

NICS  
ANNUAL  
SYMPOSIUM  
2018

BOOK OF  
ABSTRACTS

# NICS Annual Symposium 2018

## Book of Abstracts

The Network Initiative for Conservation Science, launched in September 2016 with the support of The Andrew W. Mellon Foundation, is a program designed to offer access to The Met's state-of-the-art scientific research facilities to partner institutions in New York City. In the past two years, NICS scientists have carried out collaborative work on 38 projects, resulting in the examination and scientific analysis of 209 objects and 346 samples using a wide array of analytical techniques. Works of art investigated span 2,500 years and represent cultures from all over the world. Highlights from the 2018 NICS Annual Symposium include research in collaboration with the Brooklyn Museum, the Central Park Conservancy, The Frick Collection, The Hispanic Society Museum & Library, The Morgan Library & Museum, and the New York Public Library.

# Schedule of Events

9:30 am	Registration and Breakfast	
10 am	Welcome and Introduction Andrea Bayer and Marco Leona, The Metropolitan Museum of Art	
10:15 am	Plenary Lecture <i>The Interdisciplinary Collaboration Between Curator, Conservator, and Scientist: The Dutch Approach</i> Robert van Langh, Rijksmuseum, Amsterdam	
11 am	<i>Pigment, Ink, and Gold: Discovering the Coptic Manuscript Palette at The Morgan Library &amp; Museum</i> Frank Trujillo, The Morgan Library & Museum	pg 04
11:30 am	Coffee Break	
11:45 am	<i>The Nican Mopohua and the Mexican Codex in the New World: History, Analysis, and Conservation</i> Myriam de Arteni, New York Public Library	pg 12
12:15 pm	<i>Mixing, Dipping, and Fixing: The Drawings of Thomas Gainsborough</i> Reba F. Snyder, The Morgan Library & Museum	pg 20
12:45 pm	Lunch Break	

2 pm	Plenary Lecture <i>Pasteur's Quadrant and the Status of Science in Cultural Heritage</i> Barbara Berrie, National Gallery of Art, Washington D.C.	
2:45 pm	<i>Documentation and Analysis of Romano-Egyptian Funerary Portraits at the Brooklyn Museum</i> Lauren Bradley, Brooklyn Museum	pg 28
3:15 pm	<i>Toward a Sustainable Regime of Science-Based Monuments Conservation in Central Park</i> Matthew C. Reiley, Central Park Conservancy	pg 36
3:45 pm	Coffee Break	
4 pm	<i>Bertoldo's Wild Man and the Making of His Bronzes</i> Julia Day, The Frick Collection	pg 44
4:30 pm	<i>Luisa Roldán's Craft: Materiality of Her Terracottas</i> Hélène Fontoira Marzin, The Hispanic Society Museum & Library	pg 52
5 pm	Closing Remarks Federica Pozzi and Elena Basso, The Metropolitan Museum of Art	

# Pigment, Ink, and Gold: Discovering the Coptic Manuscript Palette at The Morgan Library & Museum

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## PRESENTING AUTHOR: FRANK TRUJILLO

*Frank Trujillo has the position of Book Conservator in the Thaw Conservation Center at The Morgan Library & Museum. He holds a master of arts in library and information science and an advanced certificate in conservation from the University of Texas at Austin and a bachelor of arts from the University of Notre Dame. His research has focused on the materials and techniques of medieval manuscript illumination, French Romanesque binding structures, and the conservation history of the Coptic manuscript and binding collection at The Morgan.*

The collection of Coptic Manuscripts at The Morgan Library & Museum consists of over fifty volumes. The manuscripts formed the library of the Monastery of St. Michael, a monastery whose existence was unknown until 1910, when the manuscripts were discovered in the village of Hamuli in Egypt's Fayum Oasis. The volumes date from 822 to 914 A.D., are written on parchment, and consist of a range of religious texts including the Acts of the Apostles, the Gospels, and Epistles. The manuscripts were discovered at the bottom of a well and suffered from water and insect damage after a thousand years of hidden storage in the Egyptian landscape. The manuscripts were purchased by J. Pierpont Morgan in 1911 and remain the largest collection of Coptic manuscripts from a single location in the world. Shortly after their purchase, the volumes were sent to the Vatican Library for restoration. The manuscripts underwent extensive treatment using the most advanced concepts in parchment repair and manuscript restoration available at the beginning of the twentieth century. The leather bindings were separated from the parchment manuscripts and treated separately. The parchment with text and illuminations was treated at the Vatican Library over the course of many years and by a number of hands. Hundreds of leaves and fragments were repaired, collated, and re-sewn into bound volumes. The history of the treatment of the manuscripts and their material composition continue to be a source of interest for conservation and curatorial staff at the Morgan. In particular, the presumed use of gelatin to repair the manuscript leaves has rendered them stiff and brittle and limits the exhibition and use of the volumes.

The present work constitutes the first in-depth examination and technical study of the materials used to create and repair this body of manuscripts. Twelve manuscripts were selected for examination of their inks, pigments, metallic elements, and repair materials using X-ray fluorescence spectroscopy, Fourier-transform infrared spectroscopy, Raman spectroscopy, and matrix-assisted laser desorption ionization/mass spectrometry. The selected manuscripts contained examples of the pigments found throughout all fifty manuscripts and were extensively restored at the Vatican. The yellow, blue, orange, red, and green pigments, as well as the metallic elements and inks, were characterized noninvasively; samples of the repair material used by the Vatican Library were then taken and submitted for microdestructive analysis. Results from this research provide a view into the production of monastic Coptic manuscripts, revealing a palette that includes iron gall ink, gold, organic colorants, copper-based greens, iron-containing earth reds, vermilion, red lead, and large amounts of orpiment.



The early dates of the manuscripts and the location of the Monastery of St. Michael place the manuscripts at an interesting crossroads between East and West, while scientific analysis offers specific information about the method and materials of manufacture of these early manuscripts. This specificity helps chart a map of the minerals, plants, and animals used to create the manuscripts, and provides a basis on which to build a fuller picture of the development of pre-medieval and Renaissance manuscript practice. In addition, scientific analysis of the repair material used by the Vatican Library will inform possible future treatment decisions.



**Figure 1.**  
Morgan Library conservators Maria Fredericks and Frank Trujillo prepare a manuscript for noninvasive analysis with portable instrumentation.





**Figure 2.**  
 Left, *Homily delivered on Wednesday after Easter*, MS M.610, fol. 1v. Middle, *Hermeneiai with Various Hymns*, MS M.574, fol. 1v. Right, *Bible, 1,2 Samuel*, MS M.567, fol. 69r. The Morgan Library & Museum, New York.



**Figure 3.**  
NICS scientist Elena Basso analyzes  
a manuscript with X-ray fluorescence  
spectroscopy.



# The Nican Mopohua and the Mexican Codex in the New World: History, Analysis, and Conservation

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## PRESENTING AUTHOR: MYRIAM DE ARTENI

*Myriam de Arteni has a master of fine arts from the Accademia di Belle Arti-La Sapienza University of Rome and received her conservation degrees from the Istituto Centrale per il Restauro e la Conservazione del Patrimonio Archivistico e Librario. She also holds certifications from the Istituto Superiore per la Conservazione ed il Restauro and from ICCROM. De Arteni continued with further advanced studies in conservation in the United States. She is currently the Senior Conservator for Exhibitions at the New York Public Library. She lectures and publishes widely, is cofounder of Sol Invictus Press producing limited edition artist's books, and is a poet.*

The Nican Mopohua and Mexican Codex are two manuscripts among many relevant documents in the New York Public Library holdings. Written in the Nahuatl language, both are considered top treasures of the library's collection of American Indian literature. The New York Public Library began with the collections of Joseph Green Cogswell (1786–1871) for the Astor Library and James Lenox (1800–1880), a preeminent collector of rare books, manuscripts, and Americana. Mr. Lenox was especially interested in the discovery, exploration, and the early colonization of America, and it is through him that the Nican Mopohua became a part of the New York Public Library.

The Nican Mopohua, in the Manuscripts and Archives Collection, belongs to the Guadalupan Monuments, a set of documents concerning the apparition and worship of the Virgin of Tepeyac (Guadalupe). The title of the document, Nican Mopohua, was translated into English by Edwin B. Brownrigg and reads: "Here reference is made". The poem, apparently composed in 1556 by Antonio Valeriano (1521?–1605), relates to the 1531 apparitions of the Virgin Mary to a devout Indian from Cuauhtitlán, baptized as Juan Diego. It is said that Juan Diego Cuauhtlatotzin himself had told the story to Valeriano. This manuscript was created on Genovese paper, which was hardly attacked by insects due to the chemicals contained in the waters of the Voltri region and was thus deemed valuable for record keeping. The Mexican Codex, belonging to the Spencer Collection, exemplifies the survival of local traditions and was realized on amate paper in the early eighteenth century. In this context, the present study explores the history of the Nican Mopohua and Mexican Codex in relation to the use of different types of paper in Spain and New Spain. It discusses, too, the over 100 Genovese paper mills located in Voltri along the Leira, Cerusa, and Acquasanta rivers, as well as various trade routes to the New World. Close examination of the Nican Mopohua and Guadalupan Monuments found evidence of watermarks, or filigranas, which represent a precious source of information, being one of the auxiliary elements that may be used to confirm the dating and to ascertain authenticity of a document that is written on paper. The evaluation of the conservation condition of the Nican Mopohua and the Mexican Codex, along with the current degree of degradation caused by the iron gall ink used, the presence of tears and losses, as well as the final storage and display conditions, will be also discussed.

In an additional phase of this project, the two documents were subjected to scientific analysis to gain insight into their materials and techniques of fabrication. Noninvasive examination of the elemental

composition of the inks was performed using a portable X-ray fluorescence spectrometer, while microinvasive analysis of a selection of pigment and dye samples removed from the objects was carried out by Raman spectroscopy and high-performance liquid chromatography.

Results from the examination and technical analysis of the Nican Mopohua and Mexican Codex not only shed light on the documents' materials and techniques, but also guided the optimization of suitable preservation strategies.



**Figure 1.**  
NICS scientist Elena Basso sets up a portable X-ray fluorescence spectrometer for in situ analysis of one of the manuscripts.

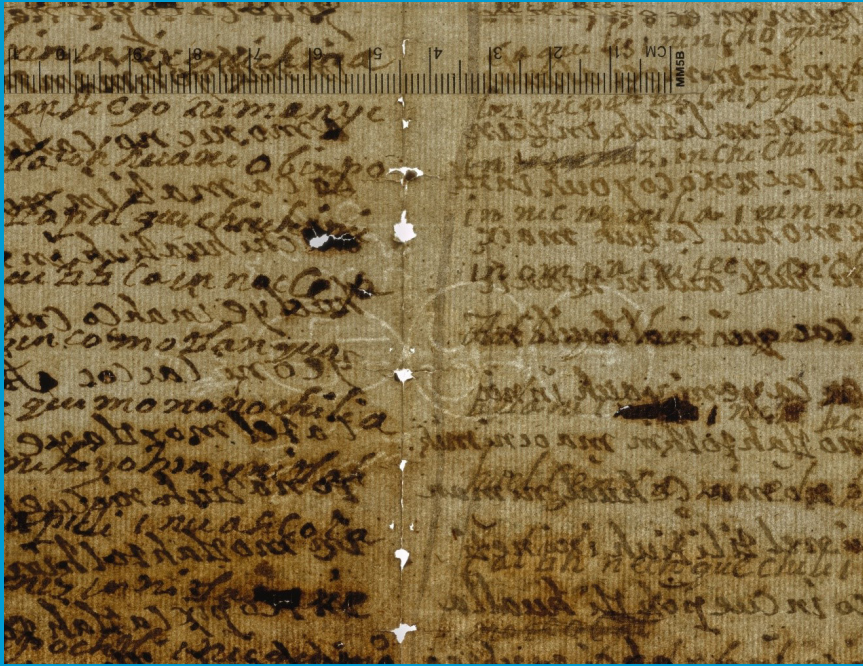


Figure 2.  
 Left, Nican Mopohua, Monumentos  
 Guadalupeños, ca. 1500-1600, Manuscripts  
 and Archives Division, MssCol 2045.  
 Right, Ocelotepec, Santa Maria, ca.  
 1700-1750, Spencer Collection, Ms. 150.  
 The New York Public Library, Astor,  
 Lenox, and Tilden Foundation.





**Figure 3.**  
New York Public Library conservator  
Myriam de Artani and NICS scientist  
Federica Pozzi examine results obtained  
from analysis with X-ray fluorescence  
spectroscopy.

# Mixing, Dipping, and Fixing: The Drawings of Thomas Gainsborough

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*Reba Fishman Snyder, a graduate of the Conservation Program at New York University's Institute of Fine Arts, has been Paper Conservator at The Morgan Library & Museum since 1995. She is actively involved with the study and treatment of old master drawings, prints, and manuscripts and is particularly interested in artist's materials and techniques. She most recently published an essay entitled "Thomas Gainsborough: A Master's Techniques Revealed" for an exhibition catalogue at the Morgan. The research for that article forms the basis of her talk.*

The Morgan Library & Museum owns twenty-five works on paper by the English artist Thomas Gainsborough (1727–1788). These drawings represent a wide range of the artist's work on paper, including highly finished landscape studies, an unfinished oil landscape sketch, and a rare preparatory study for a painting. The media used include graphite, chalk, watercolor, and oil paint on both laid and wove papers. About a dozen of these artworks were included in an exhibition at the Morgan entitled *Thomas Gainsborough: Experiments in Drawing*, which opened in May 2018. A small catalogue that contains updated descriptions of the Morgan's works as well as a technical study of Gainsborough's techniques and materials as seen in the Morgan's collection accompanied the exhibition <sup>[1]</sup>.

Conservation and art historical publications over the past twenty years as well as Gainsborough's own writings have demonstrated that he was an innovative and experimental artist, having developed some unique drawing and painting techniques over the decades of his career. Using a letter written by Gainsborough in 1773 as a primary source of information on the technique of his paintings on paper, it was apparent that gum Arabic, milk, and/or resin varnish coatings might be present in some of his works in the Morgan collection. Identification of the binders, coatings, and fixatives is important because understanding the layer structure could affect treatment decisions. Pigment identification was another area of interest, as the literature suggests that both lead and calcium whites, difficult to identify by only visual means, were used by Gainsborough in his drawings.

Initially, a selection of works was examined using magnification along with transmitted and raking light in order to identify media and understand the structure of each piece. Further photo documentation and examination with ultraviolet and infrared light were performed on selected works in an attempt to identify white pigments, resin coatings, and the presence of underdrawings. This type of examination gave insight into Gainsborough's working methods, revealing the following: only one oil on paper had an underdrawing; wet and dry chalk techniques were present in late works; complex layering of wet and dry media, of difficult interpretation, was observed; visible and invisible coatings had been applied; and analysis with instrumental techniques would be needed to conclusively identify pigments and coatings.

In a second phase of this project, scientific analyses were aimed at characterizing the different white pigments used in the Morgan's works and also, if possible, the coatings and binders on some of the more complex drawings. Identification of the whites was performed noninvasively by means



of X-ray fluorescence and Raman spectroscopies. When dealing with works on paper, where there is often little binder or organic media present, the use of noninvasive or minimally invasive techniques is always preferred. The pristine condition of many of the Morgan's drawings precludes, in many instances, removal of samples. Fourier-transform infrared spectroscopy and matrix-assisted laser desorption ionization/mass spectrometry were also used to identify the presence of milk as a fixative or coating on some of the drawings.

The technical study of a selection of these drawings, as well as examination under a variety of light sources, resulted in some clear conclusions and some open questions. Morgan conservators have gained a greater understanding of the complexity of Gainsborough's techniques, and more work will continue to be done to shed light on the artist's materials and innovative practices.

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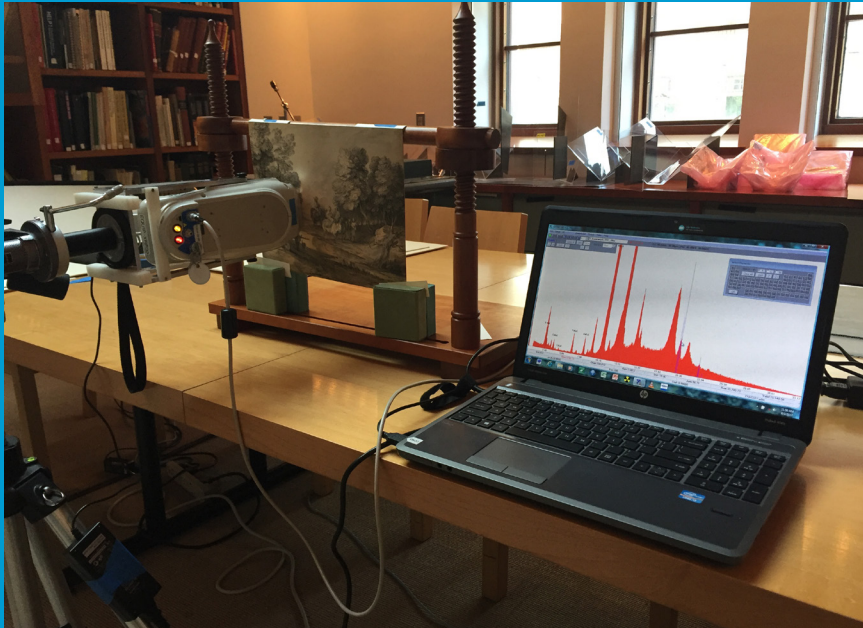
[1] Snyder, Reba F. "Gainsborough: A Master's Techniques Revealed." In *Thomas Gainsborough: Experiments in Drawing*, 27-37. London: The Morgan Library & Museum in association with Paul Holberton Publishing, 2018.



**Figure 1.**  
Detail from Gainsborough's *Wooded Landscape with Horseman, Figures, and Bridge, III, 61*, showing lead white washes and selectively applied coating. The Morgan Library & Museum, New York.



**Figure 2.**  
Normal (left) and ultraviolet (right) light  
photography of a detail from Gainsborough's  
*Landscape with Horse and Cart Descending  
a Hill, III, 63*, showing an uncoated  
corner (indicated by an arrow) possibly  
corresponding to the location where the  
work was held by the artist when applying  
a fixative.



**Figure 3.**  
In situ X-ray fluorescence spectroscopic  
analysis of one of Gainsborough's  
drawings.

# Documentation and Analysis of Romano-Egyptian Funerary Portraits at the Brooklyn Museum

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## PRESENTING AUTHOR: LAUREN BRADLEY

*Lauren Bradley, Associate Conservator of Paintings at the Brooklyn Museum, oversees the preservation of paintings dating from ancient Egypt to the present day. Before coming to Brooklyn, she worked as an assistant conservator at the Kimbell Art Museum and at the J. Paul Getty Museum. Bradley earned a master of science from the Winterthur/University of Delaware Program in Art Conservation and completed training internships at the Mauritshuis Royal Picture Gallery, the Walters Art Museum, and the Barnes Foundation.*

The Brooklyn Museum owns six Romano-Egyptian funerary portraits, two described as tempera paintings on panel and four as encaustic paintings on panel. The portraits date from ca. 95 to 230 A.D. and represent a merging of Roman painting traditions with Egyptian burial practices. All six portraits survive in remarkably good condition with relatively little interventive conservation treatment. Opportunities for in-depth study have been limited by the portraits' enduring popularity for display.

The Brooklyn Museum's participation in the international Getty initiative Ancient Panel Paintings: Examination, Analysis, and Research (APPEAR) provided the impetus for thorough documentation and analysis of all six portraits using visual examination, reflectance transformation imaging, infrared reflectography, X-radiography, X-ray fluorescence spectroscopy, fiber optics reflectance spectroscopy (FORS), Raman spectroscopy, and multiband imaging, in addition to sampling for binding media and wood identification <sup>[1]</sup>. The research findings and imaging information are shared on the APPEAR Project database accessible to participating institutions, and a paper was presented at the APPEAR conference held at the Getty Villa, Los Angeles, in May 2018 <sup>[2]</sup>.

A major focus of the project involved using multiband reflectance image subtraction (MBRIS) for the characterization of the natural blue dye indigo. Pioneered by Webb and coworkers, the technique combines one near infrared image and one visible light image in digital postprocessing <sup>[3]</sup>. This noninvasive technique can visualize and localize materials such as indigo, producing a map of an object's surface. As few references to this technique exist in the literature, Brooklyn Museum conservators not only evaluated the information gained from its application to the study of Romano-Egyptian funerary portraits, but also investigated the technique itself, refining variables in image capture and processing to optimize results and create representative images of the portraits. Protocols were developed for image capture and equipment setup using reflectance and color standards.

To evaluate the MBRIS technique, analyses were carried out on the portraits using FORS and Raman spectroscopy. FORS analysis, which essentially exploits the same reflectance phenomena as MBRIS, provided localized spectral information that corroborated the material responses observed in the MBRIS images and elucidated the circumstances under which the subtraction technique can yield misleading results. Raman spectroscopy was used as a complementary technique to substantiate or challenge material characterizations performed using MBRIS and FORS.



On three of the encaustic portraits, indigo was detected exclusively in mixtures with a red lake pigment to achieve a purple color. This natural blue colorant was identified more broadly on the two tempera portraits as being used to paint both purple and specific blue and blue-gray details. On the other hand, indigo was not found on the sixth portrait, also described as encaustic.

This research adds to the growing body of knowledge surrounding the methods and materials employed to create ancient panel paintings and the use of indigo as a paint colorant. The authors hope that this work will also help to establish MBRIS as a reliable tool that can be used as part of a holistic investigation involving other techniques to study a broad range of cultural heritage objects.

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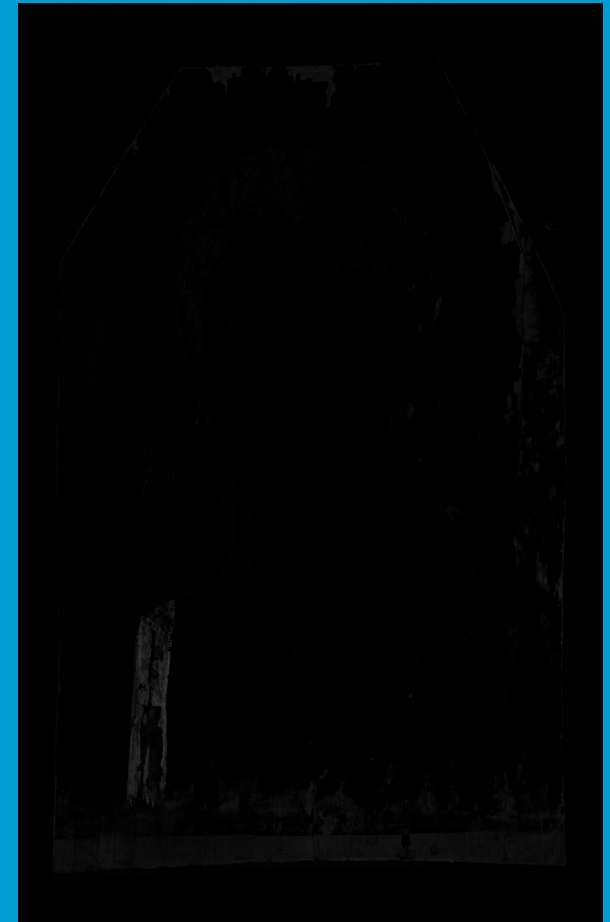
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[3] Webb, E. Keats, Rebecca Summerour, and Jennifer Giaccai. "A Case Study Using Multiband and Hyperspectral Imaging for the Identification and Characterization of Materials on Archaeological Andean Painted Textiles." *Textile Specialty Group Postprints*, 2014, 24, 23-34.



**Figure 1.** Brooklyn Museum conservators work with NICS scientists to collect photomicrographs of a portrait in preparation for sampling.



**Figure 2.**  
*Noblewoman*, Egypt, ca. 150 A.D. Encaustic on wood, 17 5/16 x 11 5/16 x 1/8 in. (44 x 28.7 x 0.3 cm). Brooklyn Museum, acc. no. 86.226.18. Left to right: visible light, ultraviolet-induced visible fluorescence, and processed MBRIS image.



**Figure 3.**  
NICS scientists Federica Pozzi and Elena Basso take in situ Raman measurements of selected areas of a portrait using a handheld Raman spectrometer.



# Toward a Sustainable Regime of Science-Based Monuments Conservation in Central Park

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*Matthew Reiley, Associate Director of Conservation/Senior Conservator for Central Park Conservancy, is responsible for the care of Central Park's historic built environment. His work blends traditional technique with the newest technologies to promote a sustainable regime of preservation for this cherished collection of monuments and features. An artist and inveterate foundryman, he is strongly drawn to cast metal sculpture as a creative medium. Reiley is an adjunct faculty member of the Columbia University Graduate School of Architecture, Planning, and Preservation and a professional associate of AIC.*

Central Park is one of the most important and beloved urban green spaces in the world. For nearly four decades, the Central Park Conservancy has worked to restore the park to the original vision of its creators. Now the organization is embarking on a new era, equipped with a new management and operations model. The Central Park Conservancy's mission to preserve the park's cultural resources for future generations shares challenges with the conservation field at large, such as increased use and health, as well as safety and environmental sensitivity. Science and technology are keys to achieving a sustainable practice in monuments conservation for this varied and historically significant collection. The Network Initiative for Conservation Science has rekindled Central Park's long-standing relationship with The Met's Department of Scientific Research. Since the Central Park Conservancy does not have widespread access to a state-of-the-art scientific research facility, this partnership broadens understanding by the discovery of critical information that leads to successful outcomes for monuments conservation projects.

Beginning in the late 1970s, many of Central Park's bronze sculptures were coated with protective layers of lacquer. Due to their difficult removal and high cost, many of the coatings surpassed their performance life and were no longer adequately protecting the sculptures. In 2010, a campaign was initiated to remove and refurbish the coatings. The plan of treatments has provided an opportunity to intimately assess the condition of de-coated surfaces, to develop suitable treatment approaches, and to consider context and strategically managed values through a contemporary lens. Since September 2016, the Network Initiative for Conservation Science has provided scientific analysis for four Central Park Conservancy monuments projects. New York's *Seventh Regiment Memorial* and the *Samuel F. B. Morse* statue are two mid-nineteenth-century figurative bronzes that represent a significant category of the collection. Additional materials analysis was performed in support of the recently completed conservation of the *Lehman Gates* (1961) and the *Frederick Douglass Circle's* (2011) wagon wheel railing to aid in stabilizing and replicating it following damage from a traffic accident. Microscopic samples were collected to classify alloys and ascertain corrosion products and remnant coatings by using X-ray diffraction, X-ray fluorescence spectroscopy, Raman spectroscopy, as well as Fourier-transform infrared spectroscopy and pyrolysis-gas chromatography/mass spectrometry techniques. The results guided the development of an optimal treatment and welding methodology, expanding research into technical art history and updating incomplete treatment history records. For a related study,



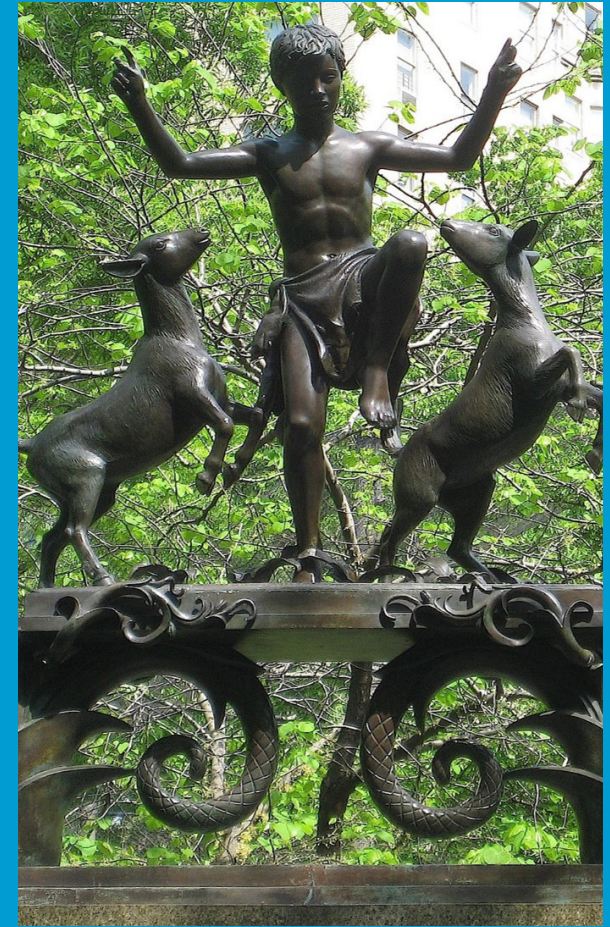
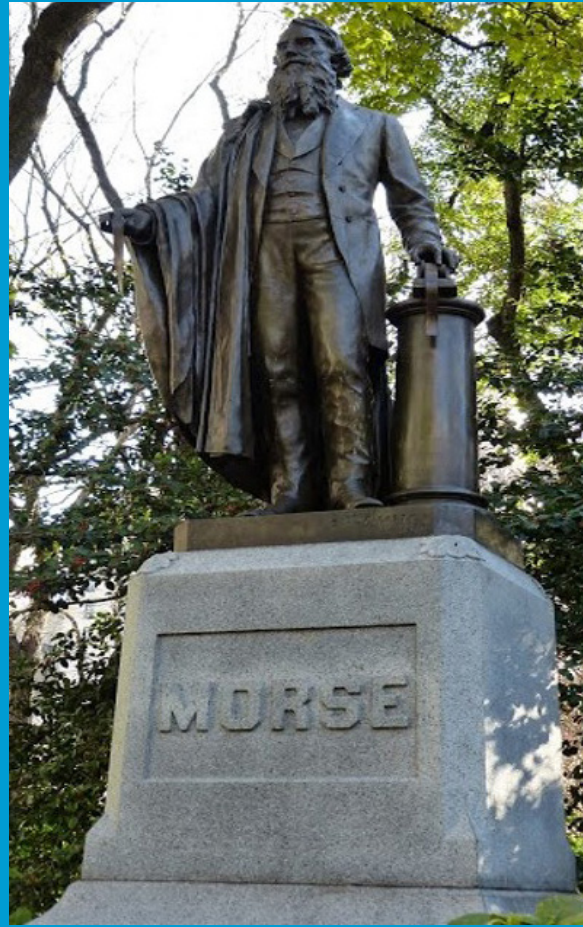
results of elemental analysis will be used to create historically representative bronze test coupons for in-field and accelerated weathering and reversibility testing of coatings, and to identify optimal operating parameters for energy-recuperative dry ice blasting.

This presentation describes the current and recent projects in detail and reflects on historical context and relevance of the artworks examined. Sharing the experience gained from its collaboration with the Network Initiative for Conservation Science on recent conservation projects in Central Park, the Central Park Conservancy aspires to provide a nascent example for best practices for the future of the field of outdoor sculpture conservation.



**Figure 1.**  
NICS scientist Elena Basso collects  
samples from the *Lehman Gates*.





**Figure 2.**  
Left, John Quincy Adams Ward (1830-1910), *Seventh Regiment Memorial*, 1869.  
Middle, Byron M. Pickett (ca. 1834-1907), *Samuel F. B. Morse*, 1871. Right, Paul Manship (1885-1966), *Lehman Gates*, 1961. The Central Park Conservancy, New York.





**Figure 3.**  
Central Park conservator Matthew Reiley  
and NICS scientist Elena Basso  
remove samples from the *Samuel F. B.  
Morse* statue.

# Bertoldo's *Wild Man* and the Making of His Bronzes

## CONTRIBUTORS

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## PRESENTING AUTHOR: JULIA DAY

Julia Day, Associate Conservator at The Frick Collection, is actively involved with the preservation of the building and its collection of decorative arts and sculpture. Her research has focused on bronzes and Renaissance Limoges enamels. Most recently she organized a study day on organic coatings, working with Research Scientist Adriana Rizzo at The Met, and collaborated on a publication on the Frick's enamels. Day received her master of arts and certificate of advanced study in art conservation from Buffalo State.

As a disciple of Donatello (1386–1466), Bertoldo di Giovanni (ca. 1440–1491) is one of a handful of Florentine sculptors who started casting small statuettes—an art form that would become synonymous with the Italian Renaissance—in the mid-fifteenth century. He was recognized in his time as the primary sculptor and medal worker for Lorenzo the Magnificent (1449–1492); however, little was recorded about his practice. An exhibition organized by The Frick Collection on Bertoldo will open in the fall of 2019<sup>[1]</sup>. The museum owns *Heraldic Wild Man*, one of the few bronze statuettes attributed to him. The exhibition provided an opportunity to carry out an in-depth technical study of this object to better understand its relationship to other bronzes attributed to the artist, including the pendant, the *Shield Bearer*, in the Liechtenstein Collection, Vienna.

Although several studies have been carried out on Renaissance Italian bronze sculptors, including the pioneering work by Richard E. Stone<sup>[2]</sup>, the working methods of Bertoldo have not been investigated in great detail. In the case of Bertoldo, few bronzes have survived, and only two objects (excluding the medals) can be securely attributed to him: *Bellerophon Taming a Pegasus* in the Kunsthistorisches Museum, Vienna, and the *Battle* relief in the Bargello, Florence<sup>[3]</sup>. Of the cast works thought to be by Bertoldo, six sculptures and nine reliefs were examined and sixteen medals analyzed.

Scientific analysis at The Met's research facilities was aimed at investigating the gilt layer, the organic coating, as well as the composition of the metal alloy and solder in original and restored portions of the Frick's bronze statuette. An array of analytical techniques was used, including X-ray fluorescence (XRF) spectroscopy, scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM/EDS), Fourier-transform infrared spectroscopy, and pyrolysis-gas chromatography/mass spectrometry. Additional information about this statuette's manufacture and previous repairs was obtained through radiography, also performed at The Met. The results obtained on *Heraldic Wild Man* were then compared with those obtained through radiography, XRF, and coating analysis on bronze statuettes in other institutions.

To date, the alloy analysis has helped to substantiate that the statuettes in the Liechtenstein Collection and at the Frick are a pair and were likely cast at the same time. In addition, surface analysis provided information on later treatments to the Frick's statuette, and investigation of the solder, in conjunction with radiography, confirmed that the base is original to the figure. It was hoped that SEM/EDS would be able to distinguish between original versus later mercury gilding on the statuette, but this would have required removal of a cross section.

Portable XRF provided a means to compare The Met's results with those of the bronzes in other institutions. The alloy compositions suggest that the use of brass for the only two gilt statuettes made by Bertoldo was unusual, given that all other statuettes and reliefs made by him were mainly low tin bronzes or ternary alloys. Close examination and radiography also supported the scientific analysis and helped to explain the chasing and foundry practices used by Bertoldo or those working with him. This study is the first attempt to clarify the attribution of Bertoldo di Giovanni's bronzes through technical examination, and it may provide a link to understanding his connection with Donatello as well as other sculptors working in Florence in the mid- to late fifteenth century.

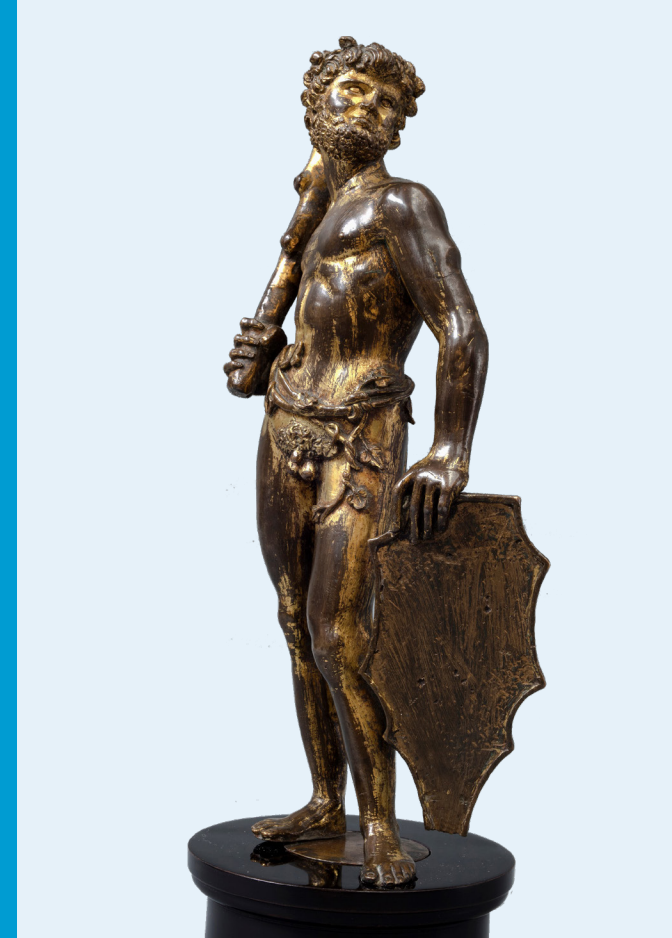
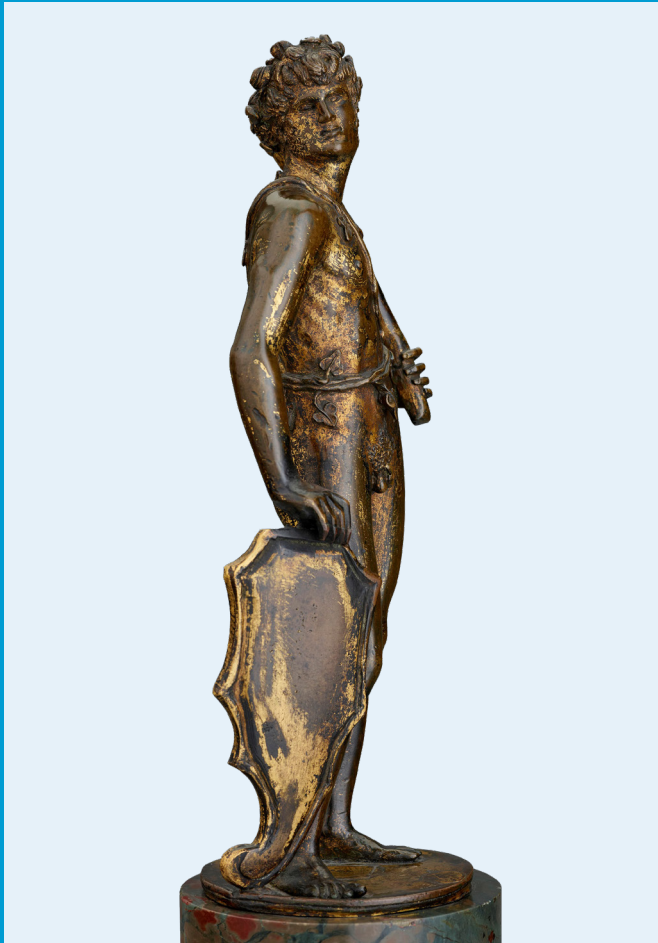
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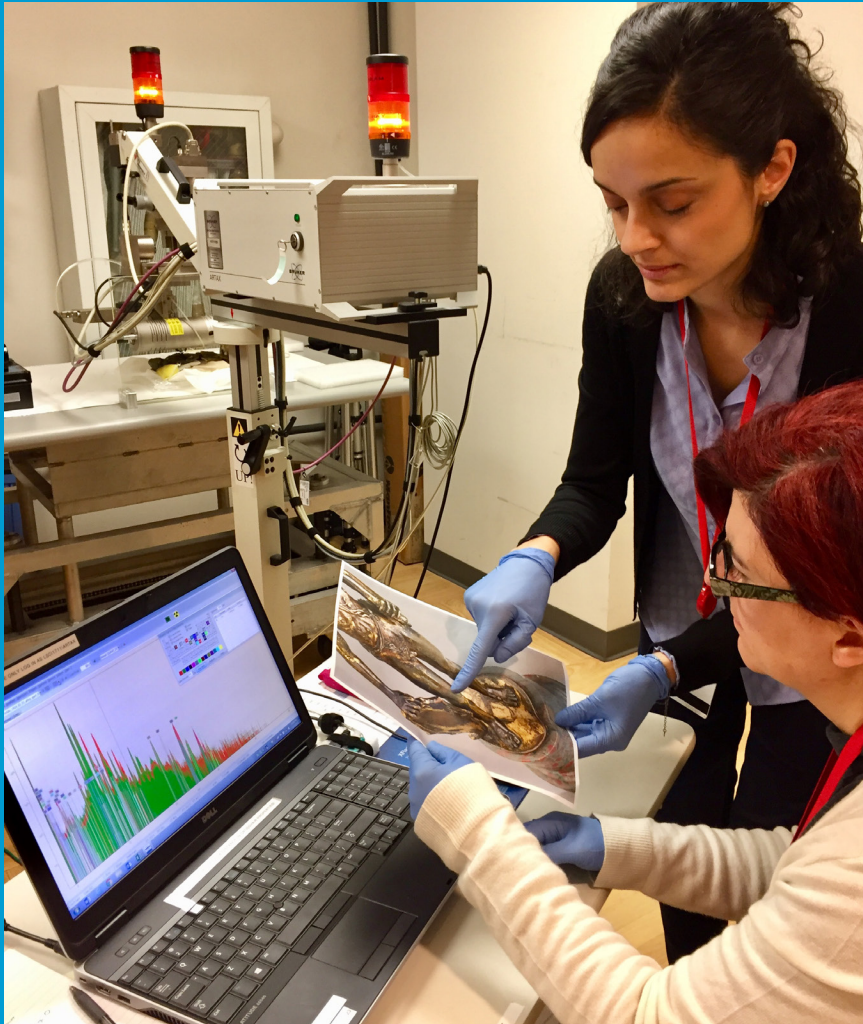


**Figure 1.**  
Frick Collection conservator Julia Day removes samples from Bertoldo di Giovanni's *Heraldic Wild Man* under the microscope.





**Figure 2.**  
Left, Bertoldo di Giovanni (ca. 1440–1491),  
*Heraldic Wild Man*, early 1470s, brass with  
mercury gilding, acc. no. 1916.2.03, The  
Frick Collection, New York. Right, Bertoldo  
di Giovanni, *Shield Bearer*, early 1470s,  
brass with mercury gilding, acc. no. SK258,  
The Liechtenstein Collection, Vienna.



**Figure 3.**  
NICS scientists Federica Pozzi  
and Elena Basso discuss the results  
of analysis by means of X-ray  
fluorescence spectroscopy.

# Luisa Roldán's Craft: Materiality of Her Terracottas

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The Hispanic Society Museum & Library owns five seventeenth-century polychrome terracotta works of art made by the Spanish female sculptor Luisa Roldán, also known as La Roldana. These five artworks include three separate and small-scale groups, namely *The Repose in Egypt*, *The Ecstasy of Saint Mary Magdalene*, and *The Mystical Marriage of Saint Catherine*, as well as a pair of near life-size decapitated heads, namely *Head of Saint John the Baptist* and *Head of Saint Paul*, only recently attributed to Roldán.

The present interdisciplinary collaborative project entailed the examination and scientific analysis of samples removed from the painted surface and clay body of these terracotta pieces in order to gain deeper insight into the artist's materials, techniques, and artistic process that led to the creation of these objects. Verifying the consistency between the materials used in *The Mystical Marriage of Saint Catherine*, the only signed sculpture in the groups under study, and those employed in the other works examined would corroborate authentication for the latter.

Luisa María Francisca Ignacia Roldán Villavicencio was born in Seville, Spain, in 1656. She learned the sculptor's trade in the prosperous workshop of her father, the prestigious Sevillian sculptor Pedro Roldán (1624–1699). After moving to Madrid in 1688, she started to create small groups of polychrome terracotta works with religious representations intended for domestic use, as decorations of houses or chapels, as well as for the convents and churches in Madrid. She became Court Sculptor in 1692 and was the first and only woman to ever hold this title. Luisa died in 1706, only a few days after being nominated a member of the Accademia Nazionale di San Luca in Rome, and was the first Spanish female sculptor to achieve such an important social and artistic recognition.

Despite her importance, there are only eight known pieces by Luisa Roldán in North American museums, five of which are owned by The Hispanic Society Museum & Library. There has been virtually no scientific analysis of her works to date, which makes the present study a major contribution to the field.

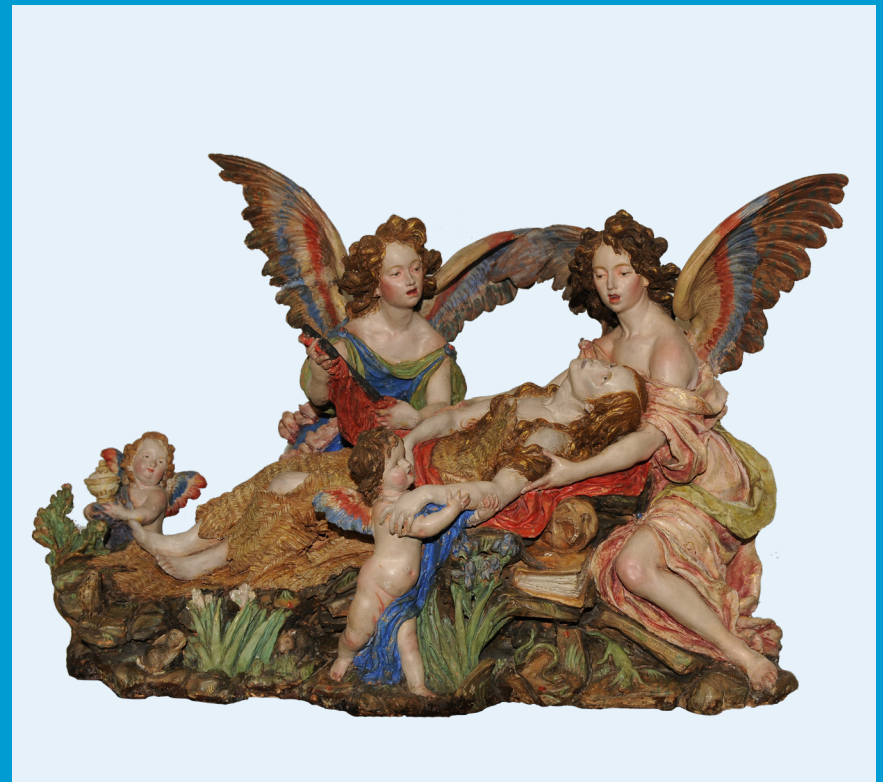
In the initial phase of this project, in situ noninvasive analysis by X-ray fluorescence spectroscopy was followed by the removal of samples from selected unadulterated sites of the two terracotta groups that are currently loaned to The Met, in an attempt to identify the composition of the clay and to characterize pigments and paint binders. These data will be integrated



and compared with results from a previous analytical campaign. In the future, the study will be extended to other sculptures attributed to Luisa Roldán, including the *Entombment of Christ*, recently acquired by The Met.



**Figure 1.**  
NICS scientists Federica Pozzi and Elena Basso remove samples from Roldán's *The Ecstasy of Saint Mary Magdalene*.



**Figure 2.** Left, Luisa Roldán (1652–1704), *The Rest in Egypt*, ca. 1690; terracotta group, polychrome, 16 1/8 × 18 1/8 × 12 in. (41 × 46 × 30.5 cm), D821. Right, Luisa Roldán, *The Ecstasy of Saint Mary Magdalene*, ca. 1690; terracotta group, polychrome, 12 × 17 1/2 × 9 7/8 in. (30.5 × 44.5 × 25.1 cm), D822. The Hispanic Society Museum & Library, New York.



**Figure 3.**  
In situ analysis of Roldán's *Head of Saint Paul* by means of X-ray fluorescence spectroscopy.

## Acknowledgments

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