to remove the embedded graphite particles trapped within the textile fibers.

PERSEVERANCE THROUGH SCIENCE

The solution to the problem would ultimately prove itself through the evolution of science and in the perseverance of networking and collaboration amongst colleagues. In 2013, museum staff attended a graduate presentation by object conservator Bartosz Dajnowski that would spark an eight-

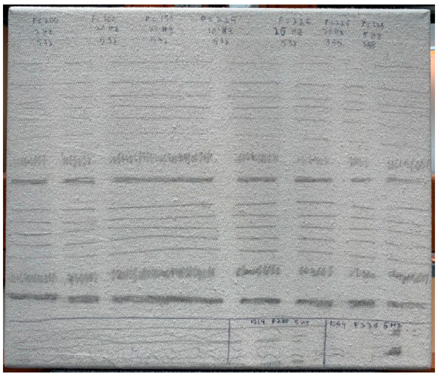

Figure 3. Test canvas 2012–2013 graduate research project with Samantha Skelton and Bartosz Dajnowski to document the effects of various wavelengths for the laser ablation of graphite from unprimed, raw, cotton duct canvases

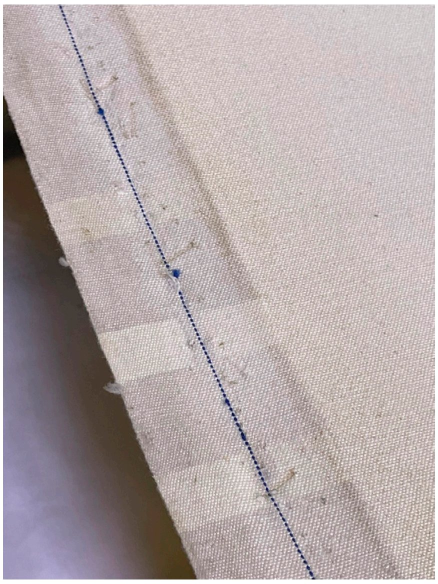

Figure 4. Detail of 2021 test cleanings using 532 nm green laser treatment to remove accumulated soot from the top tacking margin on *Beta Upsilon*

year collaborative research project and result in the design, testing, and implementation of a patented laser system that would provide the solution that SAAM conservation staff had worked so long to identify.

The methodology of laser cleaning relies on taking advantage of the fact that various materials will absorb different wavelengths of light depending on properties such as their color and chemical composition (Anglos et al. 1997, Bartoletti et al. 2020). Laser parameters such as wavelength, pulse duration, and energy density/fluence can be tuned to selectively excite a layer of unwanted material to remove it from an original surface that does not get affected by the same laser parameters. Examples of unwanted layers of material include corrosion, soiling, graffiti, and coatings (Druzik and Cass 2000). The atoms and molecules of the contaminant get so excited by the laser energy they absorb that molecular bonds are broken, particles are ejected, and the contaminant is vaporized/ablated. Unlike mechanical or abrasive cleaning methods, which rely on mechanically impacting the surface to get contaminants to break free, this method relies on selectively exciting the contaminant so that it separates from the surface on its own.

Initial cleaning tests in 2021 were conducted based on knowledge gained during prior years of testing for this project. These tests included various wavelengths, ranging from the UV to the infrared, and pulse durations (Figure 3). Their results showed that 1064 nm infrared laser pulses, which are commonly used in cleaning inorganic materials such as metals or stone, are generally unsafe for removing graphite from canvases. Light at this wavelength is absorbed by water, which can cause immediate dehydration and potential browning of cellulosic fibers. Other tests with 355 nm and 266 nm UV laser pulses were ineffective at removing carbon soiling. Finally, 532 nm was chosen as optimal for carbon removal because light at this wavelength is not absorbed by water and is therefore generally safe for cleaning organic materials.

Tests were performed on period aged canvas samples that had both new and aged pencil marks to help identify optimal parameters for laser cleaning. The optimal parameters were then tested on individual fibers and a sample of the canvas was taken from the tacking edge of the painting. The samples were examined microscopically before and after laser cleaning to verify that they were not being damaged. Additional testing on the tacking margin of the painting (Figure 4) showed not only the effectiveness of the laser ablation of the pencil marks but also proved to effectively remove accumulated soot from the canvas' surface. Among many techniques, 3D microscopic analysis showed no damage or visible alteration to the canvas fibers after laser cleaning (Figure 5). Spectral analysis with FTIR and Raman of a laser-cleaned sample of the canvas' tacking edge indicated that there was no chemical alteration of the fibers. The laser cleaning process removed not only the graffiti but also the grime and dust accumulated on the canvas surface, making it noticeably cleaner. This informed conservators that the exposed areas of the canvas would also need to be cleaned using the laser to provide an even surface and remove the pollutants that were graying the surface and dulling its appearance.

A bespoke conservation laser system was designed and built specifically for this project. The GC-532 P is a 50W 532nm green pulsed laser system

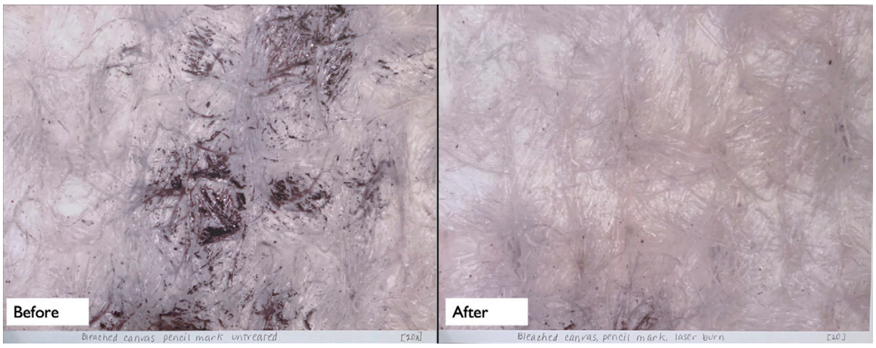

Figure 5. Hirox 3D microscope images before laser cleaning tests and after laser cleaning on an aged cotton duct canvas

prototype that has tunable pulse duration, tunable pulse frequency, tunable pulse energy, tunable circular scan speeds up to 20,000 RPM, and several interchangeable focal lenses. The patented high-speed circular scanning system, invented by Bartosz Dajnowski for art conservation applications, allows for an even distribution of laser energy across the surface with no hot spots. A portable fume extractor with prefilters, HEPA filters, and carbon filters was used in conjunction with the laser system to capture any vaporized contaminants during the cleaning process.

To facilitate overall access to the painting during the laser treatment, the canvas had two five-foot-long leading strips of canvas added to the side edges so that it could be rolled onto a tube, and then attached to a second suspended tube (Figure 6). The canvas strips were attached to the reverse side of the tacking margins using a low tack, heat-activated basting tape. The main tube with the painting was then suspended on a storage rack so that the free edge could be attached to a lower storage tube, and the painting was suspended between the two. As the treatment progressed,

Figure 6. Image taken during laser cleaning of *Beta Upsilon* showing the suspended canvas, with sectioning twine to guide the cleaning process, and the laser operator's use of a back suspension to control laser application

the tubes would be rotated so that a new section of painting would be accessible between the suspended rolls. To keep track of the areas being cleaned, two parallel lines of twine were suspended horizontally across the working surface, with free-hanging suspended sections of twine that could be positioned to delineate where the cleaning area had begun, and where it ended. The laser scanner was also suspended using a back suspension brace worn by the operator that would carry the weight of the laser scanner and provide greater control of the unit.

Exploratory testing of the paint along the tacking margin using the laser showed that the laser parameters used to remove the graffiti from the canvas could not be safely used to remove grime from the paint due to the sensitivity of the pigments; however, the use of cosmetic sponges was effective at removing the grime and soot layers on the paint bands, as well as the canvas islands between the unfurling colors, as masking off those areas was deemed too risky. The laser cleaning was effective at removing the graffiti lines (Figure 7), as well as surface-cleaning the raw canvas by removing a layer of accumulated soot and atmospheric pollutants. Natural discolorations and aging stains were unaffected by the laser, which was a desired outcome.

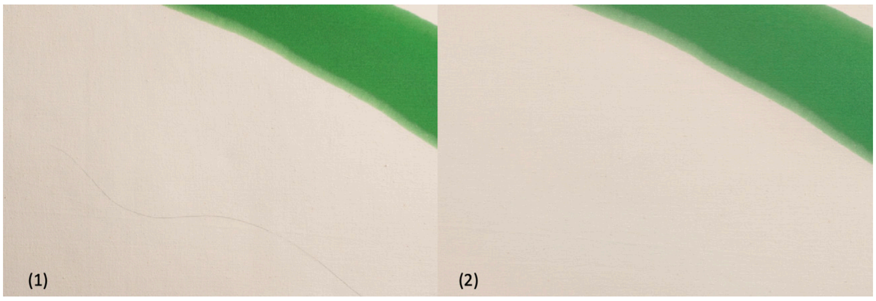

Figure 7. Detail images of an area of graffitied canvas (1) before and (2) after initial pass of laser cleaning

It should be noted that copious, precise, and careful documentation, meticulous testing, and exacting protocols were followed throughout the initial tests and laser cleaning treatment, the expansive scope and detail of which exceed the limits of this publication, but which can be provided as references to those considering a similar treatment.

SUSTAINABLE RESULTS

After three decades of research, experimentation, and testing, the painting is now being prepared for exhibition in the permanent collection (Figure 8). Light levels will be monitored to lessen overexposure and discoloration of the textile, and colorimeter readings will be used to monitor for changes in the appearance of the raw canvas. As Louis's canvases are both textiles and paintings, with conflicting protocols for the treatment and preservation of each, protecting the delicate surface texture of the canvas from disruption is as challenging as the preservation of color or gloss in the paint. As the use of lasers in the cleaning of raw canvas is a burgeoning technology, monitoring the effects of the laser cleaning on the canvas will be essential for colleagues, as will the care and preservation of the artwork in the gallery to prevent future damages, intended or unintended. The challenges of treating exposed canvas are of concern and interest in our field, and it is

Figure 8. Overall image of *Beta Upsilon* after laser cleaning and during stretching in preparation for exhibition in the permanent collection. Featured in the image are Head of Conservation and Senior Paintings Conservator Amber Kerr and graduate interns Brianna Weakley and Josephine Ren

hoped that this project will continue to provide information and alternative approaches to the conservation treatments available to our colleagues as they care for these fragile surfaces.

CONCLUSION

By one definition, to be sustainable is to uphold or defend a principle or action with the intended consequence that it would not impede on the principles or actions of future generations. At times, the hard decisions needed to support our recommendations may be challenged by others outside and within our field, requiring both advocacy and well-informed decisions to aid us in achieving treatment goals.

The lessons of persistence, patience, and perseverance that contributed to the favorable result of this treatment may inform and assist colleagues facing similar challenges in obtaining support for their recommendations. Our collective experiences provide a foundation that can sustain our practices as we move forward to greater discoveries and improvements in our field's methodologies, especially when supported by science.

The time needed to overcome the challenges of the treatment was unpredictable, but the ethical protocols and methodological approaches used in this case prevailed, as the graphite was removed, the exposed canvas cleaned, and this masterwork is now going back on view in the collection. Additionally, a newly designed laser is now available to the field for consideration in the treatment of raw canvases.

ACKNOWLEDGMENTS

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NOTES

[1] Identified material recorded by scientists in an unpublished technical report from the Smithsonian's Conservation Analytical Lab (CAL), now known as the Museum Conservation Institute (MCI).

[2] At the time of the incident, CAL performed the initial tests on *Beta Upsilon*.

[3] Experimental protocols and methodology used in the initial experiments were based on collective consultation and input from museum conservators, as well as a group of experts that included Al Albano, Mary Ballard, Hilary Hines, Alan Farancz, and Bob Lodge, among other local colleagues.

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