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Source: *The Antioch Review*, Vol. 74, No. 2, The Future of Museums: Challenges and Solutions (Spring 2016), pp. 379-390
Published by: Antioch Review Inc.
Stable URL: http://www.jstor.org/stable/10.7723/antiochreview.74.2.0379

Behind the Scenes with a Yale University Art Museum Conservator

BY CAROL SNOW

More than one hundred people crowded into a long, window-lined corridor to watch Yale University President Peter Salovey cut another blue ribbon, this one for the June 19, 2015, opening of the Institute for Preservation of Cultural Heritage Conservation Laboratory in the Yale Collection Studies Center on Yale's West Campus. Samuel Anderson Architects designed the spacious, state-of-the-art conservation laboratory as an open workspace to promote collaboration among all Yale conservators. It marks the beginning of a new era for conservation and preservation at the university.

The history of art conservation at Yale is plagued with its share of controversies, the most serious being the extreme treatment of the Yale University Art Gallery's early Italian Renaissance panel paintings in the mid-twentieth century. Following a misguided philosophical approach of the time, all previous restorations were removed and the paintings were stripped down to worm-eaten wood with islands of original paint and traces of gold leaf. Other misfortunes occurred at the hands of outside contractors across the collections from antiquities to contemporary art.

Under the leadership of Jock Reynolds, the Henry J. Heinz II Director of the Yale University Art Gallery, a new team of conservators was hired to address the mistakes of the past and perform innovative research and treatments going forward. The conservators also teach courses on technical art history and mentor emerging conservation professionals.

The Art Gallery is a major stakeholder in the 500,000-square-foot Collection Studies Center and is undertaking a multi-phased project to consolidate storage of more than 200,000 artworks from a relatively inaccessible off-site facility into an open-access system for scholarly research. The first phase is completion of the 38,000-square-foot Margaret and Angus Wurtele Study Center for housing 40,000 small-scale, three-dimensional objects. These objects will be stored for the first time by material to provide new ways to view historical and cultural continuities as well as to provide optimal environmental preservation by following recently revised guidelines for more energy-efficient climate control. The ambient conditions of the Wurtele Center are supplemented by a microclimate for metal objects in a bank of specially adapted glass cases with filtered, dry air pumped through them to prevent corrosion. Planning is already underway to provide open access and study of the Art Gallery's collections of furniture, large-scale sculptures, and paintings.

The Collection Studies Center is a new approach to museum stewardship. Like many large museums and a few other university museums, Yale is advancing concepts of centralized and shared resources to more effectively and sustainably care for its diverse collections, from Babylonian tablets to musical instruments. The Collection Studies Center is one of seventeen office and laboratory buildings on the 136-acre West Campus, the former Bayer Pharmaceutical Corporation's research and manufacturing campus that Yale purchased in 2007 for $109 million in a so-called deal of the century. There are seven scientific research institutes at West Campus: Chemical Biology, Cancer Biology, Nanobiology, Systems Biology, Microbial Sciences, Energy Sciences, and the Institute for Preservation of Cultural Heritage (IPCH), which is described as being at the crossroads between science and art. In addition to the shared IPCH Conservation Laboratory, the Collection Studies Center promotes new adjacencies and approaches to collaborative research and preservation through a shared IPCH Digitization Lab and access to conservation scientists in the IPCH Technical Studies and Aging Diagnostics Laboratories.

I arrived at Yale in September 2008 as the Yale University Art Gallery's first full-time objects conservator and immediately signed on to the concept of a centralized facility for the Art Gallery and all collections at Yale. My diverse background in museum conservation, private practice, and archaeological fieldwork provided a good fit for the Art Gallery's encyclopedic collections. Art Gallery conservators are responsible for conservation and preservation of works of art in eleven curatorial departments: African, American Decorative Arts, American Paintings and Sculpture, Ancient Americas, Ancient Mediterranean, Asian, Coins and Medals, European, Indo-Pacific, Modern and Contemporary, and Prints, Drawings, and Photographs. While the economic recession of 2008 put a hold on development of the Collection Studies Center, major renovations and expansions of the Art Gallery, America's oldest university art museum, moved forward with full funding thanks to Jock Reynolds's uncanny acumen to rally financial support. Conservation treatments that had been kept on hold for many years were suddenly top priority at the Art Gallery.

Among my first conservation projects were antiquities from excavations conducted in the 1920s and 1930s by Yale with British archaeologists at Gerasa, Jordan, and with French archaeologists at Dura-Europos, Syria. From the Byzantine Church of Saints Peter and Paul at Gerasa, a circa 540 C.E. floor mosaic is a regional type known as a city mosaic; it represents isometric views of the ancient cities of Memphis and Alexandria in Egypt. From the polytheistic city of Dura-Europos, an outpost of the Roman Empire on the banks of the Euphrates River, the circa 240 C.E. Christian House paintings are believed to portray the earliest images of Christ known to exist. Among the most important objects in the Department of Ancient Art, the city mosaic and Christian paintings had not been exhibited for decades.

At the same time I was working on a conservation priority for the Department of Modern and Contemporary Art: Marcel Duchamp's 1920 Dadaist optical experiment, *Rotary Glass Plates (Precision Optics)*, formerly titled *Revolving Glass Machine*, for a new installation of art from the Collection Société Anonyme. The Duchamp sculpture consists of five spinning glass blades painted with black and white stripes to create a spiraling hypnotic experience when viewed straight on. The conservation project involved replacing a damaged blade with new glass, matching as closely as possible the off-the-shelf, beveled, slightly green glass that Duchamp used and painting the glass to match Duchamp's stripes and drips of paint.

Another component of the Duchamp project was the design and fabrication of a working model of *Rotary Glass Plates (Precision*

Optics) in order to demonstrate the effects Duchamp intended. The working model in essence preserves the original by limiting its highly risky operation. A fabricator referred to us by the Corning Museum of Glass, John Chiles of The Hub, Ltd., in Orwell, Vermont, was hired to design and build the working model using new materials that would both provide an acceptable aesthetic appearance and meet current Yale safety standards.

A serendipitous meeting with John led to invaluable connections and unique opportunities far beyond the scope of the project. During one of several consultation visits, John noticed on my desk a copy of the 1979 *Discovery of Dura-Europos* by excavation director Clark Hopkins. John asked if he could have a look at it and opened to a page showing Yale architect Henry Pearson among the team of archaeologists. After brief training at Harvard's Fogg Museum Department of Technical Research, Henry Pearson was largely responsible for the careful excavation, backing, removal, and preservation of the wall paintings at Dura-Europos, including installation of the elaborate synagogue paintings in the National Museum in Damascus.

By remarkable coincidence, John Chiles is Henry Pearson's grandson, and John's aunt, Henry Pearson's daughter, was just then planning a trip to Jordan, Syria, and Lebanon with a small group of friends and family. Alice Pearson grew up in Beirut and is an avid traveler to the Middle East. When I contacted her about the possibility of joining them, she graciously invited me along. In doing research on the Dura-Europos wall paintings, I had come across a trove of archival images of her father's preservation work that I was eager to share with Alice during our trip in March 2010.

I met up with Alice and her group in Jordan to see the spectacular sites of Petra and Gerasa, where I wandered off to find the ruins of the Church of Saints Peter and Paul. There, among the fallen column fragments, a young shepherd grazed his sheep on the weeds invading the floor that once contained Yale's famous city mosaic. He was doing his small but valuable part in overall site management. Ancient mosaic stone tesserae remained strewn among the spring wildflowers.

Crossing the border from Jordan into Syria, we said our goodbyes to our Palestinian guide and were welcomed by our Syrian guide, a former soccer star who insisted we call him by his Western nickname, Handsome. We then toured Damascus, Hama, Palmyra, Krak des Chevaliers Castle, and Aleppo. While standing at the doorway of the reconstructed Dura-Europos Synagogue in the National Museum in Damascus, I shared with a teary-eyed Alice the images of her father at work saving these incredibly vivid figurative paintings that since their discovery have radically changed our understanding of synagogue architecture and Judaism.

Another reason for my visit to Syria was the opportunity to compare preservation of wall paintings in Syria with the condition of the wall paintings brought back to Yale under the historical laws of *partage*, i.e., the fair division of the finds. The Christian paintings in particular had suffered from repeated efforts at Yale to stabilize them with layers of synthetic varnish followed by a last-resort attempt to transfer them off of their original wall plaster onto fiberglass supports. Not surprisingly, in Damascus benign neglect had prevented damage from later interventions, but environmental factors had taken a minor toll on the synagogue paintings. A third goal of my visit was to share with my Syrian colleagues which conservation efforts at Yale had worked and which had not in the preservation of Dura-Europos wall paintings.

Unfortunately, travel to the site of Dura-Europos on the eastern border with Iraq was considered too dangerous at that time because of the overwhelming influx of Iraqi refugees entering Syria. We could not have known in 2010 what chaos and devastation was about to fall upon the Syrian people and refugees. We have since learned that Handsome was killed in the conflicts in 2015 and our local trip organizer fled to Moscow via Chechnya. My efforts to connect with Syrian colleagues now seem trivial in the context of the suffering of the Syrian people. To date the National Museum of Damascus has not been targeted, but attacks and looting by the Islamic State and others have damaged or destroyed artifacts and ancient sites, including Palmyra and Dura-Europos. It is my great hope that our new IPCH Conservation Laboratory and open access storage facilities will play a meaningful role in recovery efforts in Syria and other war-torn countries.

Back at Yale, research and development began on an innovative method to remove the deteriorating 1930s reinforced concrete backing from the Gerasa city mosaic. Reinforced concrete was a standard backing system applied to many ancient mosaics around the world. Decades later the heavy concrete and corroding steel reinforcing bars can cause ancient mosaics to self-destruct. I have seen this happen to mosaics all around the Mediterranean. We assembled an interdisciplinary team of conservators, curators, engineers, collections managers, exhibition designers, fabricators, and art handlers to investigate alternatives to industrial methods used to remove modern concrete backings and explore new backing systems to allow vertical display of the ancient floor mosaic.

One of the tools at our disposal in the Collection Studies Center, and not available to many other museum conservators, is a three-axis CNC (computer numeric controlled) machine. Our machine was originally purchased to cut massive amounts of polyethylene foam materials for a cleverly designed, standardized packing system to safely move thousands of art objects. By upgrading the motor and expanding the size of the worktable, the CNC machine can be used for new conservation challenges like the Gerasa mosaics. After testing a range of drill bits and milling disks, diamond-embedded router bits were chosen to meticulously mill through the reinforced concrete without the use of water. Programmed on the computer to avoid steel reinforcing bars that could potentially send shrapnel flying, the CNC machine was able to surgically remove the deteriorating concrete millimeter by millimeter from the reverse of the city mosaic, which had been divided into five sections in the 1930s.

New rigid, lightweight composite panels, commercially available for wind turbine blades, high-speed trains, and shipbuilding around the world, were ordered to our specifications and attached to the backs of the mosaic sections. A secondary aluminum framework system allowed four art handlers to easily assemble and install the mosaic. The treatment reduced the overall weight of the mosaic from several tons to just over 1,000 pounds. Prior to its installation in the Art Gallery's collection of ancient Mediterranean art, the Gerasa city mosaic was trucked to the Metropolitan Museum for its 2012 exhibition *Byzantium and Islam: Age of Transition*.

The shared resources of the Collection Studies Center have made numerous other major conservation projects possible. New high-resolution images and microscopes were used to meticulously restore the figures in the Dura-Europos Christian House wall paintings. Modular systems for assembly and disassembly of the Dura-Europos Roman mithraeum and two eighteenth-century Connecticut rooms were prefabricated at West Campus and facilitated their installation in newly renovated spaces at the Art Gallery. Restorations for missing sections of an intricately carved, late-nineteenth-century wood archway from Ahmedabad, India, were made by 3D scanning existing pieces and milling new sections using the CNC machine to replicate the open-work teak carvings. Analysis of paint cross-sections from the circa 1430 polychromed terracotta *Virgin and Child* by Michele da Firenze identified a salt crystal, challacolloite (KPb_2Cl_5), a mineral that naturally forms at high temperatures in the fumaroles of volcanos but has never before been reported as an agent of deterioration on any work of art; this study was made possible through collaborations with IPCH conservation scientists. Extensive research into the materials and working methods of David Smith (1906–1965) guided the repainting of his 1964 *Bec-Dida Day*, a painted steel sculpture that had been completely stripped of all original paint and repainted in the 1990s, and then vandalized in 2013. The sculpture's conservation treatment was completed for the 2015 exhibition, *The Ceramic Presence in Modern Art: Selections from the Linda Leonard Schlenger Collection and the Yale University Art Gallery.*

In addition to keeping up with the steady demands of changing exhibitions and loans, our team of conservators carried out other significant projects in a wide range of materials, including rare painted-wood Roman military shields from Dura-Europos, an elaborately decorated circa 1610 automaton clock of the huntress Diana believed to have been made in Augsburg, Germany, and now available in working order on YouTube, and establishment of an artist interview program to better preserve contemporary works of art. Much attention has also been focused on major painting conservation projects: the technical study and treatment of a recently reattributed circa 1617 Velazquez painting of *The Education of the Virgin*, conservation of the 1893 American murals from the Huntington Mansion, and the ongoing campaign to reverse the wrongs of past treatments done to the Art Gallery's early Italian panel paintings. Research is also currently being carried out in the treatment of contemporary paintings using nanotechnology pillars, also known as "gecko feet."

Now that we are settled into the new 8,000-square-foot IPCH Conservation Laboratory, one of our most ambitious conservation projects is making exciting progress. In February 2017 an exhibition of kinetic light art, *Lumia: Thomas Wilfred and the Art of Light*, will open at the Yale University Art Gallery. Thomas Wilfred (1889–1968) created his lumia, which he considered the eighth art form, from the 1920s to the 1960s. Although he exhibited with famous American artists such as Jackson Pollock and Mark Rothko, Wilfred never felt that he and his lumia were fully appreciated. The Art Gallery exhibition will be a major retrospective of Wilfred's lumia and will travel to two other venues, the Henry Art Gallery at the University of Washington in Seattle and the Smithsonian American Art Museum.

Three of Wilfred's earlier lumia are in the collections of the Art Gallery and his archives are in the collections of Yale's Sterling Memorial Library. Other examples of Wilfred's lumia works are spread across museum collections from New York to Honolulu, with a significant number of lumia in a private collection in Los Angeles. Some lumia show moving color light images reflected off curved surfaces while others are viewed through rear projection screens.

Wilfred's last major commission, *Lumia Suite, Opus 158*, was created for the Museum of Modern Art, where it was installed in 1964 in a dedicated projection room with a six-by-eight-foot rear projection screen. It ran almost continuously until 1981, at which point it was decommissioned, packed in boxes, and sent to off-site storage. When we first saw it in January 2013, its resurrection did not seem promising. The disassembled parts looked neglected and the original projection screen was a badly discolored, brittle roll.

After months of negotiations, MoMA agreed to lend *Lumia Suite, Opus 158* to Yale on the condition that we conserve it and preserve all original materials. All conservation treatment decisions were to be pre-approved by MoMA sculpture conservator, Lynda Zycherman. We agreed to the loan conditions and received the boxes and crates in February 2015, just two years before the exhibition is scheduled to open.

During unpacking of all of the parts of *Lumia Suite, Opus 158*, the project seemed even more daunting than we first realized. Museum registrars catalogued eighty-five components and tagged them with barcodes for tracking purposes. "Some assembly required" became our mantra for this project. On the bright side, *Lumia Suite, Opus 158* came with a fifty-page technical manual written by Wilfred, who provided meticulous details on how the components were made, how they work, and recommendations for maintenance to keep the kinetic light sculpture running far into the future. Never before have I conserved a work of art that came with its own instructions and troubleshooting manual.

I spent weeks familiarizing myself with the parts, gaining an understanding of the main components and their functionality, and assessing the condition of each one. I immersed myself in 1960s analog electrical technology and became very familiar with Ohm's Law: I =

V/R, where I is for current in amps, V is for voltage in volts, and R is for resistance in ohms. We used a multimeter, a device that measures current, voltage, and resistance, to check all wiring. Upon closer examination, the components appeared to be robust. I drafted an eleven-page treatment proposal that MoMA approved with very minor revisions.

The first phase of the project involved designing two framework systems on wheels that would take the place of opposing walls in the projection room. We chose T-slot, anodized, extruded aluminum, known as an industrial erector set, for its light weight and ability to be adjusted as needed to accommodate all of the components in their exact relative locations. My preliminary sketches were converted to CAD (computer-aided design) drawings and sent to a distributor who provided all materials and hardware for their fabrication. Wanting to keep costs down, I foolishly refused the distributor's offer to assemble the large frameworks for us. Unlike *Lumia Suite, Opus 158*, the frameworks did not come with an instruction manual (some assembly required).

While waiting for the framework delivery, cleaning of the main components began, following to the letter the recommendations in Wilfred's manual. The main components of *Lumia Suite, Opus 158* are: a vertical projector, a horizontal projector, a reflector tower, a pivoting arm with two concave mirrors at its end, two ultramarine flood lamps, a lamp control unit, and a mechanical device called an actuator that controls the major components, which Wilfred referred to as the conductor of the three movements of *Lumia Suite, Opus 158*. The materials used in construction of these components include asbestos, mercury switches, porcelain resistors, and off-the-shelf parts, many of which remain available today through electrical supply companies and/or eBay.

A critical exception is the source of light for the horizontal projector: a 1,000-watt lighthouse and airport beacon bulb that is no longer available and rarely appears for sale online. It is a gorgeous piece of GE industrial history consisting of a mogul base, glass tube, and coiled tungsten filament with a metal screen over the filament to catch bits of burning tungsten and keep the glass bulb clear and very bright. In his manual Wilfred describes exactly how the filament should be aligned for proper projection of the images. Wilfred emphatically stated that these bulbs must be used and that *no other will do* (italics mine). Back in the 1960s MoMA wisely bought a small stockpile of 1,000-watt beacon bulbs, each of which runs for about 500 hours, but a stipulation of the loan agreement is that we not use them during the run of the exhibition.

Therefore, we have embarked on a two-pronged approach to solving the light bulb dilemma. We are first exploring handcrafted production of the 1,000-watt tungsten bulbs by an incandescent light artist, Dylan Kehde-Roelofs, who trained in scientific glassblowing and is in his own right a self-taught historian of science. After dissecting one of the dead bulbs provided by MoMA, Dylan successfully manufactured a prototype that burns at about 1,100 watts. Plans are in progress for setting up a scientific glassblowing laboratory in the Collection Studies Center. Imagine returning to artisanal solutions for replacing relatively recent technology, like incandescent light bulbs, that quickly become obsolete in our high-tech, digital world.

We are also investigating such new technologies as halogen and LED (light-emitting diode) bulbs. These bulbs are available as replacements for the old GE beacon bulbs. Our research has brought in physicists to measure color temperature variations of the bulb options and curators to determine how acceptable these variances in color perception are as the lumia images are projected on new screen materials. We are learning that color perception theories quickly cross over from physics to psychology.

In comparison to finding a light bulb solution, the reassembly of the components and the 1960s electrical wiring was surprisingly straightforward. The first time *Lumia Suite, Opus 158* was wired all together and plugged in, we were thrilled beyond description to see all components moving in the exact sequences that Wilfred described in his manual. Once it was operational, we came to appreciate just how complex and kinetic *Lumia Suite, Opus 158* actually is.

The vertical projector has three moving parts: a color wheel made of metal, glass, and theater gels rotates, a 300-watt light bulb revolves 360 degrees within the projector, and the projector itself rocks up and down to create a vertical sequence of moving light. The horizontal projector has two moving parts: a rotating color wheel made of shards of colored glass held in place with wire and solder to allow thermal expansion and contraction, and a rotating reflective aluminum tube. The reflector tower has two tiers of seven aluminum reflectors each that turn at slightly different speeds. The horizontal projector and reflector tower produce horizontal movement of colored light on the rear projection screen. An arm with two concave mirrors moves up to catch light from the horizontal projector and beam it directly to the screen, creating an elliptical movement. The assemblage goes through a twelve-minute cycle of switching the main components on and off, but given the various speeds of all of the different moving parts within those main components, our initial calculations of the period of *Lumia Suite, Opus 158* have determined that the exact same image on the screen will not repeat itself for over 900,000 years.

Lumia Suite, Opus 158 is not only operational, it inspires other departments at Yale. The School of Art used it for a course called Screen Space, taught by artist Sarah Oppenheimer and physicist Joseph Zinter. The Center for Engineering, Innovation, and Design (CEID) offered it as a client-based project for an introductory and interdisciplinary course in which students design and build final projects. Two teams of five students each created working lumia models—one explains the physics and the other explains the art—that will provide visitors to the Art Gallery exhibition a better understanding and fuller appreciation of how these kinetic light sculptures work. For most of the students, the projects were the first time they had ever built something. Clearly they learned a great deal in the process and showed great pride in their models. We plan to use the models in the exhibition and invite the students to share how Wilfred's lumia work during special events. Again, such projects would not be possible without the resources available to us at Yale.

Art conservation can indeed pull together communities in wholly unanticipated ways. Such was the case with a recently completed project in the Collection Studies Center. Along the IPCH Conservation Laboratory corridor there are numerous windows for visitors passing by to view the activities in the laboratory. There is one blank wall just at the entrance to the laboratory, right where the ribbon-cutting ceremony took place, which was perfect for the installation of a Wall Drawing by Sol LeWitt (1928–2007).

John Hogan, the Yale University Art Gallery's Mary Jo and Ted Shen Installations Director and Archivist for Sol LeWitt Wall Drawings, supervised the installation of Wall Drawing #123B because it is in need of high-resolution photography for a catalogue raisonné of LeWitt's ephemeral art. This conceptual piece follows LeWitt's simple instructions:

The first draftsman draws a not straight black vertical line as long as possible.
The second draws a red line next to the first one, trying to copy it.
The third draftsman does the same with yellow.
Then the fourth draftsman does the same with blue, followed by the others, as many draftsmen as possible, copies the last line drawn until both ends of the wall are reached.

Conservators were joined by conservation scientists, curators, artists, students, scientists from the Systems Biology, Microbial Sciences, and Energy Sciences Institutes, administrators, facilities staff, friends, families, local politicians; in all 135 people drew lines in a pattern as per LeWitt's instructions. It took more than 1,000 lines to complete the composition. As we worked together, the project stimulated conversations on how one actually conserves ephemeral art that is intended to be a temporary installation and that will be painted over or dismantled and thrown into a dumpster. This project is yet another example of the exchange of ideas and achievements that can happen when new collaborations and synergies are encouraged and fully supported.

Yale University Art Gallery conservation projects do not stop at Yale. They are shared through teaching, professional journals, and presentations at international conferences. As a university art museum conservator, I remain awed and humbled by the depth and breadth of Yale University's collections, the talents of colleagues, the resources available to us, and the support we receive. I feel a responsibility to pass along opportunities to the upcoming generation of museum professionals. This then is my expression of gratitude and hope for what the future holds toward revitalization of university museums through advances in conservation, preservation, and a global perspective.

In April 2016 Yale is hosting a United Nations Global Colloquium of University Presidents. Yale President Peter Salovey has chosen preservation of cultural heritage as the theme for the colloquium, which will be attended by more than twenty-five university presidents from around the world and by United Nations Secretary-General Ban Ki-moon. We look forward to sharing developments in conservation and preservation at the colloquium and are committed to working collaboratively with colleagues and communities to protect and save cultural heritage from global threats of armed conflicts and climate change.