

Network Initiative for Conservation Science

NICS Annual
Symposium 2017

Book of Abstracts

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Network Initiative for Conservation Science

NICS Annual Symposium 2017

Book of Abstracts

Schedule of Events

- 9:45 am **Registration and Breakfast**
- 10:15 am **Welcome and Introduction**
Carrie Rebora Barratt & Federica Pozzi,
Metropolitan Museum of Art
- 10:45 am **Plenary Lecture**
**The New York Network Initiative for
Conservation Science (NICS)**
Marco Leona, Metropolitan Museum of Art
- 11:25 am **It's Not What It Looks Like:
Fading Colors and Altered Surfaces
in Van Gogh's Landscapes in Paris,
Arles and Saint-Rémy**
Carol Stringari, Solomon R. Guggenheim Museum
- 11:50 am **Royal Purple and Burgundian Black:
Colored Parchments in the Morgan Library's
Medieval and Renaissance Manuscripts
Collection**
Frank Trujillo, Morgan Library and Museum
- 12:15 pm **Lunch Break**
- 1:30 pm **Plenary Lecture**
**From Malachite to Methacrylate:
the Artist's Way**
Carol Mancusi-Ungaro, Whitney Museum of American Art

- 2:10 pm **Gouache, Paper, Scissors:
Characterization of Pigments and
Colorants in Henri Matisse's Cut-Outs**
Ana Martins, Museum of Modern Art
- 2:35 pm **Take It Off (Or Take It All Off):
Removal of Modern Coatings From Painted
Totem Poles at the American Museum
of Natural History**
Judith Levinson, American Museum of Natural History
- 3 pm **Coffee Break**
- 3:15 pm **Alexander Calder: *Half-Circle, Quarter-Circle,
and Sphere* (1932) and Other Early Motorized
Works of Art**
Eleonora Nagy, Whitney Museum of American Art
- 3:40 pm **Weaving the Desert Rainbow:
Vibrant Color and Complex Technology of the
Brooklyn Museum's Nasca Textile Masterwork**
Lisa Bruno, Brooklyn Museum
- 4:05 pm **How Do You Say "Bocour" in French? The Work
of Carmen Herrera and Solvent-Based Acrylic
Paints in Post-War Europe**
Matthew Skopek, Whitney Museum of American Art
- 4:30 pm **Closing Remarks**
Federica Pozzi & Anna Cesaratto,
Metropolitan Museum of Art

It's Not What It Looks Like: Fading Colors and Altered Surfaces in Van Gogh's Landscapes in Paris, Arles and Saint-Rémy

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This project comprised art historical and conservation-based research as well as technical analysis of three works by Vincent van Gogh in the Guggenheim Museum's Thannhauser collection, spanning the final three years of his life: *Roadway with Underpass* (1887, late summer?), painted in Paris and foreshadowing compositions that the artist would create in Arles in 1888; *Landscape with Snow* (February/March 1888), among the first paintings completed in Arles; and *Mountains at Saint-Rémy* (July 1889), painted in the Saint-Paul Asylum in Saint-Rémy.

Several leading questions regarding the nature and alteration of materials determined the scope of this study. First of all, all three paintings exhibited color change and fading, a phenomenon that is referenced in an extensive body of literature. Moreover, the earliest painting, *Roadway with Underpass*, has a thick, discolored varnish that covers a brown organic layer, creating an overall stippled appearance that is exacerbated by several areas where the painting has been over-cleaned. This brown layer may have been applied to cover areas of abrasion, especially in certain areas of red outline.

In addition to materials-related questions, there was an issue regarding provenance and the possibility that at least one of the three paintings was involved in a controversy around forgeries, known as the Wacker Affair in Germany and dated to 1928. Two of these works were part of a group of paintings that passed to the Thannhauser collection through a German dealer, Hans Bammann. A stamp on the canvas, viewed with an infrared camera, placed one of the paintings in the period, and was the same stamp found on other works by the artists and a canvas that van Gogh was known to have ordered from Paris.

Initial examination of the three paintings involved documentation of the brushwork, paint quality and distribution of colors under the stereomicroscope. Infrared photography and X-radiography provided additional information on the structure of the paintings and their canvas. These results were compared to those obtained from works in other collections, as well as the notes and letters that Vincent wrote to his friends and his brother Theo. Scientific investigations involved non-invasive examination of the paintings with point and scanning X-ray fluorescence (XRF) spectroscopy, followed by the analysis of cross sections and paint scrapings with optical microscopy, attenuated total reflection – Fourier-transform infrared (ATR-FTIR) spectroscopy, scanning electron microscopy coupled with energy-dispersive X-ray (SEM/EDS) spectroscopy, and surface-enhanced Raman spectroscopy (SERS). Through microscopic examination of samples and analysis with a combination of instrumental techniques,

the team identified the type and distribution of pigments used in these paintings, and concluded that both the brushwork and artist's palette are also consistent with other van Gogh works.

This study traces the progression of van Gogh's work over three of his mature years, identifies the materials and the historical context, and compares the results of scientific analysis to those obtained from other similar works. The treatment history for each painting, such as early linings and cleaning, also provides clues to the current appearance of the paintings. The study, currently in progress, will hopefully put to rest any question of provenance or inconsistency in terms of materials and techniques. Finally, digital reconstructions will be produced to give the viewer an idea of the original appearance of the paintings prior to the fading of the pinks and purples. Scholars from the van Gogh Museum, Amsterdam, will collaborate on the comparative viewing and characterization of similar paintings.

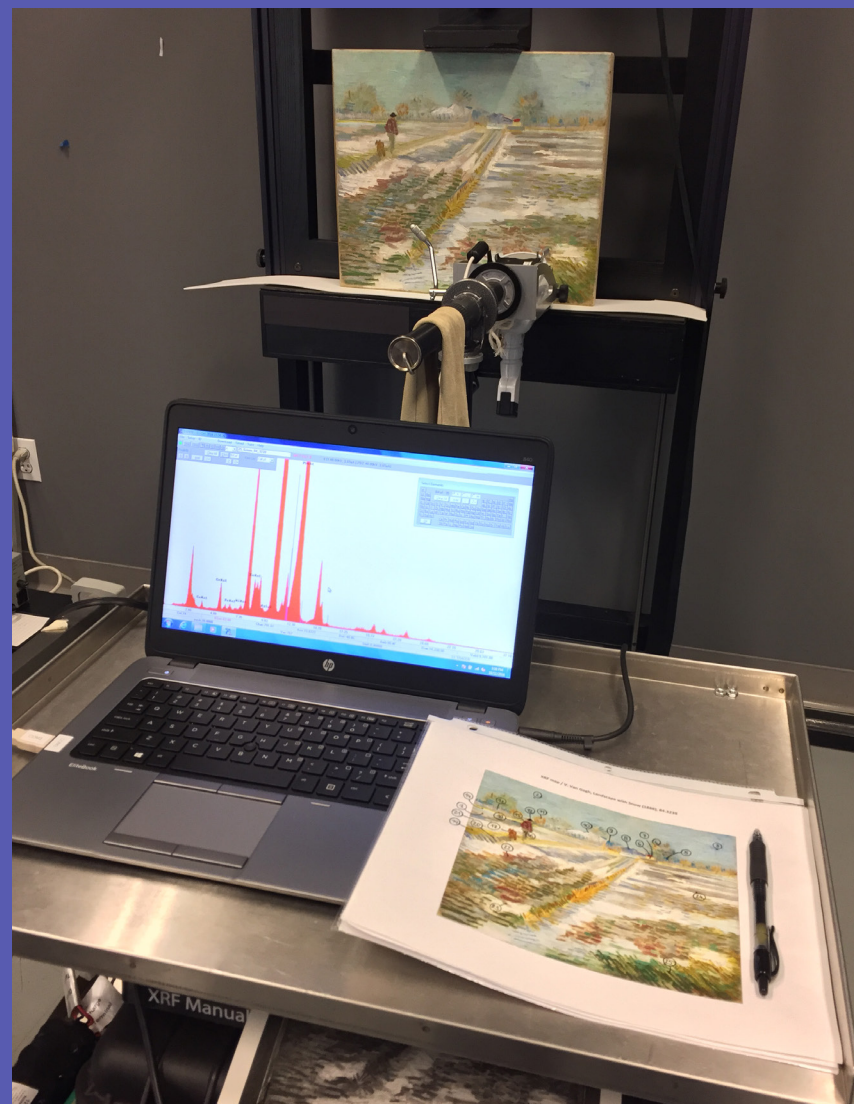


Figure 1. *In-situ* non-invasive analysis of the elemental composition of the paint in Vincent van Gogh's *Landscape with Snow* (1888) performed with handheld X-ray fluorescence (XRF) spectroscopy.

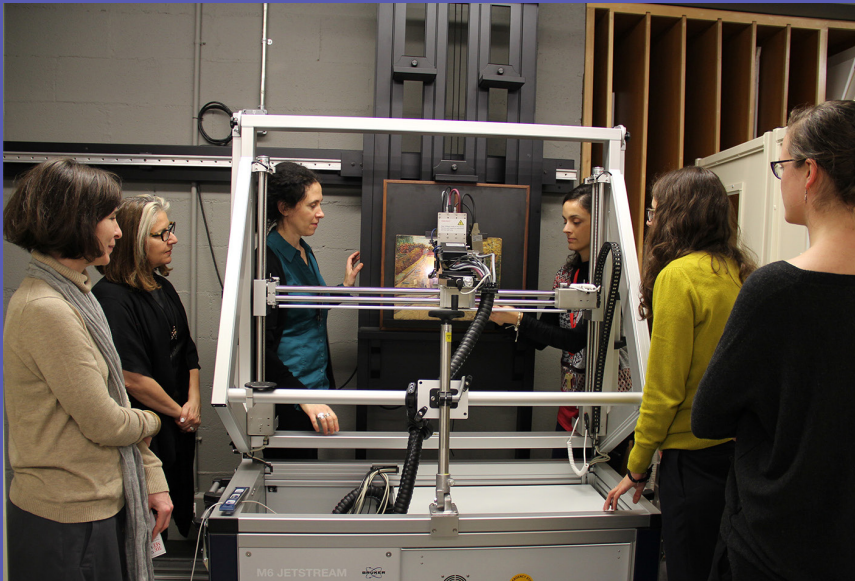


Figure 2. Non-invasive analysis of Vincent van Gogh's *Roadway with Underpass* (1887) performed at the Metropolitan Museum of Art with scanning X-ray fluorescence (XRF) spectroscopy, a technique that provides information on the distribution of elements present in the paints.

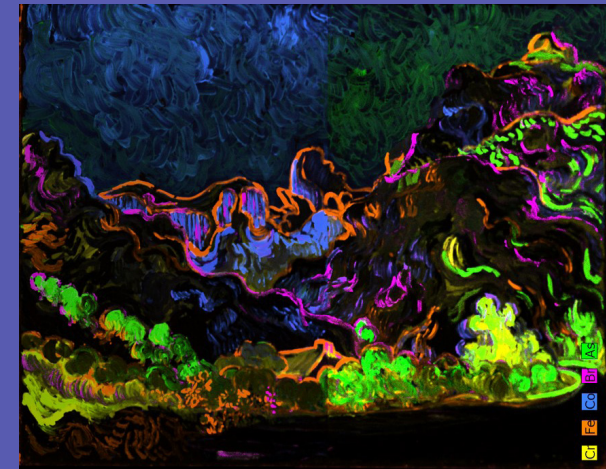
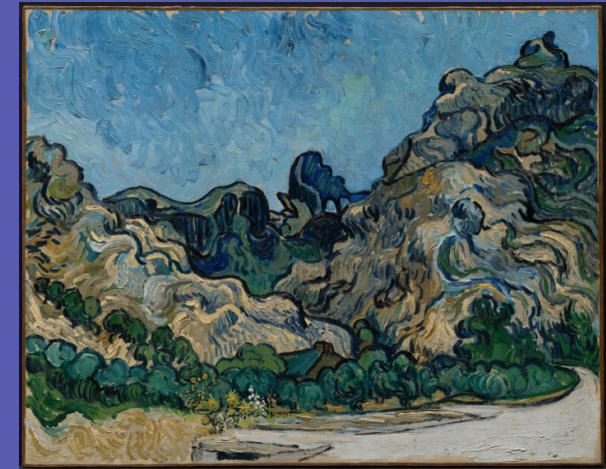


Figure 3. Vincent van Gogh (1853-1890), *Mountains at Saint-Rémy*, 1889. Oil on canvas, 28 1/4 x 35 3/4 inches (71.8 x 90.8 cm). Solomon R. Guggenheim Museum, New York, Thannhauser Collection, Gift, Justin K. Thannhauser, 1978, 78.2514.24 © Solomon R. Guggenheim Foundation, New York. Photo by Kris McKay.

Figure 4. Scanning X-ray fluorescence (XRF) map of Vincent van Gogh's *Mountains at Saint-Rémy* (1889) showing the distribution of chromium (Cr), iron (Fe), cobalt (Co), bromine (Br), and arsenic (As) in the paints.

Royal Purple and Burgundian Black: Colored Parchments in the Morgan Library's Medieval and Renaissance Manuscripts Collection

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The pages of most manuscript books during the medieval and renaissance periods in Europe and the Near East were made from parchment: a thin, flexible animal-skin material that was used by scribes and illuminators before paper was widely available for the production of books, scrolls and documents. Many surviving manuscripts are well-known to the general public for their lavish illuminations and miniature paintings, most of which are executed on natural-colored white or cream parchment made from the skins of cows, sheep or goats. Within the medieval manuscript tradition, certain exceptional books were written and illuminated on parchments that had been previously colored or dyed, creating striking effects in combination with silver and gold inks as well as brightly colored pigments. Recently, conservators and scholars have been investigating the history and significance of these unusual colored manuscripts, as well as the techniques and materials used to make them. The opportunity to collaborate with the Network Initiative for Conservation Science (NICS) team at the Metropolitan Museum of Art has allowed conservators at the Morgan Library and Museum to more fully comprehend two fascinating groups of manuscripts on colored parchment represented in the Morgan's renowned collection.

The first group consists of purple parchments upon which Gospel books, psalms and other Biblical texts were written in gold and silver inks; surviving examples of these luxury books were produced from the fifth through the eleventh centuries for wealthy individuals and churches. The symbolism of "royal" or "imperial" purple, which throughout antiquity connoted wealth and influence, was reconceived by early Christians as an emblem of Christ, King of Kings, and the triumph of his divine resurrection. In the ancient world, the most expensive and highest-quality purple dye had been laboriously produced from the glandular secretions of the Mediterranean sea-snail *Muricidae*, and was used in its pure form only for the most sumptuous textiles and garments. Recent research into the dyes used to color purple parchment codices during the medieval period has sought to determine whether these manuscripts also were created using such costly and hard-won materials (as was long assumed to be the case) or whether other more readily available colorants might have been used. Analysis performed by NICS scientists on two purple manuscripts in the Morgan's collection – MS M.23, the so-called Golden Gospel of Henry VIII, and MS M.874, a 6th-century gospel fragment – has provided definitive new data about the compositions of these intriguing colorants. The new information has implications not only for the long-term preservation

of these extraordinary objects, but also for our understanding of the economics and technology of purple manuscript production from 6th-century Syria to 11th-century Germany.

The second group, books of hours created on parchment colored entirely black, a genre known today as “black hours”, were produced in the fifteenth century in the Burgundian courts of Philip the Good and his son Charles the Bold. The Morgan’s MS M.493 is a book of hours written and illuminated on black parchment in Bruges, circa 1480. The manuscript was disbound in 1998 for digitization and reproduction in facsimile. It remains disbound and unavailable to readers due to a history of flaking pigments and worries about the stability of the black coating itself. Historical accounts of creating black parchment describe immersing the parchment in a solution containing iron and copper, both of which are known to age poorly and can cause corrosion of organic materials such as parchment. Not surprisingly, the current state of the parchment in the six or seven extant black hours in collections worldwide has been described as brittle, weak and severely degraded. By contrast, the black parchment of the Morgan manuscript is in an excellent state of preservation and appears both supple and strong, although its smooth and burnished surface has resulted in poor adhesion of the paints and inks used for the text and decoration. The NICS analysis of the Morgan’s black parchment provides an analytics-based response to the questions of how this black parchment was actually manufactured and why it remains in better condition than other examples of the genre. These recent findings will help to guide future treatment and use of this unusual manuscript.



Figure 1. Book of Hours, Bruges, Belgium, ca. 1480. 124 leaves (1 column, 17 lines), bound: vellum, ill.; 170 x 122 mm. Morgan Library & Museum, New York, purchased by J. Pierpont Morgan (1837-1913) in 1912, MS M.493. Courtesy of Morgan Library & Museum.

Figure 2. Conservators and scientists set up a manuscript from the Morgan Library’s collection for *in-situ* non-invasive analysis.



Figure 3. *In-situ* non-invasive analysis of the elemental composition of inks and pigments in a manuscript from the Morgan Library's collection performed with handheld X-ray fluorescence (XRF) spectroscopy.



Figure 4. *In-situ* non-invasive analysis of the purple colorant in a manuscript from the Morgan Library's collection performed with fiber optics reflectance spectroscopy (FORS) using an integrating sphere.



Figure 5. *In-situ* non-invasive analysis of various pigments in a manuscript from the Morgan Library's collection performed with fiber optics reflectance spectroscopy (FORS).

Gouache, Paper, Scissors: Characterization of Pigments and Colorants in Henri Matisse's Cut-Outs

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In the last two decades of his career, Henri Matisse produced one of his most celebrated series of works, the Cut-Outs. A master of color and contour, he worked intensively with scissors and pieces of papers painted with colorful gouaches, cutting shapes that he would then assemble and affix with pins to create lively figurative or abstract compositions. In the fall of 2014, the Museum of Modern Art (MoMA) organized the most comprehensive exhibition ever devoted to this innovative body of work, titled *Henri Matisse: The Cut-Outs*. The exhibition included a set of 79 samples of original painted papers that were discarded by Matisse during his artistic process, yet collected by some of his assistants and donated to MoMA by the artist's family. Such gouache paper samples, of various tonalities of violet, blue, green, yellow, orange, red, magenta, pink, brown and blacks, illustrate Matisse's palette and are intrinsically representative of the gouaches he used in his Cut-Outs.

The main concern about Matisse's Cut-Outs is related to the lightfastness of their colors, as some have reportedly faded overtime, even during the artist's lifetime. Significant fading may be caused by exceeding exposure to light or other harmful agents. Thus, in addition to providing valuable information on the range of paint materials used by Matisse, a full characterization of the pigments and colorants present in his gouache paper samples is crucial to develop proper conservation treatments and preservation strategies that could prevent or minimize damage.

The detection and identification of artists' paint materials typically requires the combined use of complementary analytical techniques and examination methods. In the initial phase of the present project, the 79 painted paper samples were characterized with the instrumentation available in the David Booth Conservation Center at MoMA, namely microfadometer, X-ray fluorescence (XRF) spectroscopy, and Fourier-transform infrared (FTIR) spectroscopy. Further analyses by Raman and surface-enhanced Raman spectroscopy (SERS), as well as scanning electron microscopy coupled with energy-dispersive X-ray (SEM/EDS) spectroscopy, available in the Department of Scientific Research of the Metropolitan Museum of Art, were then needed to confirm and advance pigment characterization. In most cases, the use of such multi-technique approach has proven successful and has allowed researchers from the two museums to achieve conclusive materials identification.

Results of scientific analysis and comparison with the available literature on paint stability showed that some of the colors in Matisse's paper samples - namely the pinks, magentas, as well as some of the violets and oranges - are

highly sensitive to light. This information was shared with the conservators and used to issue informed recommendations regarding the objects' display and optimal light exposure conditions.

Subsequently, a non-invasive analytical approach for the study of Matisse's painted papers has been evaluated. In addition to the handheld XRF instrument used in the initial phase of the project, handheld Raman and reflectance FTIR spectrometers have been tested on the same set of samples in order to assess their advantages and drawbacks. As expected, handheld instruments provide lower spectral resolution and signal-to-noise ratio compared to their benchtop counterparts; nevertheless, a combination of handheld XRF, Raman and FTIR was found to be able to successfully characterize most of the pigment mixtures present in Matisse's painted paper samples. This analytical approach was then applied to an actual Cut-Out titled *Maquettes for a set of red and yellow liturgical vestments* (ca. 1950), belonging to the MoMA collection. The promising results obtained from the non-invasive characterization of the pigments and colorants in this object open up new perspectives for the analysis of Matisse's latest body of works.

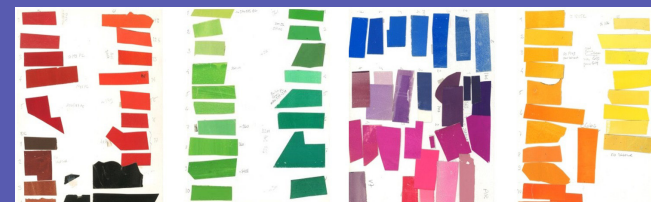


Figure 1. Henri Matisse at the Hôtel Régina, Nice, France, ca. 1952. Photo: Lydia Delectorskaya. © 2014 Succession H. Matisse.

Figure 2. Reference set of painted paper samples, ca. 1947–54. Gouache on paper, seventy-nine pieces. Gift of the Matisse family, 2014. Approximate sample size is 10 cm².



Figure 3. Henri Matisse (1869–1954), *Maquettes for a set of red and yellow liturgical vestments*, ca. 1950. Gouache on cut-and-pasted paper, mounted on paper. The Museum of Modern Art, New York, acquired through the Lillie P. Bliss Bequest (by exchange), 176.1953.5. © 2017 Succession H. Matisse / Artists Rights Society (ARS), New York.



Figure 4. *In-situ* non-invasive analysis of the pigments and colorants in Matisse's *Maquettes for a set of red and yellow liturgical vestments* performed with handheld Raman spectroscopy.

Take It Off (Or Take It All Off): Removal of Modern Coatings From Painted Totem Poles at the American Museum of Natural History

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The Hall of Northwest Coast Indians at the American Museum of Natural History (AMNH) is the museum's oldest Hall and has remained largely unchanged since 1899, when it first opened. The Hall contains approximately 1800 artifacts, among which are 77 totem poles, house posts, and other large carvings that are on open display. These carvings originate from many First Nations and Native American cultural groups, including Coast Salish, Nuu-chah-nulth [Nootka], Thompson River, Nuxalk [Bella Coola], Kwakwaka'wakw [Kwakiutl], Haida, Tsimshian, and Tlingit.

Beginning in the late 1990s, AMNH conservators undertook collection surveys in the Northwest Coast Indian Hall to document the condition of the totem poles and other large carvings. These studies ultimately resulted in a grant award from the Institute of Museum and Library Services (IMLS), matched with another from the Stockman Family Foundation, which funded conservation work on a selection of these pieces from 2009 to 2013. This project offered the first opportunity to closely investigate both structural and surface issues exhibited by the totem poles. The primary treatment goal of this initial intervention was the stabilization of the wood, as many carvings exhibited rot, splits, splintering and other forms of instability, and ongoing housekeeping caused continual damage.

The project did not aim to deal with surface issues beyond superficial cleaning, though surveys had documented the presence of numerous surface coatings overlaying bare wood as well as painted surfaces. These coatings had been applied over dirty surfaces and had darkened with time, shifting the colors of the wood and paints, and yielding improper surface appearances. Further, the coatings sunk into and essentially consolidated the very media-lean paints, complicating removal. Some early efforts were made to identify the coatings present through microchemical testing, analysis of cross sections and other means during the previously mentioned IMLS project, but the surface issues remained not well understood.

Lingering questions about the number, types, and timing of coating applications set the stage for the current research in collaboration with the Metropolitan Museum of Art through the Network Initiative of Conservation Science, which has largely focused on a set of four elaborately carved and painted Tsimshian house posts. Microscopic examination of samples removed from these totem poles and mounted as cross sections shed light on the number of coating layers present in selected areas and showed how they are intermixed with dirt and paint. Micro-invasive analysis of the samples was performed using transmission Fourier-transform infrared (FTIR) spectroscopy, attenuated total

reflection (ATR)-FTIR spectroscopy, and pyrolysis – gas chromatography / mass spectrometry (Py-GC/MS) in order to provide insight into the actual chemical composition of the coatings. Among the materials identified with these instrumental techniques are drying oil, traces of a diterpenoid resin belonging to the *Pinaceae* family, as well as cellulose nitrate and polyvinyl acetal, a resin sometimes used for the consolidation of wooden artifacts, which conveys to the surfaces examined an intense blue ultraviolet-induced fluorescence. Moreover, analysis with matrix assisted laser desorption ionization / mass spectrometry (MALDI/MS) of a water-soluble substance found on two additional totem poles revealed the presence of a plant gum, possibly mixed with starch. Results from scientific analysis have informed the development of a suitable cleaning method that does not damage the underlying paint layers.



Figure 1. Right: house post 16/566, Tsimshian, accession number 1869-90-94, 449-cm high, American Museum of Natural History photo studio. Left: house Post 16/567, Tsimshian, accession number 1869-90-94, 445-cm high, American Museum of Natural History photo studio.



Figure 2. Detail from house post 16/567, Tsimshian, accession number 1869-90-94, 445-cm high, American Museum of Natural History photo studio.

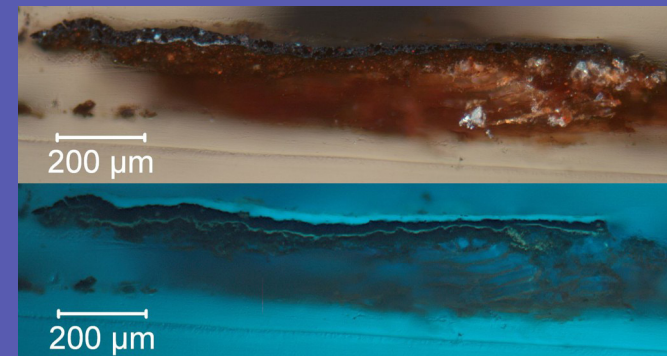


Figure 3. Removal of cross sectional samples from areas of coated wood of house post 16/567 that displayed a characteristic ultraviolet-induced fluorescence.

Figure 4. Microscopic images collected under polarized (top) and ultraviolet (bottom) illumination of a cross sectional sample of coated wood removed from house post 16/567. The organic coatings applied to the object's wooden surface, displaying a characteristic ultraviolet-induced fluorescence, are intermixed with layers of dirt.

Alexander Calder: *Half-Circle, Quarter-Circle, and Sphere* (1932) and Other Early Motorized Works of Art

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Alexander Calder is one of the best known and most beloved American artists. For most, Calder's art represents sheer, cross generational fun. Born in 1898 into a family of artists, he was trained as an engineer at Stevens Institute of Technology in New Jersey, but soon after, while on the West coast of Canada in 1923, he decided to become himself an artist. By the fall of 1926 he had left New York for Paris, then the global hub of modernity as well as tradition, fashion, pleasure and, most of all, art. Compared to the United States' increasing isolationism, prohibition, puritanism and racial divides, Paris offered enticing artistic liberties and freedom. It was a place where the most interesting artists gathered, new ideas were exchanged, and artistic inventions took place. It was there that Calder made the acquaintance of many famous artists he admired, including Mondrian, Picasso, Miro, Marcel Duchamp, Andre Kertész, Matisse, and made connections with a number of galleries that provided the perfect environment for the budding artist.

While experimenting with drawings, painting, wood carving and wire in the late 1920s in Paris, Calder became interested in motion. In the fall of 1929 he visited Mondrian's studio, and later recalled: "This one visit gave me a shock that started things [...]. I suggested to Mondrian that perhaps it would be fun to make these rectangles oscillate". This experience transformed not only his artistic carrier, but the way we think about sculpture today. Revolutionary thoughts followed: "Why must art be static? You look at an abstraction, sculpted or painted, an entirely exciting arrangement of planes, spheres, nuclei, entirely without meaning. It would be perfect, but it is always still. The next step in sculpture is motion" ("Objects to Art Being Static, So He Keeps It in Motion", *New York World-Telegram*, June 11, 1932). And, in fact, Calder's true sculptural medium became not the traditional stone or clay, but motion; kinetic in space. Around 1930 Calder started creating motorized works of art. By 1932, he exhibited his kinetic contraptions in the Gallery Vignon, Paris. Approximately 44 motorized works created by him are currently known, all made in a span of ten years.

The Whitney Museum of American Art is fortunate to own one of the largest of these whimsical motorized works - the topic of this presentation - now on display performing its designed motion in the museum's 8th floor exhibition, entitled *Calder: Hypermobility*. Made in 1932, Calder named *Half-Circle, Quarter-Circle, and Sphere* after the shapes it consists of. He bent its twisting black rod to the shape of a half circle over a quarter circle, while the red circle swings like the upside down pendulum of an old clock, both powered by one motor inside the white painted wooden base. As a non-figurative sculpture, its only meaning, as stated

by Calder himself, is its motion and relations in color and shape: "Each element able to move, to stir, oscillate and go in its relationship with the other elements in its universe" (A. Calder, "Abstraction-Création, Art Non-figuratif", 1932; 1, 6). Unfortunately, all these attributes had become compromised during the more than eight decades of its life, and now this seminal kinetic work is in need of extensive research and conservation treatment.

Acquired by the Whitney in 1969, nearly four decades after its creation *Half-Circle, Quarter-Circle, and Sphere* was subjected to a series of repairs. However, it functioned properly until 2010, as it was displayed in the Art Gallery of Ontario, Toronto, the last venue of the *Alexander Calder: the Paris Years, 1926-1933* retrospective exhibition. With the dysfunctional mechanism, the kinetic work delivered neither its motion and original colors, nor their relation to one another. While the sculpture's mechanism still retained Calder's ingenious engineering solutions, conveyed with his characteristic tinkering style execution, the motor and urethane belts, the plug and electrical wires, turned out to be neither authentic to the period, nor original.

The appearance of the sculpture had also been altered, as most painted surfaces are overpainted and, thus, do not deliver the proper hue and texture. Removal of the repainting layers on the white base and red sphere is essential to fully grasp the sculpture's true meaning according to Calder. As part of the Network Initiative for Conservation Science, an in-depth scientific study has been performed to gain insight into the stratigraphy of Calder's painted surfaces in *Half-Circle, Quarter-Circle, and Sphere*, to comprehend and restore its original appearance and kinetic motion, and to enable conservators to remove the over-paint. Similar works of the period, located at the Calder Foundation and in other collections (*Motorized Mobile*, 1929; *Dancing Torpedo Shape*, 1932; *Semi-Circle, Quadrant and Sphere*, 1932; *The Arc and Quadrum*, 1932; *A Universe*, 1934; *The White Frame*, 1934; etc.), were also studied to re-establish the original motion of the work under investigation. While conservators are still searching for another, more period-appropriate motor for this mobile, its original motion and speed have been re-established and may be enjoyed by the public and professionals alike in the Whitney galleries. In addition to describing Calder's practices for creating this sculpture, this lecture will present the process of restoring the mobile to its original motion, as well as provide a glimpse into the analytical results, their interpretation, and challenges to aid the next steps in the revival of this magical work.

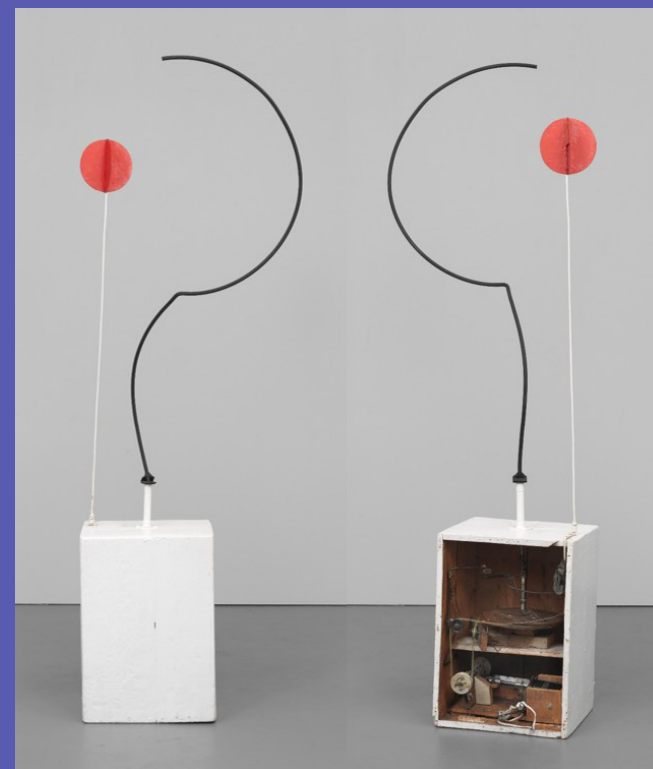


Figure 1. Front (left) and back (right) views of Alexander Calder (1898-1976), *Half-Circle, Quarter-Circle, and Sphere*, 1932. Painted metal and wood with motor, overall 76 5/8 x 35 1/2 x 25 inches (194.6 x 90.2 x 63.5 cm). Whitney Museum of American Art, New York, purchase, with funds from the Howard and Jean Lipman Foundation, Inc, 69.258.



Figure 2. *In-situ* non-invasive analysis of the elemental composition of the paint in Calder's *Half-Circle*, *Quarter-Circle*, and *Sphere* performed with handheld X-ray fluorescence (XRF) spectroscopy.



Figure 3. Removal of cross sectional samples from repainted areas of Calder's *Half-Circle*, *Quarter-Circle*, and *Sphere* for analysis of the stratigraphy with micro-invasive instrumental techniques.

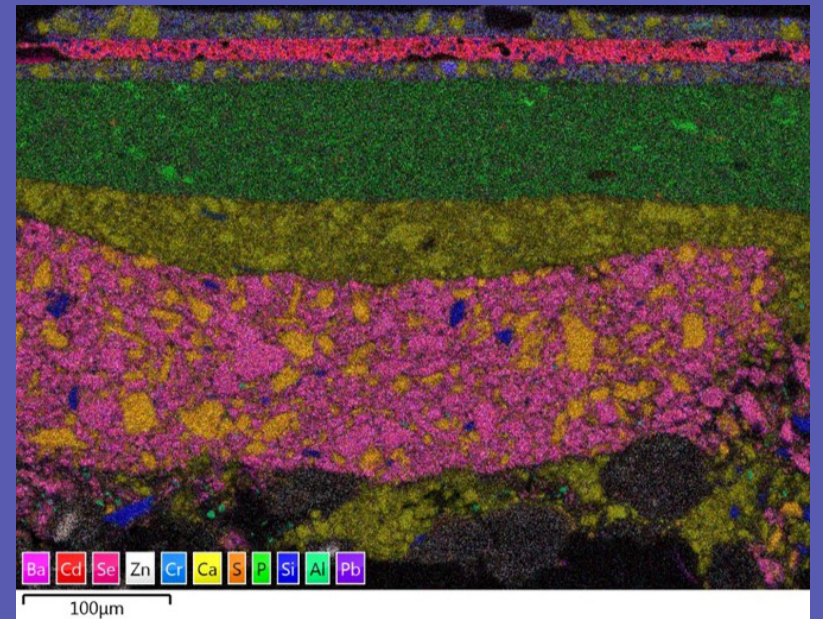
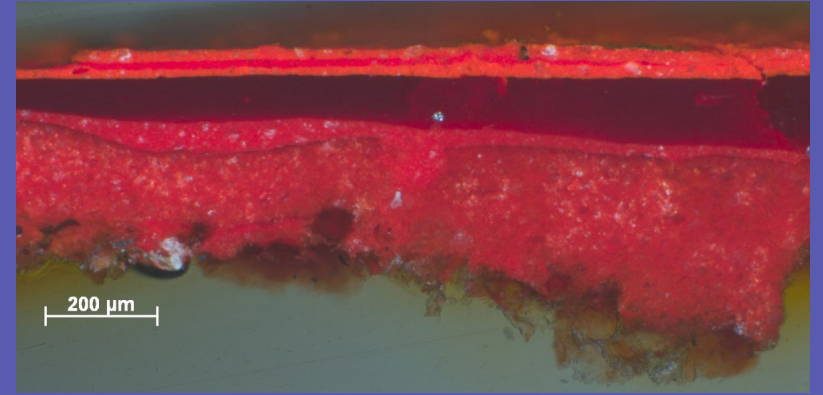


Figure 4. Microscopic image collected under polarized light of a cross sectional sample removed from Calder's *Half-Circle*, *Quarter-Circle*, and *Sphere*. The image shows that numerous paint layers of various shades of red are present below the object's surface.

Figure 5. Composite X-ray map collected with scanning electron microscopy / energy-dispersive X-ray (SEM/EDS) spectroscopy, showing the distribution of elements in a cross sectional sample of red paint removed from Calder's *Half-Circle*, *Quarter-Circle*, and *Sphere*.

Weaving the Desert Rainbow: Vibrant Color and Complex Technology of the Brooklyn Museum's Nasca Textile Masterwork

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Through the Network Initiative for Conservation Science, the Brooklyn Museum is collaborating with the Metropolitan Museum of Art on several projects which seek to characterize the materials of art objects in Brooklyn's collection. Among these is the detection and identification of pre-Columbian dyes, additives and mordants in ancient Andean textiles – an understudied field of inquiry that is relevant to Andean scholarship.

Brooklyn's rare Early Nasca (ca. 100 B.C.E. - 200 C.E.) textile 34.1579 was chosen for the initial phase of this project because of the high quality of the dyed camelid fibers and its well-conceived appropriation of a wide-range of saturated shades of blue, yellow, green, pink, purple, orange, as well as black, gray and brown, all on a clear red background. Although the original function of this now fragmentary work remains uncertain, it was in ancient times repurposed into a tunic, with embroidered neck slit and shoulder fringe. Three complete and one incomplete, large-scale figures with human and animal attributes and complex multiple appendages are dressed in elaborate headdresses and feline face masks, and hold trophy heads and weapons. Similar colorful and complex iconography is depicted on other early Nasca textiles and ceramics. Although the exact provenance of this work is unknown, in its use of color and iconography it appears related to textiles from the famous Paracas Necropolis burials.

While the woven structure of the cloth is a simple over-one, under-one plain weave, the technique of creating the highly detailed and smoothly rounded images by deploying individual discontinuous warps and wefts with single-interlocking joins is complex and unique to this era and region. One scholar who studied this work proposed that the entire fabric was likely darned over another plain-weave fabric, which was then removed, thread-by-thread (A. P. Rowe, "Interlocking Warp and Weft in the Nasca 2 Style", *Textile Museum Journal* 1973; 3(3), 67-78), meaning the process was more like embroidery than weaving.

Scientific analysis of this Nasca textile involved the use of non-invasive tools accessible within the Brooklyn Museum, such as fiber optics reflectance spectroscopy (FORS), X-ray fluorescence (XRF) spectroscopy, and multiband imaging (MBI). These analytical tools were complemented with micro-invasive techniques, such as high performance liquid chromatography (HPLC) and scanning electron microscopy / energy-dispersive X-ray (SEM/EDS) spectroscopy, available at the Metropolitan Museum. Liquid chromatography / mass spectrometry (LC/MS) analysis is currently being performed in collaboration with Bruker Optics.

At Brooklyn, the multiband images collected from the textile overall included visible light (Vis), ultraviolet-induced visible fluorescence (UV), ultraviolet reflectance (UVR), and infrared reflectance (IRR). UV fluorescence images captured a bright pink-orange fluorescence in the red, tan and orange areas, as well as a faint pink fluorescence in purple regions. Infrared subtraction images showed a response in all blue (including dark blue, almost black areas), purple, and green regions, suggesting the use of an indigotin-containing dye for each of these colors.

FORS measurements indicated the likely presence of a plant anthraquinone dye in all red, salmon pink, orange, tan and purple areas from which readings were taken, as well as the presence of indigotin in all blue, purple and green regions.

Fifteen fiber samples were removed for HPLC, including purple fibers from the neck embroidery (added when the hanging was altered into a tunic), the red background, yellow and black outlines, and other dyed fibers harvested from the figures. Results confirmed the presence of purpurin and pseudopurpurin, alongside other anthraquinones, in the red and salmon pink, suggesting the use of a plant dye from the *Relbunium* species. The tan fibers were found to contain another purpurin-rich plant dye. An indigotin-containing colorant was identified in dark blue and gray-blue samples; due to the history of Spanish conquest of South America, it is impossible to know what native indigotin-containing plant may have been used to extract the dyestuff. The same blue dye was found in combination with *Relbunium* in purple and purple-brown yarns. Cochineal was found in the purple embroidery thread at the neck opening; given that cochineal was not found anywhere else on the textile, this result supports the supposition that such embroidery may be a later addition. Most yellow colorants were identified as mixtures of luteolin, luteolin-like compounds, and flavonols, although the exact botanical sources remain unidentified due to the fact that flavonoid-containing yellow dye-stuffs can be derived from countless plant species, resulting in a lack of reference spectra to which to compare the HPLC data. Analysis with LC/MS is currently being performed in an attempt to provide a more detailed characterization of the dyes in the Nasca textile. While MBI and FORS only give a very general indication of the dye material, HPLC and LC/MS separate and characterize all the chemical components present in a sample by comparison with a database of known materials. Mordants, pH of dye solutions, and the practice of over-dyeing all complicate the process of identifying the specific plants used in dyeing. Going forward, support for the study of a wider number of Andean textiles will bring about a greater understanding of ancient dyeing practices.



Figure 1. Nasca Poncho or Tunic, 100-200 C.E.
Camelid fiber, 74 7/16 x 27 9/16 inches
(189.1 x 70 cm). Brooklyn Museum,
Alfred W. Jenkins Fund, 34.1579
(Photo: Brooklyn Museum, 34.1579_front.jpg).



Figure 2. Detail from Nasca Poncho or Tunic, 100-200 C.E. Camelid fiber, 74 7/16 x 27 9/16 inches (189.1 x 70 cm). Brooklyn Museum, Alfred W. Jenkins Fund, 34.1579 (Photo: Brooklyn Museum, 34.1579_front_detail4_SL4.jpg).



Figure 3. Visual examination of the Brooklyn Museum's Nasca textile.



Figure 4. Removal of microscopic fibers from the Brooklyn Museum's Nasca textile for dye analysis with high performance liquid chromatography (HPLC) and liquid chromatography / mass spectrometry (LC/MS).

How Do You Say “Bocour” in French? The Work of Carmen Herrera and Solvent-Based Acrylic Paints in Post-War Europe

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In the fall of 2016 the Whitney Museum of American Art organized *Carmen Herrera: Lines of Sight*, a partial retrospective of the pioneering Cuban-American artist. The exhibition focused on a thirty-year period that started with the artist's arrival in Paris in 1948, where she worked for six years before returning to New York City. The artist listed the medium of all the paintings in the exhibition, including the early work from Paris, as being acrylics. The curator of the exhibition questioned Ms. Herrera about the nature of the paint because the availability of acrylic-based artist's paint in Europe at this time was previously unknown. Surprisingly, the artist confirmed that she was quite sure she was using acrylics, recalling that they were imported from Germany and sold in an art supply store near her studio in Paris. If confirmed, this assertion would alter our scholarship regarding the early use of acrylic paints.

Shortly after Ms. Herrera arrived in Paris, she began associating with a group of diverse, international friends she met through the Salon des Réalités Nouvelles. The Salon was a prominent champion of abstract art at the time and, under the influence of these artists, Herrera's work began to swiftly evolve through a series of fairly distinct styles with this process seemingly mirrored by changes in the physical appearance of the paint. According to her, "it was an extremely interesting time for the following reason: we helped each other a lot... remember at that time there were no materials, it was almost impossible to get canvas, so when one of us discovered something, for example when what arrived from Germany started arriving, the first acrylics... we started using it" (unpublished interview with Estrellita Brodsky, April 15, 2005).

For this study a selection of five paintings from 1948-1952 were analyzed with a variety of non-invasive and micro-invasive analytical techniques in order to characterize the binding media and pigments present in the paint. Fourier-transform infrared (FTIR) spectroscopy and pyrolysis – gas chromatography / mass spectrometry (Py-GC/MS) with and without sample derivatization provided insight into the chemical composition of the binding media. In addition, complementary analyses by X-ray fluorescence (XRF) spectroscopy, Raman spectroscopy, and scanning electron microscopy coupled with energy-dispersive X-ray (SEM/EDS) spectroscopy were conducted to gather information on the identity of the pigments, colorants, and extenders.

Analysis of the earliest paintings in the study revealed that they were created with an oil-based paint. However, the later paintings showed a complex progression of organic binders, which also includes solvent-based acrylics (primarily *n*-butyl methacrylate), polyvinyl acetate, and oil-based alkyds.

Pigment analysis showed a wide range of traditional artist pigments including: cadmium yellows, oranges and reds; viridian and emerald green; and cerulean, cobalt, and Prussian blue. Many of these are fairly expensive pigments and their presence would suggest that Herrera was not using any house paints, such as Ducotone, that were commercially available at the time. Analysis of contemporary house paints has found some similar binding media, but the pigmentation consists predominantly of inexpensive organic pigments, as would be expected (P. Gottschaller, "Lucio Fontana: The Artist's Materials", Getty Conservation Institute, Los Angeles, 2012, p. 79.).

Given the results of our investigation, we propose that artist-grade paints using early synthetic binding media were being produced, most likely in either Paris or Germany, and were commercially available there by 1949. This timing suggests that their development in Europe was concurrent with the development of Magna in the United States. Further research is still needed to identify the producer, method of production, and the scale of distribution. However, the impact of this discovery on our understanding and study of the art being produced in Europe at this time cannot be understated.



Figure 1. Carmen Herrera laying out a new piece
© Carmen Herrera.



Figure 2. Carmen Herrera (b. 1915), *Iberic*, 1949.
Acrylic on canvas on board, diameter 40 inches
(101.6 cm). Courtesy of the artist and Lisson Gallery
© Carmen Herrera.



Figure 3. Visual examination of Carmen Herrera's *Siete* (1949).



Figure 4. *In-situ* non-invasive analysis of the elemental composition of the paint in Carmen Herrera's *Untitled* (1948) performed with handheld X-ray fluorescence (XRF) spectroscopy.



Figure 5. Removal of microscopic samples from Carmen Herrera's *Untitled* (1948) for analysis of the pigments, extenders, and binding media with micro-invasive instrumental techniques.

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