EDITED BY
Hariclia Brecoulaki

Archaeology of Colour

Technical Art History Studies in Greek and Roman Painting and Polychromy

ΜΕΛΕΤΗΜΑΤΑ 87

ΕΘΝΙΚΟ ΙΔΡΥΜΑ ΕΡΕΥΝΩΝ / ΙΝΣΤΙΤΟΥΤΟ ΙΣΤΟΡΙΚΩΝ ΕΡΕΥΝΩΝ
NATIONAL HELLENIC RESEARCH FOUNDATION / INSTITUTE OF HISTORICAL RESEARCH

Archaeology of Colour

Τα ΜΕΛΕΤΗΜΑΤΑ είναι η σειρά μονογραφιών και συλλογικών τόμων του Τομέα Ελληνικής και Ρωμαϊκής Αρχαιότητας του Ινστιτούτου Ιστορικών Ερευνών.

ΜΕΛΕΤΗΜΑΤΑ is the series of monographs and collective volumes of the Section of Greek and Roman Antiquity of the Institute of Historical Research.

ISBN 978 960 371 089 9

48, Vassileos Constantinou Ave., 116 35 Athens - Greece
Tel. (+30) 210 7273554, E-mail: iie@eie.gr

Distribution: https://www.brepols.net/
https://history-bookstore.eie.gr/en

Frontispiece:
Aghios Athanasios, Macedonian tomb III, façade, painted shield in VIL detail.
© Ephorate of Antiquities of Thessaloniki Region / G. Verri

EDITED BY
Hariclia Brecoulaki

Archaeology of Colour

Technical Art History Studies in Greek and Roman Painting and Polychromy

ΜΕΛΕΤΗΜΑΤΑ 87

ΕΘΝΙΚΟ ΙΔΡΥΜΑ ΕΡΕΥΝΩΝ / ΙΝΣΤΙΤΟΥΤΟ ΙΣΤΟΡΙΚΩΝ ΕΡΕΥΝΩΝ
NATIONAL HELLENIC RESEARCH FOUNDATION / INSTITUTE OF HISTORICAL RESEARCH

ATHENS 2023

Contents

Introduction

A grain of colour matters…

Ancient polychromy speaks a language of “the visible” and “the invisible”, through signs of pigments, brushstrokes and forms. Another reminder of our classical past, colour is an inherent component of artistic creation, inspiration and imagination. Random patches of colour preserved on the worn surfaces of architectural members, precious grains of pigments hidden within the folds of a statue’s drapery, damaged paint layers on plastered walls and stone, invite us to recover the missing evidence, to reconstruct the fragmentary surface, to revive the history of their creation, their meaning and use. Non-visible traces of polychromy that have lost their original appearance and integrity, and have been lying sealed beneath thick incrustations for centuries, await their revelation and inspection by our conscious eyes.

New sophisticated technologies, as well as the development of interdisciplinary studies over these past decades, have stimulated the collection and evaluation of numerous scientific data from in-situ investigation of polychrome and painted documents, and have challenged our understanding of the complexity and function of ancient painting materials and techniques. On poorly-preserved artefacts, video microscopy, elemental analysis and multi-spectral imaging techniques, allow us to track and analyse remnants of coloured surfaces, otherwise invisible to the naked eye[1]. When it comes to dealing with ancient painting, elemental mapping and multi-spectral imaging have made it possible to reveal “lost” iconographies and retrieve significant details in figured compositions[2]. Details are crucial. A grain of colour matters. A mixture or a layering of paints may reveal an intention to produce variation of hues and tones, the selection of specific pigments for specific purposes may unfold unfamiliar “ways of seeing”, and, furthermore, may prompt us to look again at the value and possible meaning with which colours were endowed, so enhancing our appreciation of ancient visual aesthetics.

What we are able to “see” today from the remains of ancient colour, thanks to the use of new technologies, is obviously far more accurate and comprehensive than what scholars saw in the previous centuries, when struggling to reconstruct the history of Greek painting through Pliny’s 35th book on minerals… Nonetheless, seminal works of scholars who painstakingly tracked all the visible remains of colour on all kinds of painted surfaces, and dared to produce reconstructions by using only their eyes and their imagination, still stand as a very precious repository of experience and reflection[3]. The same applies to the meticulous studies of ancient

---

1. On the various methods and applications of non-invasive investigation see for example Karydas *et al.* 2009; Piening 2010; Dyer, Verri and Cupitt 2013; Bourgeois 2014; Vandenabeele and Donais 2016; Delaney *et al.* 2017; Romano *et al.* 2017; Alfeld *et al.* 2018; Kogou *et al.* 2020; Yu Li *et al.* 2021.

2. Brecoulaki *et al.* 2019.

3. See for example Semper 1834; Raoul-Rochette 1836; Hittroff 1846; Lermann 1907; for recent overviews on ancient polychromy

textual sources by classical archaeologists and philologists, including erudite translations and commentaries on texts referring to colour, painting and polychrome artefacts, which offer a solid background for a more meaningful contextual interpretation of our scientific data[4].

Technical art history studies in ancient polychromy and painting can be defined today as a "new" discipline, forged through the merging of many different academic and scientific fields of expertise which complement and enrich one another[5]. Scientific results and their interpretation can only be achieved through a systematic collaboration and interaction between the members of each research team. Every single link in the chain – in-situ autopsy of the monuments, awareness of past and modern restoration interventions, non-invasive examination and analytical investigation of micro-samples in the laboratory, cross-checking of the results obtained by different techniques, evaluation of possible physico-chemical alterations of colour, art historical and historical interpretation of the results within the specific contexts of the monuments under study – is essential in order to reach trustworthy conclusions.

However, despite the robust, "objective" scientific data gained by means of sophisticated methods of investigation, modern reconstructions of ancient polychromy and painting still remain "subjective" and raise controversy, both with regard to the adopted methodology and to their presumed fidelity vis à vis the original appearance of the fragmentary archaeological evidence we possess[6]. In fact, our ways of capturing and re-constructing antiquity's "lost polychromy" are determined by the choices we make and the questions we ask: Which monuments do we decide to examine? Which approach do we choose and which scientific techniques do we apply? To what extent is our investigation complete by relying solely on non-invasive examination? Should sampling be excluded on ethical grounds or not? Should we use ancient materials and casts for modern reconstructions or try to simulate their aesthetic effect by means of digital technology and 3D virtual models? Are we trying to complete and recreate the "whole" or only parts of the evidence where colour is still fairly-well preserved? Do we opt for a single reconstruction of for multiple versions? Do we, in any way, consider the original viewing and sensing conditions of the artefacts, the ancient spectator's experience?

with bibliography see Abbe 2015; Kiilerich 2016; Stager 2022. On ancient painting reconstructions see Bruno 1977; Papadopoulos and Camp 2007; Lehmann and Löhr forthcoming.

4. Such as the seminal works discussing ancient texts on the materiality and function of polychromy and painting, by Blümner 1884 and 1887; Berger 1904; Reinach 1921; and more recently on painting and sculpture see Rouveret 1989; Primavesi 2003; Henke 2020.

5. Cardinali 2017.

6. Østergaard 2017.

To whom are our reconstructions primarily addressed; to scholars or the wider public? What matters most, to convince or to suggest?[7]

The more current scholarly research allows us to delve deeper and deeper into the investigation of ancient painting materials, to track a single grain of pigment and analyse its composition and provenance, to reach the non-visible, the more confident we feel that we are getting to know how ancient craftsmen and artists used colour, for which purposes, to what ends. It is true that we know a lot about a little, but at the same time a little about a lot...When evidence abounds, as with materials that we constantly identify in multiple Greek and Roman artefacts, such as Egyptian blue, it is possible to securely determine their uses and functions and to try to recover their original appearance even when they are poorly preserved[8]. But we still miss a lot of the original evidence and, despite the scientific instrumentation we are using, we do not always obtain the expected information. To mention an example, we are still unable to identify the composition of an organic purple colourant that ancient painters used to produce pinkish, purple and mauve hues, in pictorial layers from artefacts made of wood, marble, terracotta and figural paintings dating from the Late Bronze Age to the Hellenistic period[9].

Although non-invasive investigation with transportable instrumentation is certainly the most appropriate methodology to be adopted today for the examination of ancient polychromy and painting, sampling may be exceptionally considered necessary, in order to determine the stratigraphy of complex pictorial layers and to identify organic substances – such as egg, glue and gums – used as binding media[10]. Experimental archaeology and replication of ancient techniques can elucidate the complexity of pictorial processes and the different stages of the preparation of ancient pigments. However, if these experiments are not complemented with scientific analysis, the resulting conclusions may be misleading and controversial. The conviction, for instance, that Minoan and Mycenaean wall-paintings were true frescoes, largely supported by modern experiments with painting on wet lime-based plaster, was called into question by recent scientific investigation of numerous paint samples from the Late Bronze Age, which confirmed that secco and tempera techniques were very common in the prehistoric Aegean[11].

7. On different approaches to reconstruction see for example Brinkmann 2010; Verri, Opper, and Lazzarini 2014; Østergaard and Nielsen 2014; Brinkmann and Koch-Brinkmann 2018; Descamps Lequime 2019; Brinkmann and Koch-Brinkmann 2020.

8. Brecoulaki *et al.* in this volume.

9. See Bourgeois *et al.* in this volume and Verri *et al.* forthcoming.

10. Andreotti *et al.* 2014.

11. Brysbaert 2008; Brecoulaki *et al.* 2012; Linn 2018; Casoli 2021.

An overview of the volume

The present volume is another contribution to the ongoing exploration of the rich history of colour in the classical world; an exploration which builds on previous knowledge and opens up new horizons for a more extended understanding of the aesthetics and meaning of Greek and Roman art. It includes fifteen papers that move from Archaic and Classical Greece to the Hellenistic and Roman periods, and deal with colour on monumental architecture, marble statues and reliefs, wooden and terracotta statuettes, stone sarcophagi, paintings on stone and plaster, and pigments as raw materials.

The extraordinary Archaic limestone sarcophagus from Chiliomodi in ancient Tenea, which is presented in the first essay (Maniatis *et al.*), offers significant pictorial evidence on the relationship between vase-painting and free painting on a flat surface through the adoption of traditional decorative and figural motifs on a large scale, further corroborating our understanding of the art of painting during this early period. Furthermore, due to the identification of egg as a binding medium in its pictorial layers, a large gap between the pictorial techniques developed in Mycenaean wall-painting and the Late Classical period has been bridged, attesting the long-lasting tradition of tempera techniques on the Greek Mainland.

The authors of the three successive contributions on the monumental architectural polychromy of the Athenian Acropolis and the Agora (Fratzi *et al.*, Aggelakopoulou *et al.*, Brinkmann *et al.*) provide new information on the application of colour and the composition of pigments on the different members of the investigated buildings. Along with systematic conservation operations in the Acropolis monuments, the scientific examination of remnants of polychromy on the Porch of the Karyatids in the Erechtheion revealed the decorative pattern of its coffered ceiling, highlighting the use of Egyptian blue in the creation of the Ionic moulding and its method of application on the marble surface. Likewise, the technical investigation of the northwest raking sima of the Parthenon brought to light the exact pattern of the decorative elements in the area of the ovolo and the Lesbian cyma, which could not be discerned with the naked eye. The physical reconstruction of the ornaments of the Ionic capital A 2972 from the Athenian Agora on an actual size copy of the original in 3D print in sand, relying on the weathering ghosts and the identification of well-preserved traces of paint, offers a very close approximation of its original polychromy, simulating the visual aesthetics of the ancient capital in its specific architectural context.

New research on Late Classical and early Hellenistic paintings from funerary monuments in ancient Macedonia is presented in the three following papers, addressing issues of iconography, technique and pictorial reconstruction. On the basis of a pilot investigation of the hunt frieze of the Tomb of Philip II at Aigai (Brecoulaki *et al.*), a first assessment of the pigments and colours used for the creation of the frieze is made, putting

forward the challenges of a new, more accurate pictorial reconstruction of the original composition, urgently required due to the significant damage that its pictorial layer has undergone, thus obstructing its legibility. A comprehensive study on the iconography and the distribution of pigments of nine figured stelai from the "Great Tumulus" at Aigai, by means of multispectral imaging (Kalaitzi and Verri), brings new findings to light, in this way expanding the possibilities of the art historical and archaeological interpretation of this important material of the royal necropolis. Last, a broad archaeometric investigation of the binding media preserved in a representative number of samples from the pictorial decoration of eighteen tombs and two funerary Macedonian couches, dated to the third quarter of the fourth and the early third century BC (Avloniti *et al.*), further confirms the diachronic use of the secco and tempera techniques, based on the secure identification of egg, animal glue and tragacanth gum within the examined paint layers.

A wooden Hellenistic statuette from Kerch is the topic of the next paper (Bourgeois *et al.*). It is one of the rare examples held by the Department of Greek, Etruscan and Roman Antiquities at the Louvre, and the scientific analysis of the remains of its polychromy, which comprises gilding and pictorial layers in mauve and pinkish hues, opens up new perspectives in the study of colour on ancient wooden statuary, for which our knowledge was hitherto extremely poor. The last paper in this section treats the different ways in which skin colour was rendered in a variety of polychrome and pictorial artefacts (Blume-Jung). The author discusses the natural light complexion of Hellenistic marble statues, the traditional conventions in the pictorial representation of male and female flesh tones, the dark brown and reddish skin-colour of non-Greeks in reliefs and small-scale statuettes, the golden skin of Hellenistic rulers and heroes, and the white marble-skin colour.

The section on Roman painting and sculptural polychromy opens with a paper presenting new research on the well-known "monochromes on marble" from Herculaneum and Pompeii, a group of ten painted marble slabs with mythological scenes that were considered "monochromes", due to the damage of their original paint layers, giving the impression of a very restricted use of colour for their execution (Lenzi *et al.*). To the contrary, a much more varied gamut of pigments was identified by means of non-invasive analysis, and new iconographic elements, invisible to the naked eye, were revealed. The role of colour in the overall appreciation of Roman painted statues and reliefs crafted by ancient Macedonian and Thracian workshops, is explored across a broad range of artefacts from the rich collection of the Archaeological Museum of Thessaloniki (Veleni *et al.*). The last contribution in this section offers an overview of the scant traces of the original polychromy and ancient repaintings preserved on a selective number of Roman sarcophagi in the Vatican Museums, the National Roman Museum and the Capitoline Museums collections (Siotto).

Three more essays on the use of pigments, their provenance and their value, both material and symbolic, stress the role of colour in ancient vase decoration and free painting, from the early first millennium BC

to the Roman period. The first paper highlights the multifarious pictorial uses of the most common blue in ancient painting and polychromy, the well-known Egyptian blue, and its key role in the creation of shade and light in mimetic representations (Brecoulaki *et al.*). Next comes an in-depth discussion on the provenance of lapis lazuli, a precious mineral pigment of Antiquity rarely identified in figural painting, and two ochres, the red miltos from Sinope and the yellow ochre from Cyprus, based both on ancient textual sources and analytical data (Katsaros). The volume closes with a reflection on whether colour may have assumed a symbolic character in Greek art and may have conferred prestige to the painted artefacts, through the examination of diverse archaeological material, from Geometric clay vases to Macedonian wall-paintings of the late fourth century BC (Walter-Karydi).

The idea of the present publication originated from a round table on ancient sculptural and architectural polychromy, which was organized by the Institute of Historical Research (National Hellenic Research Foundation), in Athens, in November 2013, as part of a series of annual/biennial international meetings that have been taking place since 2009, in different institutions around the world, bringing together a network of scholars in order to discuss their new research in a multidisciplinary setting[12]. Almost half of the papers published in this volume were based on the oral presentations the authors delivered during the round table; some of the original presentations were not submitted at all, while some authors decided to publish material other than what they discussed during the round table. In addition, three more contributions, complementing this volume, are by authors that did not actually participate in the event.

The round table was hosted by the Acropolis Museum, thanks to the great generosity of its former president, archaeologist Professor Dimitris Pandermalis. Pandermalis had showed a vivid interest in ancient sculptural polychromy, having already launched, in 2012, the "Archaic Colors" initiative[13], a collection within the Museum's gallery, devoted to the polychromy of Archaic statues in the form of physical reconstructions and 3D applications, which he presented and discussed in his opening lecture. Moreover, a collection of ancient minerals used as pigments, mentioned in Theophrastus' *De Lapidibus*, was integrated into the permanent display of Archaic statues, with useful explanations on their provenance by Thomas Katsaros. Professor Pandermalis had also encouraged the experimental replication of ancient techniques in the Museum's laboratories, a demonstration of which was kindly offered by the Museum's conservator Konstantinos Vassiliadis, using wax for the application of colour to samples of Parian marble, in an effort to reproduce the original aspect and texture of the complex motifs of Archaic garments. Aside from the experimental replication of ancient

12. For all previous round tables and related publications, see https://www.polychromyroundtable.com/Past-Meetings.php.
13. Pandermalis 2012.

polychromy, during the round table two contemporary artists who have contributed significantly to the research on ancient painting techniques, Euphrosyne Doxiades[14] and Alekos Levidis[15], gave a live demonstration of painting with encaustic and tempera technique, relying on recipes described in ancient textual sources, in a context that allowed the participants to visualize the making of a painting on wood (encaustic) and marble (egg tempera). I wish to express my gratitude to all of them for sharing their art and craftsmanship with us. In recognition of Professor Pandermalis's substantial support in the realization of the Acropolis round table and for his pioneering initiatives with regard to introducing sculptural polychromy to the wider public at one of the most praised Museums in Greece, this book is dedicated to his memory.

The production of this volume has unfortunately been suspended and delayed due to a variety of reasons, one of these being the Covid pandemic period. As the editor of this volume, I feel obliged to apologize for this delay, and particularly to those authors who slightly modified their original presentations and who submitted their manuscripts within the requested time. Thank you to Alexandra Doumas and Iphigeneia Stefani for the language editing, to Marianna Poga, Christos Simatos, Evangeline Markou and Irene Kalogridou for their assistance and support in the creation of this volume.

Hariclia Brecoulaki

14. Doxiadis 1995.
15. Levidis and Roussos 2009.

Bibliography

Abbe, M. 2015: Polychromy, in A. Friedland, M.G. Sobocinsky and E. Gazda (eds), *The Oxford Handbook of Roman Sculpture*, New York.

Alfeld, M., Mulliez, M., Devogelaere, J., de Viguerie, L., Jockey, Ph. and Walter, Ph. 2018: "MA-XRF and hyperspectral reflectance imaging for visualizing traces of antique polychromy on the Frieze of the Siphnian Treasury", *Microchemical Journal* 14, 395-403.

Andreotti, A., Bonaduce, I., Degano, I., Lluveras, A., Modugno, F. and Ribechini, E. 1992: "Characterisation of natural substances in ancient polychromies", in P. Liverani and U. Santamaria (eds), *Diversamente bianco: La policromia della scultura romana*, Rome, 191-206.

Bourgeois, B. 2014: "Etudier et conserver la polychromie antique. Vidéo-microscopie et archéologie de la surface", in B. Bourgeois (ed.) *Thérapeia. Polychromie et restauration de la sculpture dans l'Antiquité, Techné* 40, 3-7.

Brecoulaki, H., Andreotti, A., Bonaduce, I., Colombini, M.P. and Lluveras, A., 2012: "Characterization of organic media in the wall-paintings of the 'Palace of Nestor' at Pylos, Greece: evidence for a secco painting techniques in the Bronze Age". *JAS* 39, 2866-76.

Brecoulaki, H., Verri, G., Bourgeois, B., Romano, F.P., Karydas, A.G., Caliri, C., Matin-Gonzalez, E. and Kavvadias, G. 2019: "The lost art of Archaic Greek painting: revealing new evidence on the Pitsa pinakes through MA-XRF and imaging techniques", *Techné* 48, 35-54.

Brinkmann, V. and Koch-Brinkmann, U. (eds) 2018: "The Riace bronzes experiment. Aesthetics and narrative". In M. Fuchs (ed.), *Ahoros. Gedenkschrift für Hugo Meyer von Weggefährten, Kollegen und Freunden*, Vienna, 215-35.

Brinkmann, V. and Koch-Brinkmann, U. (eds) 2020: *Bunte Götter - Golden Edition. Die Farben der Antike, exhibition catalog Liebieghaus Skulpturensammlung Frankfurt am Main*, Frankfurt am Main.

Brunetti, B.G., Miliani, C., Rosi, F., Doherty, B., Monico, L., Romani, A. and Sgamellotti, A. 2016: "Non-invasive investigations of paintings by portable instrumentation: the MOLAB experience", *Top. Curr. Chem. (Cham)*, 374.1:10. doi: 10.1007/s41061-015-0008-9.

Bruno, V. 1977: *Form and Color in Greek Painting*, New York.

Brysbaert, A. 2008: *The Power of Technology in the Bronze Age Eastern Mediterranean. The Case of the Painted Plaster*, London-Oakville.

Cardinali, M. 2017: "Technical art history and the first conference on the scientific analysis of works of art (Rome, 1930)", *History of Humanities* 2.1, 221-243.

Casoli, A. 2021: "Research on the organic binders in archaeological wall paintings", *Appl. Sci.* 11, 9179, 2012 https://doi.org/10.3390/app11199179.

Delaney, J.K., Dooley, K.A., Radpour R. and Kakoulli, I. 2017: "Macroscale multimodal imaging reveals ancient painting production technology and the vogue in Greco-Roman Egypt, *Scientific Reports* 7, 15509. doi:10.1038/s41598-017-15743-5.

Descamps-Lequime, S. 2019: "La couleur des bronzes antiques: recherches récentes. In B. Bourgeois (ed.), *Les couleurs de l'Antique. Actes de la 8e table ronde internationale sur la polychromie antique. Techné* 48:72-82.

Doxiadis, E. 1995: *The Mysterious Fayoum Portraits. Faces of Ancient Egypt*, London.

Dyer, J., Verri, G. and Cupitt, J. 2013: *Multispectral Imaging in Reflectanec and Photo-induced Luminescence modes. A User Manual.* European CHARISMA Project.

Hittroff, J.I. 1846: *L'Architecture Polychrome chez les Grecs*, Paris.

Karydas, G.K., Brecoulaki, H., Bourgeois, B. and Jockey, Ph. 2009: "In-situ X-Ray Fluorescence analysis of raw pigments and traces of polychromy on Hellenistic sculpture at the archaeological museum of Delos", *BCH* Supplément 41, 811-829.

Kiilerich, B. 2016: "Towards a 'Polychrome History' of Greek and Roman Sculpture", *J. Art. Hist*, 15, 1.

Kogou, S., Lee, L., Shahtahmassebi, G. and Liang, H. 2020: "A new approach to the interpretation of XRF spectral imaging data using neural, *X-Ray Spectrometry*, 50.4, Special issue: MA-XRF, 310-319. https://doi.org/10.1002/xrs.3188

Lehmann, S. and Löhr, H. (eds) forthcoming: *Antike Wand- und Marmorbilder in Aquarellkopien des Archäologischen Museums, von Otto Donner von Richter und Émile Gilliéron*, Martin-Luther-Universität Halle-Wittenberg.

Lermann, W. 1907: *Altgriechische Plastik. Eine Einführung in die griechische Kunst des archaischen und gebundenen Stils*, Munich.

Levidis, A. and Roussos, T. 2009: *Πλίνιος ο Πρεσβύτερος. Περί της αρχαίας ελληνικής ζωγραφικής. 35ο Βιβλίο της «Φυσικής ιστορίας»*, Athens.

Li, Y., Suzuki, A., Cheung, S.C., Kogou, S. and Liang, H. 2021: "Ground-based remote sensing depth-resolved multimodal material identification of wall paintings at 3-15 m," Proceedings of SPIE, Volume 11784, *Optics for Arts, Architecture, and Archaeology VIII*. https://doi.org/10.1117/12.2593844

Linn, R., Bonaduce, I., Ntsasi, G., Birolo, L., Yasur-Landau, A., Cline, E., Nevin, A. and Lluveras-Tenorio, A. 2018: "Evolved gas analysis-mass spectrometry to identify the earliest organic binder in Aegean style wall paintings", *Angewandte Chemie* 57.40, 13257-13260.

Østergaard, J.S. and Nielsen, A.M. (eds) 2014: *Transformations. Classical Sculpture in Colour*, Copenhagen.

Østergaard, J.S. 2017: "Colour shifts: on methodologies in research on the polychromy of Greek and Roman sculpture", *Proceedings of the Danish Institute at Athens*, 8, 139-166.

Pandermalis, D. 2012: *Archaic Colors*, Athens.

Papadopoulos, J.K. and Camp II, J.McK. 2007: *The art of Antiquity: Piet de Jong and the Athenian Agora.* American School of Classical Studies at Athens, Athens.

Piening, H. 2010: "From scientific findings to reconstruction. The technical background to the scientific reconstruction of colours", in V. Brinkmann, O. Primavesi and M. Hollein (eds), *Circumlitio. The Polychromy of Antique and Mediaeval Sculpture*, Munich, 108-113.

Primavesi, O. 2003: "Farbige Plastik in der antiken Literatur? Vorschläge für eine differenzierte Lesung", in V. Brinkmann and R. Wünsche (eds), *Die Farbigkeit antiker Skulptur*, Munich, 219-237.

Raoul-Rochette, D. 1836: *Peintures antiques inédites précédées de recherches sur l'emploi de la peinture dans la décoration des édifices sacrés et publics, chez les Grecs et chez les Romains: faisan suite aux Monuments Isnédits*, Paris.

Reinach, A. 1921: *La Peinture ancienne – Recueil Milliet. Textes grecs et latins relatifs à l'histoire de la peinture ancienne*, Paris (revised edition 1984).

Romano, F.P., Caliri, C., Nicotra, P., Di Martino, S., Pappalardo, L., Rizzob, F. and Santos, H.C. 2017: "Real-time elemental imaging of large dimension paintings with a novel mobile macro X-ray fluorescence (MA-XRF) scanning technique", *J. Anal. At. Spectrom.* 32:4, 773-781.

Rouveret, A. 1989: *Histoire et imaginaire de la peinture ancienne (Ve siècle av. J.-C. - Ier siècle ap. J.-C.)*, Rome.

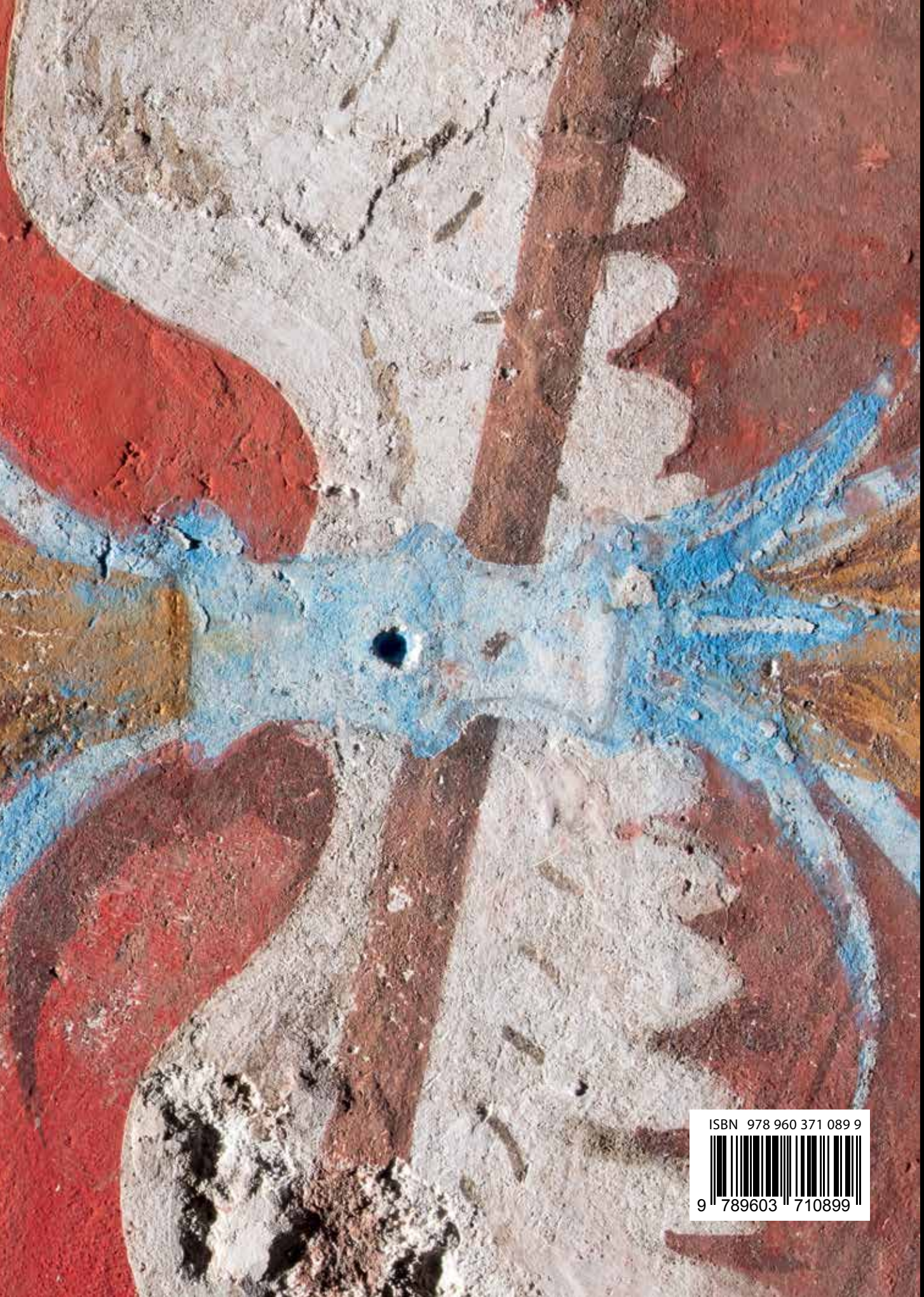
Semper, G. 1834: *Vorläufige Bemerkungen über bemalte Architectur und Plastik ben den Alten*, Altona.

Stager, J.M.S. 2022: *Seeing Color in Classical Art*, Cambridge.

Vandenabeele, P. and Donais, M.K. 2016: "Mobile spectroscopic instrumentation in archaeometry research". *Appl. Spectrosc.* 70.1, 27-41. https://doi.org/10.1177/0003702815611063

Verri, G., Thorsten O. and Lazzarini, L. 2014: "'In picturae modum variata circumlitio'?: the reconstruction of the polychromy of a Roman ideal female head (Treu Head)", in P. Liverani and U. Santamaria (eds), *Diversamente bianco: La policromia della scultura romana*, Rome, 149-183.

Verri, G., Bourgeois, B., Yannick, V., Jeammet, V., Pérez-Arantegui, J., Degano, I and Carò, F. forthcoming: "Purple for the δῆμος: art and luxury in Greek coroplastic polychromy of the 4th-3rd century BCE", in J. Pflug and S. Zink (eds), *Color and Space. Interfaces of Ancient Architecture and Sculpture. Proceedings of the 10th Round Table on Polychromy in Ancient Sculpture and Architecture*, Berlin, November 10-13 2020.



ISBN 978 960 371 089 9