

## *The Polychromy Roundtable: Past, Present, and Future*

**Jan Stubbe Østergaard**, Ny Carlsberg Glyptotek, Copenhagen

The lecture is divided into three parts, as indicated by its title.

Part I, the Past, unravels the sequence of events leading to the first Polychromy Round Table in 2009. This brings us back to the work done in the 1960s by Volkmar von Graeve on the polychromy of the Alexander Sarcophagus and its influence on his student, Vinzenz Brinkmann. The first paper given on the subject of polychromy at a scholarly conference was by Brinkmann, 1985, on the polychromy of Archaic Greek sculpture. That meeting was the beginning of the Past. There followed papers on polychromy given at conferences on the role of colour in ancient Greece, in 2000 and 2009, and in 2003 on polychromy as an aspect of research on Greek terracotta 'Tanagra' figurines.

The first meeting devoted to polychromy in the sculpture of Classical Antiquity was the Circumlitio colloquium in 2008, at the Liebieghaus Skulpturensammlung. This marks the end of the Past, and the beginning of the Present. The international and interdisciplinary character of polychromy studies was now firmly established; 'Circumlitio' demonstrated that a scholarly meeting on the subject was meaningful.

Part II, the Present, begins with the first Round Table in September 2009. Since then, the Polychromy Round Table has grown organically, has been interdisciplinary and international – venues included - and has encompassed the symbiotically connected polychromies of sculpture and architecture. It has included the polychromies of Western Asia, the Ancient Near East, and of post-antique Europe. The meetings have gone from being annual, to being biennial and live-streamed; the publication of the proceedings have developed from the bare online-only bones of speaker and title, to publications in print by courtesy of the host institutions.

This Present has grown out of its Past. Its growth is due to efforts of scholars from a broad range of disciplines. They share a recognition of the fundamental, multi-level cognitive shift entailed by the entry of colour as a fully integrated element of sculpture and architecture.

Part III, the Future of the Polychromy Round Table: this rests – safely I think – in the hands of the next generation. Interdisciplinarity, an international outlook, focus on Classical Antiquity, sculpture and architecture in symbiosis. Project designs building on interinstitutional teams and with clearly defined, well-argued research questions – preferably in close collaboration with a museum collection or an archaeological site. The challenge which looms and is beyond the Past and the Present is how polychromy can help intensify public experience and understanding of history – to a point which can compete with material consumption incompatible with the resources of our planet. Immaterial enrichment through all available media platforms and wherever possible revolving around museum collections.

One has to have dreams to see them fulfilled...

***“A Rare Gem of Art.” New Investigations into the Polychromy of a Sarcophagus from Ancient Cyprus in The Metropolitan Museum of Art***

**Sarah Lepinski, Dorothy Abramitis, Ameya Grant, Federico Carò, Mishael A. Quraishi,**  
Massachusetts Institute of Technology, Cambridge, Massachusetts

As part of the *Reimagining the Galleries for the Art of Ancient Cyprus* project, The Met's Departments of Greek and Roman Art, Objects Conservation, and Scientific Research have conducted extensive investigations on significant works of art in the Cesnola collection of art from ancient Cyprus. The study has advanced our understanding of polychromy on monumental sculpture and relief in the ancient Cypro-Archaic and Cypro-Classical periods, which is a topic that remains understudied in the art and archaeology of ancient Cyprus. It has also enhanced our knowledge of the 19<sup>th</sup> century restoration and conservation histories of several works of art, which took place both in Cyprus prior to their acquisition by the museum in the mid-1870s and also later at the Met.

This paper focuses on investigations into the polychromy of the Amathus Sarcophagus (74.51.2453), an elaborately carved and painted limestone sarcophagus in The Met's collection that has been dated to the later fifth century BCE. This work is one of the most significant in the Cesnola collection and depicts processions of chariots escorted by attendants on horseback and foot soldiers on its long sides, and rows of figures on each short end. The artistic style and iconography reflect creative amalgams of Greek, Egyptian, Near Eastern, and Cypriot visual elements. Its vibrant colors were studied extensively when the sarcophagus was conserved in preparation for the installation of the previous renovation of the Cyprus galleries in The Met, which opened in 2002. This study revealed a rich palette of colors including three distinct blues (azurite, Egyptian Blue, and a modern pigment identified as Prussian Blue), bright red (cinnabar), green (terre verte), and black (carbon-based). A dilute limewash mixed with raw sienna covered 19<sup>th</sup> c. plaster restoration, original limestone, and areas of original polychromy.

Our current project offers the occasion with which to revisit the results of the earlier analyses utilizing advanced methods and technologies, including multiband imaging, microscopic examination, Raman spectroscopy, micro XRD, and SEM-EDS. Our ongoing work has identified a more extensive range of minerals on the surface of the sarcophagus, including the widespread presence of the uncommon green copper arsenate lavendulan. Our presentation will further contextualize the results of our investigations within the expanding field of polychromy studies, alongside new discoveries of ancient sarcophagi on the island (Larnaca, Palaipafos), and underscore the significance of color for conveying cultural, social, and economic meaning in ancient art from Cyprus.

## *Investigating color on Archaic architecture: The Gigantomachy on the west pediment of the Temple of Apollo at Delphi*

***Giasemi Frantzi***<sup>(1)</sup>, Panayiotis Theoulakis<sup>(1)</sup>, Andreas Germanos Karydas<sup>(2)</sup>, Peter Vandenaabeele<sup>(3,4)</sup>, António Candéias<sup>(5,6)</sup>, Anastasia Rousaki<sup>(7)</sup>, Athanasia Psalti<sup>(8)</sup>, Eva Vermeersch<sup>(4)</sup>, Sara Valadas<sup>(5,6)</sup>, Nikoletta-Kanella Kladouri<sup>(2)</sup>, Kalliopi Tsampa<sup>(2)</sup>, and Harikleia Brekoulaki<sup>(9)</sup>

(1) Department of Conservation of Antiquities and Works of Art, University of West Attica, Ag. Spyridonos Str., 12243, Aegaeo, Greece

(2) Institute of Nuclear and Particle Physics, National Center for Science Research "Demokritos", Patr. Gregoriou E & 27 Neapoleos Str, 15341 Ag. Paraskevi, Greece

(3) Department of Archaeology, Ghent University, Campus Ufo, Ghent, Belgium

(4) Department of Chemistry, Ghent University, Campus Sterre, Ghent, Belgium

(5) HERCULES Laboratory, IN2PAST Laboratory (Associate Laboratory for Research and Innovation in Heritage, Arts, Sustainability and Territory, Institute for Advanced Studies and Research), University of Évora (Portugal)

(6) City University of Macau Chair in Sustainable Heritage, University of Évora (Portugal).

(7) Institute of Nanoscience and Nanotechnology, National Center for Science Research "Demokritos", Ag. Paraskevi, Athens, Greece

(8) Ephorate of Antiquities of Fokis, Delfi, 33054, Delfi, 33054, Delfi (Prefecture of Fokida)

(9) National Hellenic Research Foundation of Greece, Institute for Historical Research, 48 Vassileos Constantinou Ave., 11635 Athens, Greece

***Giasemi Frantzi***, corresponding author: [gfrantzi@uniwa.gr](mailto:gfrantzi@uniwa.gr)

The Gigantomachy of the West Pediment of the Late Archaic temple of Apollo at Delphi, represents an impressive work of early Greek architectural sculpture. Made of porous stone recovered with plaster and paint, the few figures that survive are distinguished by their material from those of the East pediment which are made of marble. The surviving fragments of the West pediment originally belonged to a standing male wearing a robe and animal skin, preserved only partially from the waist down, identified either as Apollo or Dionysos; a fighting female dressed in a chiton moving left, identified as Athena; and a nude male in a prone position and three-quarter view with extended leg in profile, most probably representing the serpent-footed giant Enkelados, also mentioned by the chorus of Euripides's *Ion* who describes this scene. The present study focuses on the documentation and analysis of the polychromy of this remarkable piece. On the plaster surface that covers the stone of the figures, the remnants of rich colorful decoration are preserved and detected using combined in-situ non-destructive analytical and imaging techniques. The results thus far obtained offer significant evidence for a more accurate evaluation of the nature and function of Archaic polychromy in Greek architecture, in its specific archaeological context. The non-invasive scientific research investigation of the West pediment's polychromy includes Macro X-ray fluorescence scanning (MA-XRF), mobile Raman spectroscopy, visible induced luminescence (VIL), and multi-spectral imaging techniques. The securely identified pigments include Egyptian blue, cinnabar, and ochre-based yellows. The research also involves the examination of natural blue and green copper-based pigments, ochre-based reds, and the white calcitic ground. A more extensive investigation of the Gigantomachy is likely to further enrich our knowledge of the chromatic gamut of Archaic artists and the application of polychromy on porous stone sculpture.

## ***The crafts of the women we have never learned: Evidence of colour on the Amazonomachy metopes***

**E. Aggelakopoulou**, The Acropolis Restoration Service, Hellenic Ministry of Culture; **C. Vasiliadis**, The Acropolis Museum; **G. Verri**, The Art Institute of Chicago

The metopes on the west side depict scenes of combat between Greeks and adversaries in oriental garment, identified as Amazons, a mythical tribe of all-female warriors. When the local Athenian hero, Theseus, abducted one of them, Antiope or Hippolyta, the Amazons invaded Attica, only to be defeated by the Athenians soon afterwards.

In 2012, four of the fourteen west metopes that decorate the NW (WMO-1, WMO-2) and SW corner (WMO-13, WMO-14) that preserve the most of sculptural decoration were removed from the monument. The removal occurred in order to protect them from the environment and they are now exhibited in the Acropolis Museum. A systematic conservation and restoration program began upon their arrival at the Acropolis Museum. This conservation program included documentation, removal of material from previous interventions, surface stabilization and the cleaning of loose deposits and black crusts by means of laser technology, implemented in collaboration with the Institute of Electronic Structure and Laser (IESL) of the Foundation of Research and Technology-Hellas (FORTH) in Crete.

Although the four west corner metopes have suffered damage and deterioration, they still retain traces of the original paint layers including green on the Amazon's mantle of NW (WMO-1) and traces of blue on the quiver of the fourteenth west metope. In the present study, these metopes are investigated by means of imaging (raking light, portable digital microscopy and visible induced luminescence) and non-invasive analytical techniques (X-ray fluorescence and fiber optics reflectance spectroscopy) that provide valuable results regarding the paint layers' characterization and the metopes' final aesthetic appearance.

## ***A skillfully woven apparel: investigations on the polychromy of a 4<sup>th</sup> C. BCE votive relief of Apollo and a worshipper***

**Giovanni Verri**, Art Institute of Chicago; **Maria Stamatopoulou**, University of Oxford; **Anthi Batziou**, Athanasakeion Archaeological Museum of Volos

In 1973, a group of architectural members, three sculptures of children, an inscribed base, and a votive relief were unearthed in the *pronaos* (east porch) of a temple at the site of Soros, near Volos in Magnesia, Greece. The findings from the excavation are now housed in the Athanasakeion Archaeological Museum of Volos. As published in 2006 by Iphigeneia Leventi, the group originally belonged to a sanctuary, likely, albeit unusually, dedicated to *kourotrophic* Apollo (protector of children), as deduced from an inscription found at the site.

Among the sculptures of the group and dated to the first or second quarter of the 4<sup>th</sup> C. BCE, a votive relief (Λ782), depicting Apollo and a woman, stands out for its refined carving and iconography. The woman, likely representing a mortal, based on her smaller scale, is shown with raised forearms. She wears a peplos and closed shoes. The beardless god reaches to his head, or crown, with the right hand, while his left hand is shown empty and relaxed at his side. He wears sandals and a voluminous himation, which covers his left shoulder and the lower section of his body.

Visible-induced luminescence imaging revealed the use of Egyptian blue, the presence of which was confirmed with fiber optic reflectance spectroscopy, for the background of the composition. In addition, the pigment was found in the shoes of the female worshipper and, notably, in elaborate floral decorative bands of the himation of Apollo. This type of highly complex decoration for the representation of garments worn by deities has parallels in other media, such as vase painting. It also serves as a link with illustrious precedents, including the Parthenon sculptures, attesting to a continuing tradition of luxurious textiles, the evidence for which is referred to in textual sources.

## ***The Bochum Treasure Chest of Ancient Polychromy and Paintings***

**Clarissa Blume-Jung**, University of Bochum, Germany

Painted stelae from Athens, Demetrias and Vergina, Paintings on marble from Herculaneum, wall paintings from Macedonian Tombs and Pompeii, sculptures with polychrome remains from Delos, Athens, Istanbul or painted friezes and metopes – old and therefore valuable documentation of these and many more key examples of ancient painting and polychromy is preserved in the so-called Bochum Painting Archive.

The archive of the Institute of Archaeological Sciences of the University of Bochum houses the photographic material of the research campaigns carried out by the pioneer of polychromy-studies: Prof. Volkmar von Graeve and his team from the 1960s onwards. It mainly consists of ektachromes and slides documenting the state of preservation of the polychrome coating or painting of the individual pieces at that time. Moreover, it comprises numerous redrawings of the paintings on grave stelae and marble slabs. On top, each piece studied has a file of written documentation of these research campaigns. In my presentation, I will show the range of pieces and its professional documentation in images and drawings in a state of preservation of the last century. The Bochum painting archive is like a treasure chest we have to know of when studying ancient polychromy.

## ***The polychromy of epigraphy: pigment analysis within a multi-disciplinary study of the epigraphy of Ancient Sicily***

**A. Coccato**, University of Oxford; **G. Barone**, University of Catania, Italy; **P. Mazzoleni**, University of Catania, Italy; **J. Prag**, University of Oxford

In the light of past and current archaeometrical research, it appears that epigraphic documents have generally been omitted from ancient materials characterization, and particularly the field of polychromy. The bivalent nature of inscriptions as objects and texts is commonly resolved in favour of the latter; and despite increased attention to the material form and context of inscriptions the use of colour on inscribed texts ('rubrication') is largely unstudied. Moreover, the practice of making squeezes has negatively affected the preservation of polychromy traces, either removed in the cleaning process or transferred to the paper fibres. The characterization of what is left of the original pigments in inscriptions is sporadic and unsystematic, yet it offers important evidence for understanding ancient practices and the interpretation of epigraphic culture.

Within the interdisciplinary project "Crossreads: Text, materiality, and multiculturalism at the crossroads of the ancient Mediterranean" (<https://crossreads.web.ox.ac.uk/>), a full work package is dedicated to materiality, alongside palaeography and linguistics, for the study of the epigraphic culture of ancient Sicily (c. 5000 inscriptions). Important results are being obtained on applied polychromy through a multi-analytical approach that includes both non-invasive methods with portable instruments (X-ray fluorescence, Raman spectroscopy, digital microscopy using visible, infrared, and ultraviolet illumination) and minimally invasive ones, i.e. micro-Raman spectroscopy of Q-tip samples of the pigments.

The most widely used colour in Greco-Roman epigraphy appears to be red, followed by blue and others, seemingly corresponding to the ancient palette used in sculpture and architecture. Pliny suggests the use of expensive *minium* (the mineral cinnabar) for painting letters, on walls, tombs and monuments. However, its occurrence is exceptional and related to specific contexts. The other reds used in antiquity (ochres and red lead) are also identified, sometimes mixed with other pigments, alongside metallic leaves and inlays.

Within the Crossreads project, detailed knowledge of the pigments used in epigraphy complements the ongoing characterization of the stone supports (including marble provenance), which will provide the first systematic account of the material aspects of epigraphic culture. Moreover, innovative approaches based on machine-readable information will allow further exploration of the dataset, which includes (besides the materials data) chronology, place, object type, inscription type, execution, language, palaeographic annotations and linguistic data.

By undertaking the first systematic archaeometric study of pigment use in epigraphic texts we hope to integrate epigraphic study into the wider field of ancient polychromy, while initiating a new line of inquiry within the study of epigraphic culture.

## ***Toga and paludamentum: research on polychromy and meaning of a group of statues from Formia (southern Latium)***

**Paolo Liverani**, University of Florence and Italian National Council of Research, Institute of Heritage Science (ISPC-CNR); **Giovanni Bartolozzi**, Italian National Council of Research, Institute of Applied Physics (IFAC-CNR); **Roberta Iannaccone**, Italian National Council of Research, Institute of Heritage Science (ISPC-CNR); **Sara Lenzi**, University of Pisa; **Donata Magrini**, Italian National Council of Research, Institute of Heritage Science (ISPC-CNR); **Elisabetta Neri**, University of Florence

In the city of Formia (southern coastal Latium, in the province of Latina) archaeological excavations in the 1920s in the Sarreca Garden directed by Salvatore Aurigemma near today's piazza Mattei brought to light extensive Roman structures and a group of sculptures in good condition from the 1<sup>st</sup> century AD. Among these are two togati and two male statues in heroic nudity (Hüftmantel and Schulterbausch type respectively) that retain important traces of colour. All four are preserved in the local National Museum but are only known from partial publications or preliminary reports.

The togate inv. Nr. 88483 is the one with the best-preserved traces of polychromy: the red colour of the toga is very evident, but it has traces of skin colour on the left cheek, as well as both eyes well outlined with pupils, irises, eyelashes and eyebrows. The other statues also offer interesting traces of ochre, of an organic red pigment and – to a small extent – of Egyptian blue.

The paper provides an overview of the group and analyses the traces of colour on them using non-invasive techniques.

A topic of particular interest concerns the relationship between the colour of the clothing and the status of the portrayed figures. On this basis it seems to be excluded that they are members of the local nobility, rather they should be recognised as Roman magistrates.

The red cloak is the *paludamentum*, the hallmark of Roman generals and their military authority (*imperium*), while the colour of the toga requires more in-depth discussion. It cannot be a triumphal toga, as triumph in the 1<sup>st</sup> century is reserved for the emperor. A careful analysis of the sources suggests that the togati may be figures of consular rank, since these magistrates could on particular occasions wear a toga of this colour.



## ***Illusion and allusion: the polychromy of Roman architecture in north-western Italy***

**Furio Sacchi, Sara Lenzi, Luca Polidoro, Università Cattolica del Sacro Cuore, Milan, Italy**

The aim of this paper is to present some preliminary results of a new project, “Illusion and allusion. Rediscovering colours in Roman and early Medieval architecture”, which constitutes pilot research on the constituent characteristics of the ‘skin’ of Roman and early Medieval buildings in northwestern Italy: the original colour and treatment of masonry surfaces and structural/decorative components are a key part of fragile, crumbling architecture of which only fleeting traces often remain. The study of the architectural complex as a whole (traces of polychromy on elements of architectural decoration/structures in particular) is crucial for reconstructing the original appearance of architectural heritage and understanding how it was perceived in its era, an immaterial aspect that should not be ignored in the investigation of the past. The focus is therefore colour, both that of the material itself but especially the colour applied to surfaces with various techniques, which conditions the interpretation of decorative and structural details, generating phenomena of illusion and allusion, the significance of which changes over time. This paper presents some new, unpublished data about traces of colour and gilding on Roman architectural decorations from Milan (*Mediolanum*), Tortona (*Dertona*), Serravalle Scrivia (*Libarna*), Ivrea (*Eporedia*), Novara (*Novaria*), Pavia (*Ticinum*), Cremona (*Cremonium*), thus deepening the knowledge about original polychromy of capitals, frames and other architectural elements inside ancient buildings.

## ***The Venus de Clercq: Polychromy, Provenance, and Cultural Context***

**Mark B. Abbe**, University of Georgia; **Marie Svoboda**, J. Paul Getty Museum; **Monica Ganio**, Joy Mazurek, Getty Conservation Institute

The Venus de Clercq (72.AA.93) in the collections of the J. Paul Getty Villa is a remarkably well-preserved marble statue from the Roman period representing the famous nude Aphrodite of Knidos at her bath. The meter tall sculpture is conventionally named after its late 19th century owner, Louis de Clercq, the French archaeological photographer and art collector active in the Middle East. This presentation describes multidisciplinary investigations of ancient polychromy and gilding recently discovered on the surface of the statue. The historic provenance and marble carving technique of the sculpture suggest it is closely associated with a larger group of similar marble statues, now in the Louvre, reported to originate from the so-called "Mithraeum" at Sidon discovered around the 1880s.

Multiband imaging, microscopic examination, and scientific analyses (XRF, FORS, GC/MS, FT-IR) have revealed traces of ancient pigments over large areas of the statue. These include two shades of red, pink, yellow, and blue on the garment, yellow on the goddess' hair, pink and gold leaf on her tainia, and yellow on her bathing hydria. An unexpected discovery of pigment, not visible to the naked eye and only detected by visible-induced luminescence imaging and digital microscopy, suggests a jewelry necklace was represented on the upper chest of the statue. The limited evidence in this area allows for different possible interpretations, but this jewelry adds to our understanding of the sculpture's once elaborate decoration, which originally also included added metal earrings and inlaid eyes.

A new cultural understanding of the Venus de Clercq and its once sumptuous material appearance may be proposed in the context of Roman Syria, and specifically Sidon. This iconic representation was arguably viewed by its intended audiences as much more than an expertly finished marble replica of one of the most celebrated and widely reproduced works of historical Greek sculpture. The goddess and her elaborate bejeweled polychromy likely would have been seen by contemporaries as an assertion of local identity and cultural difference within the cosmopolitan language (*koine*) of the period.

## ***Colours revealed – New results of the PolychroMon project on Roman monuments from the Danubian provinces***

**Gabrielle Kremer**, Austrian Archaeological Institute, Austrian Academy of Sciences; **Robert Krickl**, Austrian Archaeological Institute, Austrian Academy of Sciences; **Robert Linke**, Federal Monuments Authority Austria; **Georg Plattner**, Kunsthistorisches Museum Wien; **Eduard Pollhammer**, State collections of Lower Austria; **Nirvana Silnović**, Austrian Archaeological Institute, Austrian Academy of Sciences; **Stephanie Stoss**, Kunsthistorisches Museum Wien

The ongoing interdisciplinary project on polychromy of Roman stone monuments from the Danubian provinces, financed by Heritage Science Austria, Austrian Academy of Sciences, has yielded new results, which will be presented using several outstanding examples of sculpture and architecture. The focus is on the materiality of the pigments, binders and primers used and on the possibilities of interpreting the existing colour residues in their object-related and archaeological context. The use of different non-invasive and traditional analytical methods will be presented. The possibilities of visualisation and the implementation of the results obtained in the museum and monument conservation environment will be discussed.

A separate study as part of the project was on objects of the Mithras cult and the significance of colour in a religious and ritual context. The results of the investigations, which included around eighty monuments, will be presented, concentrating on the paramount questions of whether a specific colour code can be distinguished and on the related issue of colour symbolism.

The PolychroMon project represents the first systematic study of the polychromy of Roman monuments in the north-west and central European provinces. The aim is to create a basis for comparative analyses that allow statements to be made about artistic and economic networks in this area of the ancient world.

## ***Unveiling Ancient Polychromy in Pannonian Sarcophagi***

**Eliana Siotto**, Italian National Research Council - Institute of Information Science and Technologies “Alessandro Faedo” (CNR – ISTI); **Jasmina Davidovic**, Museum of Srem, Serbia; **Bojan Djurić**, University of Ljubljana, Slovenia

In the course of investigating the stone provenance and workshop origin of Roman sepulchral monuments in Pannonia, our attention was drawn to the presence of various traces of ancient color. Specifically, remnants of ancient polychromy have been identified on sarcophagi discovered in and around Sremska Mitrovica, now housed in various European museums. Produced in the 3rd century AD, during the zenith of Roman Sirmium, these sarcophagi hold fundamental significance in multiple aspects.

Made from all the materials we have identified in Pannonia (Alpine marble, travertine, Neogene limestone and volcanic rock), their sources are well documented. Significantly, these artifacts were made in known locations and finished by local artisans. Meticulous examination of the preserved traces of color within this defined group of sarcophagi provides a unique opportunity to deepen our understanding of this crucial production. This study promises to know the materials, techniques and pictorial styles adopted, as well as insights into the artists' intentions, shedding light on the aesthetics, symbolism and cultural values of ancient Sirmium.

Furthermore, a comparative analysis of the marble sarcophagi with polychrome evidence made in Rome from the beginning of the 2nd century to the end of the 4th century AD aims to reveal the affinities and disparities between these two pivotal production centers. This comprehensive approach contributes to the broader narrative of Roman sepulchral art, clarifying connections and distinctions that enhance our understanding of the cultural and artistic landscape of both Sirmium and Rome during this historical period.

## ***The Afterlife of Ancient Polychromy***

**Hariclia Brecoulaki**, National Hellenic Research Foundation, Athens

The 'afterlife' of ancient polychromy, experienced through our senses and our scientific tools, embodies a significant disjunction in the relationship between its materiality and its meaning, between the legacy of color in Antiquity and the scarce physical evidence in existence today. For all those who have decided to delve into the fragmentary, albeit fascinating, universe of polychromy in ancient Greece and Rome, over these past decades, a fundamental question persists: how much of our modern perception is produced by historical evidence, and how much by the cultural imagination of the present?

The 'natural history' of ancient color may be traced through the science of paint layers and grains, allowing us to collect robust scientific data through state-of-the-art methods of investigation. It is a micro-archaeological approach to the surface, an exploration of the artistic micro-context. Through the testimony of grains, we restore the intention of an erased pictorial touch; we recapture the imprint of a lost technique; we rediscover a rare pigment. Science allows us to consolidate certain answers, to verify a series of hypotheses through analyses, to give an 'objective' opinion on what could have been possible or not. But what happens with the larger image, once we take our eyes off the magnifying lenses of a microscope? The boundaries between current documentary evidence and previous reality remain blurred, the intangible assets of aesthetics and meaning stimulate the imagination, generate decisions and debate.

Does a trace of gold leaf on the famous copy of the Diadumenos by Polykleitos attest that the effigy was originally entirely gilded? Does a touch of lead white on the edge of a fold of the cloak of a small golden Aphrodite reflect the intention of the ancient painter to create a sense of 'light'? Are a few grains of Egyptian blue enough to reconstitute the tone, the original value of a pictorial layer? It is an oscillation between the objectivity of the autopsy and the subjectivity of a hypothesis; between the reliability of scientific data and the uncertainty of the previous reality of a surviving surface.

How can we project the future of ancient polychromy, free of censure and misconception today? To what extent do patinas, fragmentation, damage, and ambiguity constitute part of what we refer to as *heritage*? Is 'afterlife' meaning? To what extent does our vision of the lost polychromy legitimate its recreation through sophisticated tools of investigation and artificial intelligence, which allow us to dissimulate damage and loss in order to recover the lost narrative, to consolidate the new 'myth' of Polychrome Antiquity?

## ***Sculpting the Invisible: Bridging Art and Science through 3D Chemical Imaging of Polychrome Sculptures***

Roxanne Radpour, University of Delaware; Zelin Deng, University of California Los Angeles; Moupi Mukhopadhyay, UCLA/Getty Conservation Program, University of California Los Angeles; Doug Daniels, University of California Los Angeles; **Ioanna Kakoulli**, University of California Los Angeles

This paper presents a groundbreaking approach in the field of art conservation for documentation and analysis, focusing on the integration of 3D modeling techniques with visible to near infrared (400-1000 nm) hyperspectral data to map artist materials on polychrome sculptures. Our methodology not only charts a new course in understanding the intricate techniques and materials used by artists but also significantly enhances the workflow of documentation for assessments.

At the core of our approach lies the innovative integration of hyperspectral data into 3D reconstructions. This technique allows for a more detailed and accurate mapping of the artist's materials, revealing insights that were previously inaccessible through conventional methods. The 3D models generated offer a comprehensive view of the sculpture, encompassing both the visible information and chemical composition of the materials used. This dual perspective is crucial in understanding the artistic techniques and in planning conservation strategies. By combining detailed 3D modeling with hyperspectral imaging, this integration also allows for a nuanced analysis of the sculpture's condition, considering both its physical and chemical properties, which is vital in making informed conservation intervention decisions.

A significant advantage of our approach is the improved accessibility it offers. The 3D models, enriched with hyperspectral data, serve as an invaluable tool for education, outreach, and exhibitions. They allow viewers to engage with the artwork in a more interactive and informative way, bridging the gap between expert knowledge and public understanding.

Moreover, this enhanced 3D mapping serves as a foundation for developing novel AI models for polychromy. By feeding comprehensive visual and chemical data into machine learning algorithms, we can predict degradation patterns, suggest optimal conservation methods, and even recreate lost or eroded sections of sculptures in a virtual environment. Additionally, AI can assist in deciphering the technical aspects of an artist's style, particularly in identifying the types and combinations of pigment mixtures. The integration of AI with 3D chemical mapping not only aids in conservation, but also but also enhances our knowledge of historical art production methods.

## ***Letting the Light In: A Comparative Assessment of Visible Bandpass Filters Used in Multiband Imaging for Art Conservation***

**William Mastandrea**, Katherine McFarlin, Chris Heins, Ameya Grant, Rachel Greenberg, Anna Serotta, & Dawn Kriss, The Metropolitan Museum of Art

Multiband imaging (MBI) has proven to be an effective, non-destructive method for investigating and differentiating the materials which constitute an art object, especially so for polychrome artworks. First published a decade ago as part of the EU-funded Cultural Heritage Advanced Research Infrastructures: Synergy for a Multidisciplinary Approach to Conservation/Restoration (CHARISMA) project, *Multispectral Imaging in Reflectance and Photo-induced Luminescence modes: A User Manual*, recommended UV/IR blocking filters like the IDAS-UIBAR bandpass filter for use in visible (VIS) and ultraviolet luminescence (UVL) imaging. Favored for its steep wavelength cutoffs at circa 380nm and 700nm, this filter has become widely adapted for MBI applications in the context of art conservation. Recently, however, the manufacturer has ceased mass-production of the IDAS-UIBAR filter in the necessary size required for image capture. While custom orders from IDAS are possible, the exceedingly high-cost bars even the largest and most well-funded institutions from pursuing this option. With this important tool no longer accessible, there is a need in the heritage imaging field for a suitably equivalent and cost-effective visible bandpass filter for these applications.

This paper will endeavor to review the performance and cost of the IDAS-UIBAR filter in comparison to five other visible bandpass filters currently utilized for MBI capture: the MidOpt SP700, MidOpt BP550, Peca #918, X-Nite CC1, and the Kolari Vision UV/IR Cut Hot Mirror Pro 2 (including combinations thereof with the Kodak Wratten 2E Pale Yellow). Evaluations and a case study of a Roman Egyptian cartonnage fragment will be presented along with suggestions and discussion around suitable filters/combinations. VIS and UVL images will be taken within a blackout environment to mitigate unwanted visible light bleed using scene-referred color calibration to establish standardized visual comparability between filters. Calibration will utilize the X-Rite ColorChecker Digital SG and the ISA FADGI 19264 charts for VIS imaging and a UV Innovations Target-UV for UVL imaging. A Labsphere Spectralon Diffuse Reflectance Standard (99%) will be used to assess the degree of deviation from the values produced by the IDAS-UIBAR imaging. Potential replacement filters will be assessed using these standards, along with visual comparisons of the resulting images, and comparisons of the respective wavelength cutoffs within each of the filter transmission curves.

## ***Unmixing Polychromatic Art: A Statistical Approach to Mapping Pigment Mixtures***

**Mari Kelley, Jeffrey T. Pietras, Hilary Becker, Tyler Rust, Binghamton University**

Which pigments were used and mixed by an artisan? Was there more than one artist sourcing different pigments for the same color? Which pigments were used for restorations? Increasingly, conservators, historians, scientists, and archaeologists are using X-ray fluorescence (XRF) spectroscopy to map the distribution of elements, a proxy for pigment type, on art and archaeological artifacts, making it possible to better understand the state of an artwork and how it came to be created. Knowledge of elemental composition provides an opportunity to determine which pigments were used and allows for the investigation of pigment provenance, forgery, and previous restorations among other topics. Beyond simply determining if cinnabar (mercury sulfide) or red ochre (iron) was used as a red pigment, minor and trace element chemistry can provide a diagnostic fingerprint to differentiate pigments within a family, like red ochres sourced from different sites.

In this study we test the feasibility of a multivariate factor analysis approach called positive matrix factorization (PMF) to statistically unmix a large XRF-based elemental dataset into unique factors from a painting made with known endmember pigments. PMF modeling provides a fingerprint and relative abundance of statistically significant factors from large datasets. Eight natural pigments were acquired and characterized by X-ray diffraction to determine their mineralogy and XRF spectroscopy. They were mixed at known weight percentages yielding 112 mixtures. Finally, a painting was created using the eight endmember pigments. Elemental concentration data was collected for the known mixtures and from a 2,000-point grid on the painting using a Bruker Tracer III-SD pXRF spectrometer with a resolution of 3 mm by 3 mm. All three datasets were combined and analyzed using *EPA PMF v.5.0*. Preliminary results indicate that; 1) elemental ratios of known two-pigment mixtures lie on mixing lines between their endmember pigments, 2) elemental maps correlate to the distribution of pigments on the painting, 3) PMF-based factor contributions also correlate spatially with pigments on the painting, and 4) some factor fingerprints match well to know end member pigments while others appear to correlate to minerals common to more than one pigment.

Understanding pigment mixtures is a key element in the future of art restoration and conservation. A technique to statistically unmix historical paints with a non-invasive approach is an important step forward in the scientific study of pigments.



## ***Possible Sequential Laboratory Procedure for Greco-Roman Statuary Polychromy Research Utilizing Lab-generated Samples***

**Harley Boyan**, Independent Scholar

Chemical analysis of modern samples created from ancient paint recipes creates a data set to identify polychromy signatures, without violating ancient pieces. This study tested the applicability of lab-generated polychromy samples created from ancient sources to develop reliable reference data to supplement a sequential laboratory procedure for studying statuary. Using Egyptian Blue ( $\text{CaCuSi}_4\text{O}_{10}$ ) in different paint mixtures the first two steps in the proposed methodology were assessed. Fourier transform infrared spectroscopy (FT-IR) and proton nuclear magnetic resonance ( $^1\text{H}$  NMR) analysis were performed on all samples. FT-IR proved to be accurate at identifying both organic and inorganic components.  $^1\text{H}$  NMR produced an unexpected result that led to the conclusion that carbon thirteen NMR could be a better method for paint suspected to be made with long chain carbon binding agents like wax. The reproducible nature of the samples generated valuable reference data. Based on the data gained from the experiment, this kind of reference producing research supports a standardized sequential laboratory procedure and lends scientific legitimacy to polychromy reconstructions while protecting cultural heritage statuary.

***Technical Imaging and comparative research on Canosan polychrome pottery:  
the case study of a Pyxis in the J. Paul Getty Museum***

**Eleonora Piccirillo**, Conservator of Cultural Heritage, Italy; **Claire Lyons**, J. Paul Getty Museum; **Monica Ganio**, Getty Conservation Institute

The 3rd century BCE lidded Canosan pyxis with dove-shaped feet in the J. Paul Getty Museum collection is a rare example of a medium-sized funerary ceramic decorated with a polychrome figurative frieze. A comprehensive technical study conducted between 2022 and 2023 aimed to visualize the decorative scheme, understand the pigments used for its decoration, and to identify prior treatments. The scientific analysis of the cold painted slip involved the use of multiband imaging (UVF, IRR, UVR, VIL, FCIR), X-ray fluorescence (XRF) spectroscopy, and Raman spectroscopy on a representative number of samples. The results confirm the chromatic 'palette' used by Hellenistic Canosan artists, as determined from scientific literature that aggregates multiple case studies. This palette includes Egyptian blue, calcite for white, manganese black, an organic purple, and iron oxides for red. Additionally, it reveals an unexpected use of cinnabar. The investigation opened questions that resulted in an extensive search for comparanda of Canosan pyxides within the collections of European and Northern American museums. The decoration on the dome-shaped lid, which is significantly deteriorated, spans three registers, each separated by a ledge. Positioned at the center of the dome is a conical-shaped knob, featuring a molded relief of a gorgoneion. Interpreting the results from our scientific analyses and the comparative study allowed us to better understand the possible patterns once adorning the lid. From the outer edge to the inside, it was presumably decorated with a red and purple band, a band of blue rosettes, and a band of blue crossed squares. A rollout image of the pyxis provided the entire decorative scene painted on the box's circumference. The preserved decoration consists of, from the bottom towards the top, a band with red cross-hatched pattern, followed by a figurative frieze with three blue-winged dancing erotes and a double-flute player. Enhancement of selected details on the painted slip using D-Stretch, a post-processing digital technique, revealed illegible decorative designs supporting the hypothesis of a previous and different decoration layer below the figurative frieze. Although the surface of the pyxis was in poor condition, flaking and powdering, the technical study revealed a rich amount of information that may aid in the evaluation of other objects of the same genre.

## ***On pigments and their mixtures for the depiction of textiles in ancient paintings***

**Giovanni Verri, Ken Sutherland, Katharine Raff, Art Institute of Chicago**

Since the advent of digital technical imaging in the X-ray, ultraviolet and infrared ranges—alongside the increasing sophistication of microanalytical techniques—more and more evidence for elaborate painting techniques used in antiquity has emerged. This includes complex and targeted mixtures of pigments to achieve different hues and transparencies, and the use of particular painting materials for specific purposes. For example, thus far Egyptian blue – in addition to its obvious use for blue-colored elements - has been found in the representation of shadows in textiles, in skin tones and in the whites of the eyes. This unprecedented level of technical insights into paint composition and application technique allows for a more informed interpretation of primary textual sources. In addition, thorough investigations of well-preserved painted surfaces enhance our understanding of examples on which scant original material survives.

The Art Institute of Chicago holds in its collection a 2<sup>nd</sup> century CE funerary portrait of a man wearing a laurel wreath (1922.4799). Created in Egypt during the Roman imperial period, portraits of this type reflect a syncretic combination of Egyptian, Greek and Roman traditions. The painting was investigated using broad-band and hyperspectral imaging, macro-X-ray, Raman and Fourier transform infrared spectroscopy, and pyrolysis gas chromatography mass spectrometry. This presentation will discuss the painting materials used in its creation, as well as the techniques employed to apply them, with a particular focus on the representation of textiles. While drawing further comparisons with ancient paintings from antiquity, it will attempt to interpret the scientific evidence within the wider context of primary sources.

## ***The Painter of the Ladies in Blue: polychromy as a tool for attribution***

**Brigitte Bourgeois**, Yannick Vandenberghe, Centre de Recherche et de Restauration des Musées de France; Violaine Jeammet, Louvre Museum

The scientific study of polychromy can provide important evidence for the attribution of a work of art to a regional production, a workshop or even in some cases to a painter's hand, when set up within a larger context and combined with archaeological and art historical data. Our contribution intends to briefly present such a methodological approach with the case-study of an exceptional group of five Tanagra-style terracotta figurines, the so-called "Ladies in Blue", that were dug out in the late 19<sup>th</sup> century from a single tomb in the Schimatari necropolis (Boeotia). This group, dated to the years 330-300 BC. and probably ordered by a riche customer of the city of Tanagra, has a particularly refined polychromy. Its chromatic scheme which combines painting (with Egyptian blue and madder) and an unusual large use of gilding for the ornamentation of the sumptuous mantle, remains unique so far.

In possession already of one of the statuettes, acquired in 1876, the Louvre Museum has just bought another element of the group from the heirs of a Parisian art dealer, Ernest Le Vée (1874-1951). The newly acquired figurine is in many aspects the twin sister of the famous "Lady in Blue" that was part of the Tanagra exhibitions in 2003 (Paris) and 2010 (Valencia, Spain). Since the time of the shows, our knowledge of the elaborate techniques of painting and gilding on ancient Greek terracotta figurines has vastly expanded due to the development of international scientific studies and research projects. Among them, the investigation carried out within the framework of the Pilina program (Louvre-C2RMF-French School of Athens), soon to be published, allows us to better set in context the results of the scientific studies performed on the two "Ladies in Blue" (technical imaging, non-invasive analyses (FORS, XRD, Raman) and SEM-EDS analysis). The similarities between the two statuettes in the selection of the color materials and elaborate painting and gilding *techné* hint at the work of a talented artist.

## *Investigating the presence of orpiment on a Tanagra-type figure*

Ella Andrews, Ruth Allen, Renée Stein, Michael C. Carlos Museum, Emory University; Flavia Fiorillo, The Fitzwilliam Museum, University of Cambridge; **Tyler Holman**, Emory University

Hellenistic terracotta figurines, conventionally known as Tanagra figurines, have been appreciated, collected, and studied since the 19th century. Although named after the site of Tanagra in Greece, where they were first discovered in significant numbers, “Tanagra style” figurines were produced across the ancient Mediterranean world and were used for a variety of purposes, including as votive offerings—and grave goods. The figurines were made in molds using local clay. Heads were sometimes made separately, with hairstyles, jewelry, and accoutrements such as fans or mirrors added in varied combinations. The figurines were then brightly painted, often with delicately detailed facial features. The Michael C. Carlos Museum at Emory University acquired an example of this type of figurine in 1986 from the New York art market. This figurine is of a standard type, depicting a standing, draped female replicating a Classical Greek sculptural prototype known as the Large Herculaneum Woman. Without archaeological provenance or detailed collection history, identifying a place of production or use on stylistic grounds alone is difficult because the diffusion of molds and figurines was widespread. This study attempts to recover a place of manufacture based on analyses of the polychromy and clay. The remaining paint was investigated using x-ray fluorescence spectroscopy, polarized light microscopy, and multispectral imaging, including visible induced infrared luminescence and reflected ultraviolet. Analyses revealed the presence of Egyptian blue and orpiment. Extensively used in ancient Egypt, orpiment has not otherwise been documented on Tanagra figurines that have been scientifically studied, most of which come from Greece or Asia Minor. The presence of Egyptian blue and orpiment suggests that this figurine comes from Egypt. Mineral characterization and sourcing of the clay may corroborate this hypothesis, as will comparison of both polychromy and clay analyses from excavated examples.

## ***Defining Vestorian blue, made from the finest part of Egyptian blue***

**Hilary Becker**, Binghamton University; Gregory D. Smith, Indianapolis Museum of Art

An ancient Roman wall painting with a blue sky tells little of the range of colorant choices from which a Roman artist potentially could choose. Gradients of Egyptian blue were available in a good commercial market. This range is made clear by two sources, Pliny the Elder's *Natural History* (late 1<sup>st</sup> c. A.D.) and Diocletian's *Maximum Edict of Prices* (301 A.D.), both of which indicated that there more than one kind of Egyptian blue existed, each at a different price point. This study seeks to define the three Egyptian blues discussed by Pliny, exploring in particular what feature(s) might have differentiated the most expensive variety, known as Vestorian blue, from the other Egyptian blues. A tripartite study was undertaken to explore the differences in Roman Egyptian blues. First, a careful exploration of Pliny the Elder's text is fruitful. Then, the scientific analysis of archaeological examples of raw Egyptian blue has been surveyed in order to explore what variables in manufacturing techniques or ingredients might set these blues apart. Finally, the information gleaned from the literary and archaeochemical study were tested by manufacturing modern examples of Egyptian blue. These manufactured samples were then evaluated for their suitability for painting and measured archaeometrically in order to understand their properties. Such a study makes it possible to better understand the knowledge of materials that Egyptian blue artisans had in mind when making materials.

## ***Provenancing Egyptian blue by isotope analysis: Case studies from Egypt and Lebanon***

**Alexandra Rodler-Rørbo**, Austrian Archaeological Institute, Austrian Academy of Sciences;  
**Cecilie Brøns**, Ny Carlsberg Glyptotek; **Gilberto Artioli**, University of Padua

Pigment provenance research is a new and promising direction in archaeological sciences that has recently been applied for elucidating trade in antiquity. People processed various materials to use them as colorants and ancient texts emphasize that material quality and provenance mattered. This study explores the provenance of the copper used to produce the Egyptian blue from two painted artifacts from two ancient cultures: One is a fragment of an architectural relief from the so-called Palace of Apries in Memphis, Egypt, which dates to the 6th century BCE. The other is a marble sarcophagus from Sidon, Lebanon, dating to the 5th century BCE.

There are currently no known production centers of Egyptian blue in Egypt, or elsewhere from this period. In fact, only a few production centers of Egyptian blue are known from the archaeological record and most of this evidence belongs to the period around the 1st century BCE (Memphis, Egypt; Kos, Greece; Bay of Naples, Italy). The lack of evidence for production is surprising, considering the extensive use of this specific pigment from the 3rd millennium BCE onwards. Although overlaps in the use of resources and production technologies argue for shared trade networks with other commodities such as glass, little is currently known about the trade in materials used for Egyptian blue production.

Previous studies have indicated that Aegean copper might have been used at the 1st century BCE Egyptian blue production hub in Memphis, indicating it was part of a long-distance trade network. The current study investigates Egyptian blue from Memphis and Sidon, thus extending to the 5th and 6<sup>th</sup> century BCE in an attempt to start filling this gap in our knowledge. The Pb-isotope results suggest that copper from Timna and Feynan (sarcophagus from Sidon) and from the Arabian Shield (relief from Memphis) was used in the production. This indicates a possible local production near Sidon as well as a change in raw material supply between the 6th and 1st century BCE for the Egyptian blue used in Memphis. Mineralogical-petrographic and geochemical analyses can therefore help evaluating material provenance to contribute to our understanding of (changes in) trade in pigments and/or raw materials used for their production as well as the organization of trade networks.

## ***Preliminary Report on the Polychromy of the Hermes in Olympia and New Considerations on Gilding and Purple***

**Jakob Salzmann**, Goethe-Universität, Frankfurt Liebieghaus Skulpturensammlung

My doctoral thesis project at the Goethe University in Frankfurt, supported by the Liebieghaus Skulpturensammlung and its Polychromy Research Project, on the “Use and significance of precious metals in the context of ancient sculpture polychromy from the Archaic period into the beginnings of the Roman Empire” pursues multiple aspects. To achieve the main goal, it is necessary to do research for traces of gilding by studying the originals. At the Getty round table, I would like to present one of these recent studies. Both in 2023 and this year, I have been able to examine various objects in several museums and depots that show traces of gilding. These sites include Olympia, Thessaloniki, Athens and Corinth, as well as Rome. It seems that the statue of Hermes with the Infant Dionysus in Olympia is of particular interest. At the end of the 19th century, the German archaeologist Georg Treu reported traces of paint and the remains of gilding on the sandal straps. Half a century later, Carpenter claimed that the hair had been gilded on the basis of red, because he believed the red to be the ground layer. Both reports aroused curiosity and called for an investigation, but they also opened up the idea of studying old documents referring to traces of polychromy. In November 2022 I was able to examine the statue in detail together with Vinzenz Brinkmann and Ulrike Koch-Brinkmann. We found many traces of color. I will be back in Olympia this year to consolidate the results and would like to present those in the form of a preliminary report at the Getty. A second aspect I would like to stress, which is not all new but has presumably not been sufficiently researched, is the connection between gold and a purplish tinted marble surface. The essay by Heinrich Piening from 2013<sup>1</sup> is one of the first decisive scientific approaches. The study is based on two examples in which he is able to prove that a decay product of gold could look like a purple color. It becomes more and more clear how helpful this insight is for my research. For as soon as you look through the collections and storerooms investigating remnants of polychromy you gradually establish a set of clues which you should pay attention to. One of those clues is that certain shade of purple, which is easy to recognize provided you are familiar with it. And the more objects I was able to investigate, the more often I came across this purple color. So how do you deal with purple stains on statues? What scientific information do you need to associate these purple spots with gold? A question I would like to discuss is if a purplish colored spot on marble can be enough of a clue to identify former gilding. Furthermore, I would like to show how this decay product of gold behaves on the marble, how gold can still be detected in some cases even when the gold itself is totally lost, and what this implies for my research.



## ***Pigment Characterization of Polychrome Sinopiae in Roman-Byzantine Mosaics, Southern Levant***

**Yotam Asscher**, University of Haifa, Israel, Analytical Laboratory, Israel Antiquities Authority, Jerusalem, Israel

Since the Hellenistic period, mosaics depicted religious figures, theatrical scenes, mythological stories, hunting scenes, with increasing demand in controlling the hues and correct placement of the tesserae in this architectural colorful medium. As a result, polychrome *sinopia* began to appear below mosaics. *Sinopia* is a preparatory drawing that is found embedded in mortar layers below a mosaic, acting as guidelines for placing the tesserae based on style, colors, and content. These preparatory drawings are invaluable archives of pigments, techniques, and artistic expressions that were destined to remain concealed beneath the mosaics.

Polychrome *sinopiae* were made by visionary master mosaicists, using pigments such as red and yellow ochre, green earth, carbon black and cinnabar, all applied using the *fresco* technique. Since coloured tesserae were placed in wet supporting mortar, artisans who executed the vision of the master had to follow closely the guidelines of these freshly painted *frescoes*.

Mosaic tesserae are made of plain or colored limestone or glass, protecting the delicate hidden *frescoes*, allowing to study information on the workers, painting techniques, presence of exotic pigments and even the chemical interaction between the pigments in the mortar and stone tesserae, which is an overlooked subject in conservation sciences.

In this paper we discuss the characterization of polychrome *sinopiae* in the Bird Mosaic at the Armenian Chapel in Jerusalem, The hunting scenes at the Roman Lod Mosaic, and the Byzantine Church of the Glorious Martyr in Beit Shemesh. We show that multi-analytical approach involving mineralogical and chemical characterization may identify the pigments in use, and their compatibility with the coloured tesserae that were available to the mosaic workshop. We demonstrate how non-invasive methodology, including portable X-ray fluorescence (pXRF), digital microscopy and fiber optic reflectance spectroscopy (FORS) allow distinguishing between different painting techniques using red ochre and carbon black. We also show that mosaicists worked together with wall-painting artists at the planning and executionary steps, advancing step-by-step as the mosaic evolves, with implications for historical and artistic specialisations at mosaic workshops.

## ***Parthenon's west pediment - Evidence of ancient colors***

**Eleni Aggelakopoulou**, National Technical University of Athens, Acropolis Restoration Service, Ministry of Culture and Sports, Greece; **Asterios Bakolas**, National Technical University of Athens

The aim of this research is to investigate the polychromy of the Parthenon's west coronation (raking simas with the lion-head, raking cornice blocks and tympanon) where traces of paint layers and decoration can still be observed. Various imaging techniques (raking light, portable digital microscope, Visible-induced Infrared Luminescence (VIL) and Ultraviolet-induced Visible Luminescence (UVL)) were applied in situ. Moreover, laboratory techniques (Stereomicroscope,  $\mu$ -Raman spectroscopy, ATR-FITR spectroscopy and SEM/EDX) were applied on selected micro-samples from the conserved paint layers. VIL revealed the decorative pattern in the area of the ovolo of the raking sima. In addition, Egyptian blue was also identified on the background of the lesbian cyma that was decorated with heart-shaped leaves. Azurite, Egyptian blue, conicalcrite, red ochre and red lead were identified as the main pigments for the decoration of the Parthenon's coronation. Beeswax is also, identified as binder in plenty of investigated microsamples. The decoration of these parts was slightly different to the descriptions we have from early drawings of the Parthenon crafted by European travelers, architects and painters of the 18<sup>th</sup> and 19<sup>th</sup> centuries.

## ***Polychromy as Provenance Research: A Statuette of Venus and Cupid from Roman Syria(?)***

**Roko Rumora**, Toledo Museum of Art; Alison Whyte, Institute for the study of Ancient Cultures, The University of Chicago

A Roman marble statuette of Venus with Cupid was recently exhibited for the first time since the 1950s at the Institute for the Study of Ancient Cultures (ISAC) Museum at the University of Chicago. It was purchased in 1957 from a Beirut-based dealer who claimed that the statuette was found in the Syrian town of Al-Rastan (Arethusa in the Roman period). As part of the object's conservation treatment in preparation for the exhibition, the surface of the marble was examined using digital microscopy, longwave ultraviolet light, XRF spectroscopy, and Raman spectroscopy. These analyses revealed vestiges of different pigments and other decorative elements on the seemingly nude parts of the body of the goddess. The results of this study have given insight into both the original appearance of the statuette and its provenance, as stylistic comparisons with more securely contextualized Roman sculpture reveal affinities with statuettes of Venus from the Roman East, many of which feature comparable configurations of highly ornamented body jewelry. This study sheds light on the production of painted mythological sculpture in Roman Syria but also underscores the importance of interdisciplinary approaches in provenance research. The integration of art historical analysis with scientific examination has proven valuable in piecing together the history and origins of this Roman statuette, demonstrating the potential of such collaborative efforts for studying unprovenanced antiquities in museum collections.

## *The colors and painting techniques of Gorgo Medusa at tomb C of the Ipogeo dei Cristallini in Naples*

Vinzenz Brinkmann, Liebieghaus Skulpturensammlung, Goethe-University; Claudio Falucci, M.I.D.A. Roma; **Ulrike Koch-Brinkmann**, Georg-August-University, Göttingen; Sara Martuscelli, Ipogeo dei Cristallini, IE University Antiquity & Middle Ages Research Centre; Heinrich Piening, Bayerische Schlösserverwaltung, Munich

The colors and painting techniques of Gorgo Medusa at tomb C of the Ipogeo dei Cristallini in Naples. The Ipogeo dei Cristallini includes four tombs that were used from the early Hellenistic period to the imperial era. These four neighboring tombs were discovered almost undestroyed in 1889 by Baron di Donato during construction work on his palace and are still privately owned today; they have been undergoing extensive conservation work for several years and are open to the public yet. The entire complex was meticulously sculpted in situ and the tombs are carved in tuff. The colorful paintings on the walls and interior, as well as several marble tombstones, have been exceptionally well preserved. This contribution focuses on the face of a gorgo, which is partially sculpted in pietra lavica nera as the shield device of a pelta and integrated into the painting of the lunette on the main wall of Tomb C. In a joint research project, the color materials and painting techniques are being examined using various scientific methods. The results will be visualized and discussed as part of a reconstruction project. This reconstruction will serve visitors of the Ipogeo dei Cristallini and the public in general as a reading and understanding aid for the original and its historical background.

## ***The Mensa Isiaca: New Findings on Its Composition, Construction, and Original Appearance***

**Susanne Gänsicke**, J. Paul Getty Museum; **Monica Ganio**, Getty Conservation Institute; **Karen Trentelman**, Getty Conservation Institute; **Johana Herrera**, J. Paul Getty Trust

The Mensa Isiaca, a large bronze table decorated with elaborate polychrome metal inlays of Egyptian-style figures and pseudo-hieroglyphs, is among the founding artefacts of the Museo Egizio, Turin, collections and likely the most important example of multicolored ancient metalwork. First appearing in Rome in the 16<sup>th</sup> century, its manufacture, origin, and significance have been the subject of much inquiry and speculation. This paper will discuss the results of a recent technical study into the materials and technologies used in the creation of the Mensa Isiaca and the implications of these findings for understanding the concept of its metal polychromy.

Utilizing non-invasive and non-destructive examination methods, including optical microscopy, X-ray fluorescence (XRF) spectroscopy, macro XRF (MA-XRF) scanning, and X-radiography, the study provided an unprecedented level of detail and understanding into the construction of the table and its inlays. The base and inlaid figures were created using a minimum of seven distinct alloys, including silver, black bronze, and multiple copper/zinc alloys. The element maps obtained by the MA-XRF scanning offer the most accurate visualization of the decorative inlays and pseudo-hieroglyphs to date, providing scholars with the opportunity to explore the imagery of the Mensa Isiaca with greater ease and clarity. The element maps also reveal previously undetected relationships between the alloys used for different design elements. In particular, the alloys used for the clothing and skin tones appear to have been specifically selected to enhance the visual contrast between these elements. Using these new findings as a guide, a digital reconstruction of the proposed original appearance of the metal polychromy was created.

Comparanda of inlaid metalwork from ancient Egyptian through the Roman periods place the Mensa in a long-standing tradition of using metal inlays of different alloys to create chromatic contrast in imagery. If and how the color values of the inlays on the Mensa can be related to the ancient Egyptian color canon will be evaluated. While many questions remain, this technical study provides a more complete picture of the Mensa Isiaca, which will afford scholars new tools for unraveling the significance of this piece, appreciating its original appearance, and its context within the ancient world.

## ***Towards a New Approach of Decrypting the Decoration of Ancient Egyptian Temples. The Newly Revealed Ancient Polychromy of the Temple of Esna***

**Daniel von Recklinghausen**, University of Tübingen

In 2018, a joint Egyptian-German project by the (then) Egyptian Ministry of Antiquities (now Tourism and Antiquities) and the Dept. of Egyptology of the Institute of Ancient Near Eastern Studies of the University of Tübingen was launched to fully reveal, conserve, and document the ancient polychromy of the pronaos of the temple of Esna from Greco-Roman times, ca. 60 km south of modern-day Luxor/Egypt. After five years of intensive work the completion of the conservation of the ceiling zone and the 18 free-standing columns marks one milestone of the project. For the first time after nearly 1800 years, it is now possible to have a look at the original decoration scheme, which had been covered by soot, dust and dirt.

Even before the second phase of the conservation-project (i.e., the conservation of the walls) has started (supposedly in spring 2024) it has become clear that an in-depth analysis and comprehension of the inscriptions and the depictions of deities, Roman emperors, and celestial phenomena, e.g. the twelve zodiac figures, cannot be undertaken without knowing their coloration pattern. The same holds particularly true for the hieroglyphic inscriptions, since many passages were never carved but only inked (this is why they remained completely unknown until recently). Often, those passages contain cartouches with the names of the Roman emperors—and for this reason the texts they belong to can now be securely dated for the first time. Thus, our understanding of one of the latest testimonia of the ancient Egyptian religion or theology will be thoroughly enriched as well as our knowledge of the process and sequence of the decoration work. Furthermore, it has already become clear that the coloration pattern in the temple decoration of the Greco-Roman periods were carried out according to local parameters and thus the temples substantially differed from each other.

Next to a general overview of the site, the conservation work, and the results already achieved the paper will offer various examples of the re-gained color-scheme that offers one—or various—new approach(es) in our understanding of an ancient theology and the techniques in doing so. Next to the idiosyncrasies in terms of architecture and hieroglyphic writing—for which the temple of Esna is already famous—the nearly intact coloration scheme will undoubtedly need to be added when it comes to characterizing the temple's impact on ancient Egyptian religion, art, architecture, and history.

## ***Painted in lifelike colors: The polychromy of Romano-Egyptian plaster busts***

**Jens Stenger**, Cecilie Brøns, Ny Carlsberg Glyptotek

The collections of the Ny Carlsberg Glyptotek, Copenhagen holds an intriguing collection of ten Romano-Egyptian mummy busts, representing eight men and two women. They are sculpted in plaster and painted naturalistically in a varied palette and with inlaid eyes made of glass, making them appear very life-like. They all seem to express highly individualistic personalities, and their hairstyles follow the fashions of Imperial Rome. The busts have very different complexions, ranging from an almost white to a dark red skin tone, underlining their individuality. These intriguing and slightly eerie busts provide a unique perspective into the sculptural polychromy of funerary art in Roman Egypt during the period from the first to the third centuries CE. Moreover, they provide a compelling, three-dimensional parallel to the polychrome portraits of Imperial Rome in marble and plaster.

It was therefore decided to perform a multi-analytical study using technical imaging, cross-sectional and chemical analysis of the ten busts to establish their materials and the techniques used for their production and to gain insight into their original appearance. Preliminary results are obtained for the first three busts. On the bust ÆIN 645, UV-induced fluorescing materials emitting white, yellow, and orange light are detected. Forming an essential part of the otherwise black drawing of a mummy on the back of the neck, their presence is no longer visible to the naked eye. Cross-sectional analysis reveals a sophisticated painting technique using up to six layers including coarse and fine plaster as the painting support. On ÆIN 644 a similar painting technique is observed in the stratifications. In addition, a proteinaceous material is detected in the red and black passages of the face. The abundant presence of protein could be responsible for the strong greenish UV-induced fluorescence. The white mineral pigment huntite is present in the skin color of ÆIN 648 and in the coating on the inlaid eyes, which fluoresces yellow upon UV excitation.

Building on archaeological studies on mummy busts, further in-depth technical research is ongoing to investigate the complete set of ten busts for a broader comparison with other forms of Romano-Egyptian funerary art as well as with contemporary Roman Imperial portraits.

***"Farben sehen / Seeing colours!" - the interdisciplinary pop-up exhibition for polychromy researchers***

**Katharina Ute Mann**, Freelance Art Historian and Artist, Cologne

The sustainably conceived pop-up exhibition "Seeing Colours" takes a new mediation approach in which current scientific research on polychromy in ancient times is not only presented in an interactive way but can also be supplemented on the basis of re-usable resources (analogue/digital) at different locations and countries according to another research focus.

The FAU edition "Farben sehen! Antike im Spannungsfeld von historischem Bild und Raum / Seeing colours!" "Antiquity in the interplay of historical image and space" (13-17 March 2024), presented in the Department of Classical Antiquities at Friedrich-Alexander-Universität Erlangen-Nürnberg, with the goal of providing transdisciplinary impulses with regard to social structures, gender images and artistic concepts. In a dialogue between two art genres, sculpture and decorated ceramics, which illustrate the significance of colour in ancient society in different ways, colour is juxtaposed as an instrument of gender differentiation, as a symbol of status as well as power and as an expression of the prevailing zeitgeist.

In the exhibition, Dr Arne Reinhardt presents impulses from his current research work on decorated ceramics. The exhibition focuses in particular on the use of opaque white, which both expands the representation in terms of colouring and serves to build up the images and emphasise them. The hybrid nature of the vase aesthetic becomes clear, in which colours are subordinate to the contrast between figure and ground on the one hand, but on the other are partially representational and develop a certain creative value of their own.

In my ongoing research, I am investigating how and in what way the recipients' awareness of the polychromy of the Ancient World can be permanently changed. Using four different lines of argument ("big history", "role models", "zeitgeist" and "heritage of antiquity"), my intention is to make visitors aware of the fact that people have a much longer tradition of painting their sculptures than not, and to create an understanding of the political idea behind the painting. The FAU's collection of classical antiquities will be combined with hypothetical colour reconstructions (in the form of coloured 3D models, drawings and in augmented reality) to show visitors the aesthetic effect of painted sculptures compared to monochrome and white ones. A questionnaire will also be made available on the website to evaluate the mediation methods in the exhibition. The results will then also be made available on the website.



***PERCEIVE Project: novel approaches and interactive/digital technologies applied to the study of the original appearance of ancient sculpture***

**D. Magrini**, C. Barandoni, I. Cerato, R. Iannaccone, & S. Pescarin, Institute of Heritage Science, National Research Council, Florence Italy; D. Ferdani, Institute of Heritage Science, National Research Council, Rome Italy; G. Verri, Art Institute of Chicago; P. Liverani, Università degli studi di Firenze, Institute of Heritage Science, National Research Council, Florence Italy; ML. Giacco, Archaeological Museum of Naples; P. Stavroulakis, Institute of Electronic Structure and Laser of the Foundation for Research and Technology-Hellas; S. Sotiropoulou, Institute of Electronic Structure and Laser of the Foundation for Research and Technology-Hellas, Hellenic Open University, Patras, Greece; Y. Arteaga, Norwegian University of Science and Technology, Colourlab, Gjøvik, Norway; S.N. Sinha, Fraunhofer IGD, Germany

Often, only miniscule traces of the original polychromy of ancient Greek and Roman sculpture are perceivable today with the naked eye. Attempts at reconstructing their original appearance are a priority to, on the one hand, understand better ancient art, and, on the other, to contribute to the necessary measures to care appropriately for its survival for future generations.

The EU-funded **PERCEIVE** project is developing methods for studying, reconstructing, rendering and exhibiting coloured collections. The project highlights five scenarios, focusing on specific needs and requirements to better identify digital solutions for the scientific community, citizens and creative industries.

The first PERCEIVE scenario investigates the 'lost' appearance of ancient polychrome sculpture, and at ways in which its original appearance can be reconstructed and communicated to the public and scholars alike. Despite the methodological complexities related to the reconstruction and presentation of the original appearance of ancient sculpture, the project strives to offer a transparent and accurate approach, including the training of the eyes of museum visitors in the identification of original colours, to avoid potential misinterpretation of the scientific evidence.

Examples of sculptures from the National Archaeological Museum of Naples, most of them of Pompeian provenience and preserving traces of original paint, have been selected as case studies for the project. Preliminary results obtained from the analytical investigations, together with a WebXR interactive visual tool, and the first attempts at developing digital services available to the public, will be presented.

## ***In the Eye of the Beholder – How Polychrome Reconstructions are Shaped by their Makers***

**Anna Silberg Poulsen** (they/them), University College London

A reconstruction of a polychromic surface is not simply a window to the past. It is a result of a mixture of artistic choices and scientific results. This, however, is rarely made clear to the average museum's visitor. This presentation draws on research conducted in my unpublished master thesis "Colours on Neo-Assyrian reliefs and polychrome reconstructions". It explores the relation between interpretations, perception and space, in connection to polychrome reconstructions of Neo-Assyrian reliefs. To this end, the polychrome surface of three reliefs from the Northwest palace, Nimrud, Iraq, were created, namely two reliefs from the Ny Carlsberg Glyptotek's collection *Æ.I.N 1723*, *Æ.I.N 1491*, and one relief from the British Museum's collection, *BM118876*. The reliefs themselves do not show many visible traces of their original splendor. The reliefs from Ny Carlsberg Glyptotek have been subject to a preliminary scientific examination in 2013, whereas the relief from the British Museum to my knowledge, remains to be examined. The polychrome surfaces were reconstructed using Photoshop, Procreate, and Twinmotion. The lack of visible traces of polychromy made it necessary to apply a pragmatic approach based on current and past research of polychrome reconstructions of Neo-Assyrian reliefs and their sources of inspiration. The results of the 3D visualisations made clear that colour and light have an important impact on how the painted surfaces are perceived by the spectators. The visualisations also caused a new understanding of how not just colour and light impacted this, but also the space itself, whether it being the original palatial context or a museum exhibition. The 2D reconstructions explored scientific bias and attempts to convey the hypothetical nature of polychrome reconstructions by leaving parts of the relief uncoloured. Creating the reconstructions resulted a new approach to the question of what constitutes a scientific polychrome reconstruction, and how to best present polychrome reconstructions to the public. It has highlighted the need to clarify for the audience the technical and artistic prerequisites for reconstructions of ancient artefacts.

## ***The Parthenon Metopes and Public Presentation***

**Katherine A. Schwab**, Fairfield University

Recent exhibitions of ancient color—including *Gods in Color* and *Chroma* at The Metropolitan Museum of Art—have been influential in drawing public attention to the use of paint on Ancient Greek and Roman sculpture, while deepening an ongoing discussion among scholars. An international collaborative conversation needs to continue to steadily overturn centuries of assumptions that these sculptures were unpainted. More than a century after exhibitions on ancient polychromy occurred in the U.S., the erasure or muting of knowledge about the use of color remains our challenge. This paper will present recent work with the Parthenon metopes to demonstrate ways in which the presentation of color can be achieved for both scholars and the public.

Most of the surviving panels of the original ninety-two metopes from the Parthenon are badly damaged. My research on the Parthenon east and north metopes has yielded clues and discoveries to help complete our understanding of several of the marble panels. Relying on graphite drawings for both the current condition and hypothetical reconstructions move us toward making the images accessible to scholars and the public. Thanks to the significant work being done in ancient polychromy studies, it is increasingly plausible to develop color renderings of these metopes in 2-D, 3-D, and virtually.

My own experimentations began with the app Procreate to show the richness of color in some of the Parthenon north metopes. Procreate provides colors close to those identified by the scientific team in the Acropolis Restoration Project. Parthenon North metopes 24-25, with Menelaos chasing Helen during the Sacking of Troy, are an ideal experimental vehicle. Color transforms the two compositions and interplays with the natural light on the original marble panels. At Fairfield University we have the only U.S.-based plaster cast of North 25, and its display and labeling include my work.

Exploring 3-D and virtual polychromatic images lead in two directions. The first incorporates small plaster casts of Parthenon metopes for seminar students to paint. The results of the students' work are presented in our Undergraduate Symposium. The second involves communicating polychromatic renderings for the FlyOverZone's virtual tour, *Athens Reborn: Acropolis*. The results of a collaboration with the project modeler made it possible for the metopes to be recreated in virtual reality.

## ***Approaching colors on Treveran grave monuments – aligning 2D and 3D documentation of the Albinus Asper monument***

**Anja Klöckner, Ute Kelp**, Goethe-University Frankfurt

Treveran grave monuments with their rich coloring were preferably situated along transport routes on water and land. Within the frame of the DFG-funded project “Contextualizing Treveran Grave Monuments” that started in 2022 ([https://www.unifrankfurt.de/128552583/Trier\\_\\_Grabdenkmäler\\_im\\_Kontext](https://www.unifrankfurt.de/128552583/Trier__Grabdenkmäler_im_Kontext)), we aim to analyze the network of references regarding these grave monuments and to reconstruct the funerary landscape in this eastern part of the northwestern Roman province Gallia Belgica. Our project has its focus on their formal, spatial, functional and semiotic contextualization. We build on the documentation carried out during our previous projects on these monuments.

One of our main goals is to analyze the visibility and perception of funerary landmarks such as the monument of the Secundinii also known as column of Igel. Still standing tall and in situ, the monument came into view on the Roman road as well as on the river Moselle approaching or leaving *Augusta Treverorum*, the ancient capital of the *civitas Treverorum* and modern city Trier in Germany. To capture the different perspectives during the approach to the grave monuments, we include dynamic elements in our visualization and work with view-shed-analysis. Color had a defining impact on a monument’s visual effect, but we still do not know enough about the polychromy of Treveran sculpture in general. Color residues on these monuments confirm *that* they were painted, but we do not know, *how* they were painted.

Thus, a pilot study centers on the color-coding and polychromy of these monuments. From the extensive material in the Rheinisches Landesmuseum in Trier, we chose the monument of Albinus Asper from Neumagen for our pilot study. Scientific analyses of the color residues on limestone and sandstone monuments for this region and period are still a desideratum. To develop scientific standards, we explore the possibilities of multispectral imaging (MSI) techniques using VIS (including DStretch filters), UVL and VIL as non-invasive methods for the reconstruction of the original colors. Guided by our research interest, we are mapping the documented color residues on a 3D model of the monument. Aligning 2D and 3D documentation of an immobile object by photogrammetry resulted in various MSI 3D models such as a 3D VIL model showing the pigment distribution of Egyptian blue. In overlaying these models, they can be used for the partial color reconstruction of the monument. The aim is to establish a routine that could be adapted for other monuments while investigating polychromy in Treveran funerary culture and beyond.

## ***Art + Science in the Art Museum Gallery: Presenting a Technical Lens on Forgotten Fragments from Dura-Europos***

**Kate Smith**, Caitlin Clerkin, Katherine Eremin, Georgina Rayner, Harvard Art Museums

In 1940, three boxes of painted plaster fragments excavated at Dura-Europos (near modern Salhiyah, Syria) were donated as samples of ancient painting to Harvard University's Fogg Museum (now part of the Harvard Art Museums). Little studied for some 80 years, a recent cataloguing project occasioned technical investigation and analysis of the fragments' pigments and plaster by the Straus Center for Conservation and Technical Studies, meeting their originally intended research value with updated methods. A selection of the fragments has recently been installed in the museums' ancient Middle East gallery. Displayed VIL and UV images of example fragments both show how we investigate color and introduce the idea that what is visible today does not completely reflect original, ancient appearances, while accompanying pigment samples offer a window into the specific artists materials used. Joining a color reconstruction of a relief from Persepolis already on view in gallery, this installation amplifies for visitors the reality of the colorful built environment of ancient Middle Eastern life and the role of scientific approaches in deepening such knowledge.

Technical and scientific inquiry have long been essential aspects of the Harvard Art Museums' institutional identity and practice; recent initiatives have sought to make conservation and materials science activities visible to visitors through special exhibitions, programming, and, as in this example, permanent gallery interventions. This presentation offers the Dura-Europos installation as a case study of collaborative work undertaken by the Straus Center and the curatorial team to engage visitors with ancient polychromy and scientific study. In addition to presenting our findings, we discuss the display's interpretive aims. Indeed, the installation's interpretive "Big Idea" was less communication of the specific technical findings and more an invitation to the broader ideas that underpin the research: that scientific research occurs in art museums; that scientific investigation helps us understand how art is made; and that different techniques of looking (e.g., via multispectral imaging) can help us "see" a fuller, more colorful picture of the past.