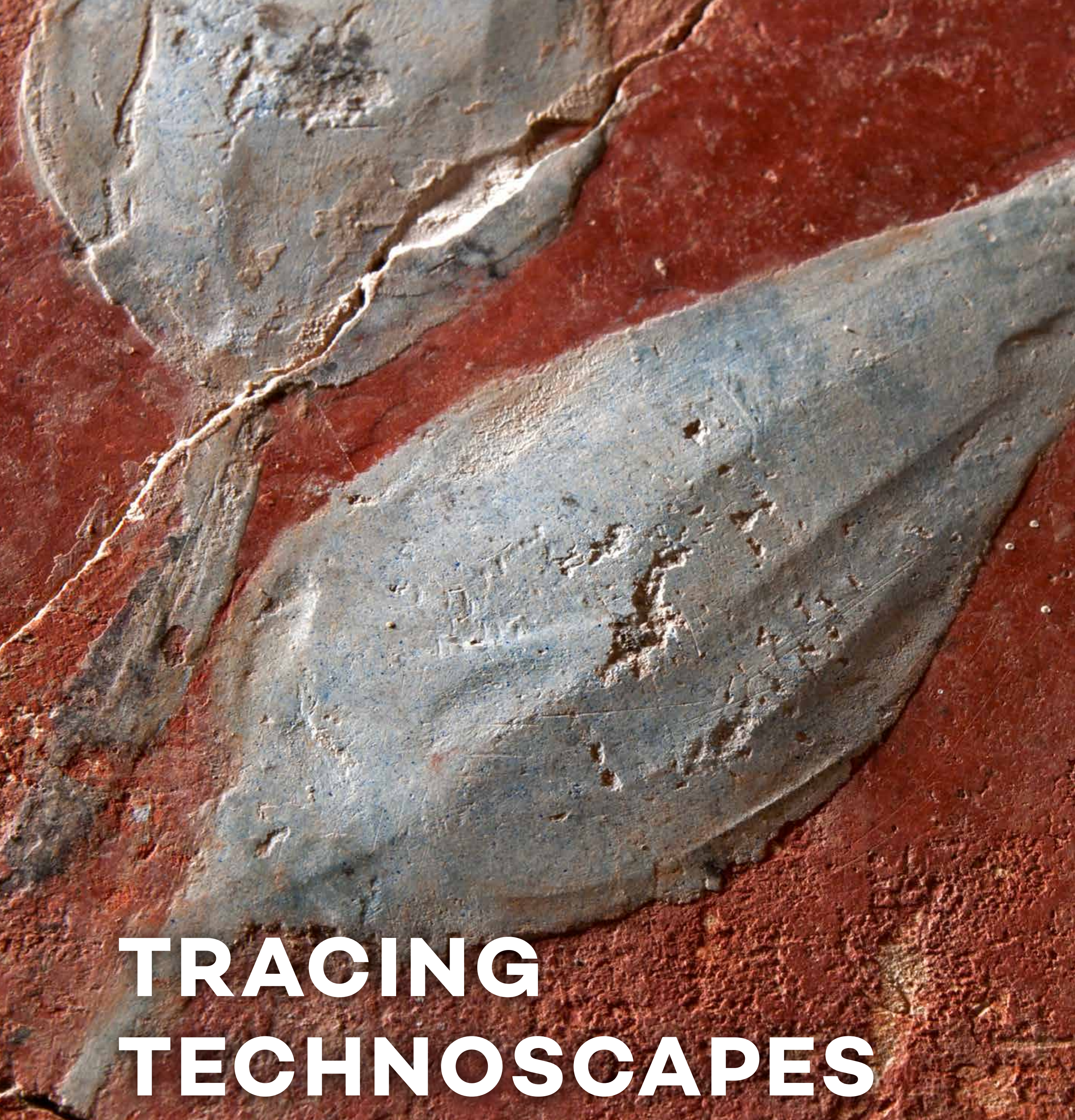

TRACING TECHNOSCAPES

THE PRODUCTION OF BRONZE AGE WALL PAINTINGS IN THE EASTERN MEDITERRANEAN

edited by
Johannes Becker, Johannes Jungfleisch,
and Constance von Rüden

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Sidestone Press

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Published by Sidestone Press, Leiden
www.sidestone.com

Lay-out & cover design: Sidestone Press
Photograph cover: Detail of Fragment F00001 from Tell el-Dab[c]a (by Johannes Becker)

ISBN 978-90-8890-687-9 (softcover)
ISBN 978-90-8890-688-6 (hardcover)
ISBN 978-90-8890-689-3 (PDF e-book)

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Tracing Technoscapes in the Production of Eastern Mediterranean Wall Paintings

An Introduction

Constance von Rüden, Johannes Jungfleisch, and Johannes Becker

Wall paintings as colourful surface treatments form an integral element of vernacular and élite architecture of ancient societies. Despite their often fragmentary state of preservation we can act from the assumption that they furnished most palatial buildings, temples and in general more elaborate houses of the Eastern Mediterranean in the 2nd millennium BCE. During the 19th and most of the 20th century CE, archaeologists and art historians were mainly attracted by the iconography of these paintings, which provides modern beholders with insights about past realities as well as interconnections between different visual systems. But of course, this is only one side of such a material. Beyond iconography, wall paintings offer the long-marginalised opportunity to study the technical aspects inherent in the production of these colourful images. They embody a whole range of specific technical choices and gestures, which are involved in the artistic formation. Within the Eastern Mediterranean a comparison of these technical processes is of greatest interest to understand the extent to which these craft traditions have been interwoven even across the Mediterranean Sea, and thus to trace communication networks or even common traditions.[1]

Regarding the transregional spread of technical knowledge, Arjun Appadurai's concept of different fluid and constantly shifting scapes[2] is particularly interesting. It emanates from his engagement with modern globalisation, by which he realised that the entity of culture and space dissolves through an intensification of worldwide social relations. Instead of confined cultures at specific places, Appadurai describes cul-

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1 First attempts in this direction have been made by Ann Brysbaert, cf. Brysbaert 2007c; Brysbaert 2008.

2 Appadurai 1990; Appadurai 1996.

in: J. Becker, J. Jungfleisch and C. von Rüden (eds.) Tracing Technoscapes. The Production of Bronze Age Wall Paintings in the Eastern Mediterranean (Leiden 2018) 7-26.

tural flows across space and distinguishes five kinds of deterritorialised and interrelated scapes: ethnoscapes, financescapes, mediascapes, ideoscapes and technoscapes.[3] As the Eastern Mediterranean network of the 2nd millennium BCE never reached the degree of interconnection of modern globalisation, it would be misleading to use the term globalisation in this context. Nonetheless, the tight interregional relations observable in this period surely afford a perspective which is not restricted to a local sphere. Similar to Appadurai's concept, a transregional approach is required to understand cultural flows and the layout and quality of the networks behind them. The dynamic flow of different Bronze Age motifs and iconographies, for instance, can be easily described as Appadurai's mediascapes. If it comes to techniques, the term technoscapes is indeed helpful to specifically focus on the transregional flow of different technical practices which obviously reached beyond the single cultural entities we often tend to construct in archaeological research. For this approach it is secondary whether these techniques first emerged within a certain region. It is central that they were not constrained to these groups and communities, but reached individuals and groups beyond, who adopted and transformed these technical practices to something new, aligned to their own needs and desires. Appadurai's concept guides our attention to these flows, their specific quality and to the involved actors. Accordingly, this volume aims not only to present the different wall painting techniques of single sites, but also to contextualise them within the diverse technoscapes of the Eastern Mediterranean. To achieve this research aim, the volume brings different regional research traditions of the Eastern Mediterranean together, as for instance Egyptology, Western Asiatic archaeology and Aegean prehistory, as well as different methodological strains reaching from typology or iconography, archaeometry and conservational studies to specific theoretical considerations.

In the field of Egyptology, technical studies were conducted already since the very beginning of the discipline. The multiple preserved ancient drafts, sketches or remains of preliminary drawings surely inspired the study of planning and painting processes from early on, even though the identification of a figurative canon still was the centre of attention.[4] Since the beginning of the 20th century CE, this interest also emerged in the studies of other regions of the Eastern Mediterranean. Arthur Evans in Knossos,[5] Robert C. Bosanquet in Phylakopi,[6] Gerhart Rodenwaldt in Tiryns,[7] Leonard Woolley in Alalakh[8] and André Parrot in Mari[9] referred to technical aspects within their studies and description of wall paintings from different sites. But while they mentioned such observations rather *en passant*, the early applications of archaeometric methods by Noel Heaton[10] or Harold Barker[11] can surely be considered as pioneer works regarding the

3 Appadurai 1996.
4 For instance the very early descriptions by Charles Blanc (1867), Somers Clarke (1896) or Norman de Garis Davies (1917), Ernest Mackay (1917). For a more recent compilation and restudy see Robins 1994; Robins 2001.
5 Evans 1921, 524–551.
6 Bosanquet 1904, 79.
7 Rodenwaldt 1912.
8 Woolley 1955, 228–232.
9 Parrot 1958.
10 Heaton 1911; Heaton 1912.
11 Barker 1955.

analytical dimensions of wall painting research. They prepared the ground for later studies on the composition of plaster and pigments as well as attempts to identify painting methods, notably whether the pigments had been applied on damp or on dry ground. Even if these archaeometric analyses perhaps might not fulfil our standards today, they represent the first and important attempts to integrate archaeometry into iconographical and technological studies.

In the 1970s, these early technical approaches were primarily utilised within the British tradition and led to further fruitful collaborations. A major actor in this field was surely Mark A. S. Cameron. In his detailed study of the Knossian wall paintings he not only tried to stylistically identify different hands and painting schools, but he also retraced the actual painting process and planning methods by an examination of the overlapping paint layers in a similar way as had been earlier conducted for Egyptian paintings.[12] Moreover, he collaborated with Richard E. Jones and S. E. Philippakis in a major archaeometric article to characterise the pigments and the qualities of different plasters on a statistical base.[13] These scholars' principle research layout was aligned with the earlier studies by Heaton and Barker. By the use of more recent methods and a better statistical base, Cameron and his colleagues were more consistent with the then current processual archaeology and the rising importance of scientific studies which accompanied this development. This *zeitgeist* is also mirrored in other studies of the late 1960s, 1970s and 1980s. Within Aegean archaeology, Lawrence Majewski and Marjorie Reich studied some fresco samples from Ayia Irini,[14] K. Asimenos focused on technical observations on the wall paintings from Thera[15] and Mabel L. Lang integrated a survey of the technique in her book on the wall paintings from Pylos.[16] In Egyptology and Western Asiatic archaeology, archaeometric studies fostered our understanding of the pigments used, as for instance the work by Uta von Eickstedt *et al.*, Ahmed El Goresy *et al.*, Heiner Jaksch, Josef Riederer, Olivier Rouchon *et al.* and Yoko Tomabechi.[17]

Since the last decades of the 20th century CE, the number of archaeometric studies have been steadily increasing.[18] This is particular surprising as it is often extremely difficult to get access and sample permission for fragments stored in the great museums of Egypt, Western Asia, Greece, Europe or the US. This proper boom of archaeometric studies permitted numerous insights into details of the manufacturing process and raw material accession and hence added many formerly neglected aspects.

12 Heaton 1911, 709–710; Evans 1930, 211 fn. 3; Cameron 1976, Vol. I, fig. 41.

13 Cameron *et al.* 1977.

14 Majewski – Reich 1973.

15 Asimenos 1978.

16 Lang 1969, 10–25.

17 Riederer 1974; Tomabechi 1980; El Goresy *et al.* 1986; Jaksch *et al.* 1983; Jaksch 1985; Rouchon *et al.* 1990; von Eickstedt *et al.* 1994.

18 Perdikatsis 1998; El Goresy 2000; Perdikatsis *et al.* 2000; Colinart 2001; Heywood 2001; Pagès-Camagna – Colinart 2003; Pagès-Camagna *et al.* 2006; Photos-Jones *et al.* 2003; Ambers 2004; Daniels *et al.* 2004; Uda *et al.* 2000; Uda *et al.* 2004; Jones – Photos-Jones 2005; Brysbaert 2006; Brysbaert 2007a; Brysbaert 2007b; Winkels 2007; Brecoulaki *et al.* 2008; Brecoulaki *et al.* 2012; Hatton *et al.* 2008; Middleton – Uprichard 2008; Pagès-Camagna *et al.* 2010; Pappalardo *et al.* 2010; Sotiropoulou *et al.* 2012; Westlake *et al.* 2012; Vlachopoulos – Sotiropoulou 2013; Tournavitou – Brecoulaki 2015; Linn *et al.* 2017.

In many archaeometric studies the samples were carefully chosen by colour or technical characteristics. Often, however, the sample fragments were not assignable to a certain painting of the respective corpus. This shortcoming has of course different reasons. One is surely related to the sample permits which mostly allow one to take only non-diagnostic pieces. In other cases, the identification and reconstruction of the single paintings had simply not happened before the samples were taken and, consequently, the archaeometric results cannot be adequately related. Among other reasons, this also surely has to do with the fact that in times of citation indexes it is simply not profitable to invest in a very time-consuming detailed material study and the publication of a monograph, if a prompt analysis of single aspects promises an acceptance in a high-ranked journal. While these shortcomings are indeed understandable in the light of today's research logic and conservation ethics, we need nonetheless to ask to what point they are methodologically acceptable. What does it mean if the analytical results cannot be directly related to a specific painting, and is it indeed possible to extrapolate from a rather randomly chosen sample to the *chaîne opératoire* of every painting in a corpus? Of course, certain technical aspects can be considered as more generally valid, but others are very specific. It goes without saying that some designs afford the choice of specific techniques, materials and tools and that it matters whether it is a large-scale or small-scale image, a figurative or repetitive pattern, or if there are differences in architectural structure etc. This separation of single aspects from the whole manufacture process, and thus an alienation of single details from the technical practice, has been additionally fostered by often costly and very specialised analytical procedures. Therefore, many studies exclusively concentrated on pigments,[19] plaster composition[20] or binders[21] and only a few tried to integrate these archaeometric analyses into a comprehensive study, including the painting process and the design.[22] This one-sidedness can be also observed on the "other side", where only few works reached beyond the analysis of the images into at least the macroscopic observations of the painting process.[23] Nonetheless, the number of integrated and comprehensive studies is rising in the last few years. Nevertheless, they are lacking for many wall painting corpora and regions of the Eastern Mediterranean, and this volume aims to fill some of these gaps and inspire more research in this direction.

Moreover, the above described fragmentation of the painting procedure into single technological aspects has partly resulted in an alienation of the wall painting manu-

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19 Pigments: Perdikatsis 1998; Dandrau 1999; El Goresy 2000; Perdikatsis *et al.* 2000; Uda *et al.* 2000; Colinart 2001; Heywood 2001; Brysbaert 2002; Pagès-Camagna – Colinart 2003; Photos-Jones *et al.* 2003; Uda *et al.* 2004; Jones – Photos-Jones 2005; Brysbaert 2006; Pagès-Camagna *et al.* 2006; Brysbaert 2007a; Hatton *et al.* 2008; Middleton – Uprichard 2008; Pagès-Camagna *et al.* 2010; Sotiropoulou *et al.* 2012; Westlake *et al.* 2012; Vlachopoulos – Sotiropoulou 2013; Linn *et al.* 2017.

20 Plaster: Seeber 2000; Brysbaert 2002; Photos-Jones *et al.* 2003; Uda *et al.* 2004; Jones – Photos-Jones 2005; Brysbaert 2007a; Brysbaert 2007b; Winkels 2007; Middleton – Uprichard 2008; Pagès-Camagna *et al.* 2010; Linn *et al.* 2017.

21 Binders: Brecoulaki *et al.* 2012.

22 Integrated archaeometric studies: Brecoulaki *et al.* 2008; Seeber 2000. Others were more focused on the conservational aspects and have led therefore to a specific focus of the studies: cf. Muller 1990; Muller (under the name of Muller-Pierre) 1993; Seeber 1994; Middleton – Uprichard 2008.

23 Iconography and macroscopic painting process: Bietak *et al.* 2000; Bryan 2001; Dandrau 2001; Robins 2001; Aslanidou 2007; Palyvou, in: Bietak *et al.* 2007, 47, fig. 45; Laboury – Tavier 2010; von Rüden 2011, 53–60; Di Ludovico – Ramazzotti 2012; Hartwig 2013; Angelidis *et al.* in press.

facture from human practices and thus the actor as the centre of these procedure.[24] Controlled experiments, which would be a possibility to bring all these aspects together, are still very few in number.[25] Thus we need to ask how we can overcome this fragmentation and trace the person, his or her habitualised movements and specific choices behind these processes.

The described disintegration is indeed a major problem if we try to compare the paintings and techniques of the different regions in the Eastern Mediterranean. It is often not very informative and methodologically problematic to simply compare single motifs, stylistic elements, pigments or plaster ingredients at the different sites. Without embedding them within a *chaîne opératoire*, within the different access patterns to raw materials and the respective social context, such a comparison remains eclectic, and at best a hint for a possible interrelation. Only the painstaking and time-consuming reconstruction of a *chaîne opératoire* for each painting can be used as a base for further considerations.

But while reconstructing the painting process and studying the techniques we are confronted by several theoretical challenges: In sequencing the *chaîne opératoire* we sometimes tend to treat our evidence as static stages of production, connected by mechanics and physical qualities, and hence prefer to restrict ourselves to the hard facts of externalised technology. By doing this we often marginalise the human sensual entanglement through body techniques and the skill of the craftsperson.[26] It is obvious that it is not enough to sequence all the used raw materials and tools in a linear order, as technical choices and gestures are not only related to environmental aspects and physical characteristics of the materials. They are also guided by norms, taboos, and habitualised customs, which are all integrated in the craftsperson's social practices and the involved discursive and embodied knowledge, or body knowledge as Willeke Wendrich has named it.[27] The cultural dimensions of body techniques have been already described by Marcel Mauss in the 1930s[28] and embodied knowledge and skill have been recently intensively discussed in philosophical, sociological and anthropological studies of apprenticeship.[29] They showed us the complexity of technique transmission from one person to another, no matter if this happened temporarily from generation to generation or spatially as for instance across the Mediterranean.[30] For us as archaeologists parts of the craftsperson's knowledge are reflected in the materialised results of his or her practices: in the plaster and pigment preparation, in the way paint has been applied, and of course also in the conception and execution of the compositions. The theoretically informed analysis of these traces by carefully executed microstudies and archaeometric analysis can trace not only the technological aspects of the *chaîne opératoire*, but also the far-reaching social aspects involved in the personal

24 Cf. discussion, von Rüden 2015a.
25 Chryssikopoulou *et al.* 2000.
26 For a critique, see von Rüden 2015a; von Rüden 2017.
27 Wendrich 2006; Wendrich 2012. See also Dobres 2000, 164–211.
28 Mauss 1973.
29 Cf. Downey 2010; Marchand 2010; Ingold 2011a; Ingold 2011b; Ingold 2011c; Ingold 2011d; Ingold 2013.
30 In Eastern Mediterranean archaeology, see for instance Brysbaert 2002; Brysbaert 2007c; Brysbaert 2008; von Rüden 2015a; von Rüden 2015b; von Rüden 2017.

knowledge of the craftsperson. These recent anthropological and theoretical developments have the potential to foster a more comprehensive approach by bringing all these single valuable strains together into a more holistic interpretation.

Apart from the already discussed methodological and theoretical challenges we are also confronted with very practical problems: the different traditions in the respective subfields of archaeology. These lead to specific foci and consequently to different research questions which often hamper a direct comparison of the varying corpora. Consequently, we thought that a workshop with a clear focus on technical aspects could be a first step to provide insights into the various technical approaches and underlying bodies of knowledge in the different wall painting traditions of the Eastern Mediterranean, Egypt, and West Asia. To highlight these different regional traditions and of course possible deviations and transcultural developments, we decided to organise the volume according to the different geographical regions. We are aware of the danger that this might be interpreted as the desire to describe culturally enclosed entities. Since all the editors are currently concentrated on the case of Tell el-Dab^{c}a with its obvious transregional interwovenness, we hope that we can convince the reader that such is not the aim. On the contrary, it is simply the attempt to find a possible and rather neutral organisation, even though the latter is never possible in total.

The Western Asian section consists of four papers tackling technical issues of the paintings from Ebla and Mari in modern Syria, Tell el-Burak in Lebanon and Tel Kabri in Israel. The chronologically earliest paper is a contribution by Alessandro Di Ludovico and Marco Ramazzotti and permits us a deep insight into the still very poorly known Early Bronze Age paintings from Syria. In their article "Wall Painting Techniques in Early Bronze Syria. Clues of Parallelism with the Traditions of the Mediterranean and Mesopotamian Regions"[31] they present a detailed study of the macroscopically observable details and reconstruct the planning method and workflow conducted for a repetitive decorative scheme of a profiled door frame in Building FF2 at Ebla. Based on the material traces of theses wall paintings, the authors reveal possible cross-cultural craft interactions between the Levant and Mesopotamia in the Early Bronze Age.

The following article deals with the largest corpus of paintings known to us from Bronze Age Syria: Mari. Béatrice Muller, who has dedicated many years of research to this important material and has scientifically supported and evaluated the most recent conservation of many of those fragments now in the Louvre in Paris,[32] contributes a paper with the title "Contextes techniques et historiques des peintures murales du Grand Palais Royal de Mari. Une mise au point". In this stimulating article she collects for the first time all the technical and analytical data available from this important corpus and brings to light not only the different used plaster and paint techniques, but also offers important insights into the chronology of these paintings within the Great Palace of Mari.

The rather recently found wall paintings from Tell el-Burak in the coastal zone of Lebanon are the central focus of the article "Preliminary Remarks on the Technical and

31 Some aspects have been formerly discussed in two article by the same authors, cf. Di Ludovico – Ramazzotti 2011; Di Ludovico – Ramazzotti 2012. See also the fragments found in Tell el-Sweyhat (Holland 2001).

32 Muller 1990; Muller (under the name of Muller-Pierre) 1993.

Iconographical Aspects of the Middle Bronze Age Wall Paintings from Tell el-Burak (Lebanon) in Relation to the Aegean and Egypt" by Julia Bertsch. The astonishing paintings with their distinct Egyptian, but also local iconographic elements, are an extraordinary finding from the Levant. Julia Bertsch's study of the paintings and their technical aspects has shown for instance that the red outlines of the sketches were executed on still damp plaster. This might indicate a technical relation to those paintings from Hattusha,[33] Alalakh,[34] Qaṭna,[35] or Tel Kabri,[36] which in general are primarily related to Aegean traditions.[37]

The last paper in this section with the title "The Advantages of Visible Induced Luminescence Technique for the Investigation of Aegean-style Painting" by Ravit Linn, Eric H. Cline and Assaf Yasur-Landau explores new technological ways of analysing Egyptian Blue with Visible Induced Luminescence Imaging technique. This new method allows them to trace and characterise the use of Egyptian Blue in the findings from Tel Kabri and to exclude the use of other blue pigments.[38] Moreover, it helped to characterise the way the pigment was spread, layered or mixed with other pigments and, therefore, has proven to be a helpful archaeometric approach for the study of pigment's use.

The first contribution of the Egyptian session, written by Bianca Madden and Hugues Tavier, discusses "Original Painting Techniques. Methods and Materials in 18th Dynasty Tombs in the Valley of Nobles, Egypt". By their multi-disciplinary approach they investigate the methods, techniques, raw materials, and painting procedures used in the Theban élite tombs from different perspectives through the integration of archaeometric, conservational and archaeological data in an exemplary manner. As an almost holistic approach, the paper reveals many highly important details of this craft and raises many new seminal questions for future research.

The palace of Malqata, one of the few surviving palaces from ancient Egypt, is the central topic of the next article "Malqata – The Painted Palace". Based on the documentation of the Tytus and the Metropolitan Expeditions, Peter Lacovara and Alexandra Winkels provide us with an invaluable overview of its architecture and decoration program. Moreover, they permit us an insight into the first results of an ongoing in-depth archaeometric analysis which has already revealed details of the different plaster types used in this corpus. In addition, the authors provide evidence that the paintings – at least in the case of decorated floors – were executed on still moist lime plaster, an approach which reminds us of examples from Tell el-Amarna.[39]

The following three contributions are mainly dedicated to the huge corpus of painting fragments discovered at the site of Tell el-Dabᶜa in the eastern Nile delta. In "How to Paint a Landscape. Technical Perspectives on the 'Aegean'-style Landscape Paintings

33 von Rüden – Jungfleisch 2017.
34 Woolley 1955; von Rüden in press.
35 von Rüden 2011; von Rüden 2017.
36 Cline *et al.* 2011; Cline – Yasur-Landau 2013.
37 For more general approaches on this problem, see Niemeier – Niemeier 2000; Bietak 2007; von Rüden 2013.
38 As it has, for instance, been shown by A. Brysbaert regarding the use of lapis lazuli in Mycenean Greece, see Brysbaert 2006.
39 Weatherhead 2001, 58; Weatherhead 2007, 361–375.

from Tell el-Dab^{c}a" Johannes Becker explores the way a large-scale griffin in a landscape setting[40] was executed and follows the *chaîne opératoire* of this painting from the application of the rough plaster coat to the final polishing of the surface. By tracing the technical practices, it becomes clear that final work steps were executed on the still malleable surface and, moreover, that the craftspersons seemed to intend to paint on damp plaster. Notwithstanding that this painting is highly fragmented, the various steps of the painting process are clearly traceable. Despite differences in the specific execution technique, technical details hint to an approach similar to the *giornata* of later Renaissance painters.

Johannes Jungfleisch draws our attention in his paper "For Further Information Please See the Back of the Plaster. Architectural Impressions in the 'Aegean'-style Wall Paintings from Tell el-Dab^{c}a" to the rear side of the plaster and hence to the impressions of now bygone architectural features. His detailed analysis of the ceiling plaster and the 'Aegean'-style architectural simulations from 'Palace G' at Tell el-Dab^{c}a[41] illustrates how the rather neglected reverse sides of plaster fragments can be examined to retrace the structure and construction techniques of the wall paintings' often poorly preserved architectural contexts. Besides these methodological aspects he addresses the question of possible cross-cultural craft interactions based on the plaster technique within an élite building, which evidently mingles local and Aegean architectural features.

"Between Common Craft Tradition and Deviation. The Making of Stucco Reliefs in the Eastern Mediterranean" is the title of the paper by Constance von Rüden and Tobias Skowronek. It focuses on the manufacture technique of the stucco reliefs from Tell el-Dab^{c}a in comparison to those from the 'palace' of Knossos. By an analysis of the raw materials and the reconstruction of the craft's *chaîne opératoire,* the contribution aims to reveal the specific technical choices and habitualised procedures in this process and compares it with practices traceable in the Aegean to identify common craft tradition, as well as deviations in both regions.

Although Lyvia Morgan's paper "Forming the Image. Approaches to Painting at Ayia Irini, Kea and Tell el-Dab^{c}a" was placed in the Aegean session, it is equally related to Egypt. As she has had the opportunity to study wall paintings from two sites, she compares the techniques used in painting small-scale friezes at Ayia Irini on the Cylcladic island of Kea and Tell el-Dab^{c}a in the Nile Delta. Morgan focuses on the pigments used, how the images were planned and the order in which the paints were applied. In doing so, her comparative study of the painting processes aims to provide insights into the network of artistic interconnections.

In the article "The Find Contexts of Knossian Relief Wall Paintings. Some Ramifications", Matthew Haysom discusses a topic which is central to every technical study of Aegean murals: the divergent chronologies ascribed to the important wall painting finds from the palace of Knossos. In focusing on one particular group of wall paintings, the so-called relief paintings, Haysom examines their stratigraphic evidence on basis of Mackenzie's original excavation records. His evaluation of the contextual data provides detailed insights not only into the circumstances of finding but also into the history of research on the contested dates. On this base he argues for a major

40 Becker 2016.
41 Jungfleisch 2016.

chronological shift in Knossian relief painting which Haysom conclusively considers in the light of the broader history of the Aegean.

The final paper of this volume by Sofia Michailoglou, Maria Karoglou and Asterios Bakolas "Bronze Age Wall Paintings from Thebes. Technical Aspects and State of Conservation" presents new results regarding wall paintings from the three known centres of Late Bronze Age Boeotia. Their comprehensive archaeometric analysis of selected wall painting fragments from Thebes, Gla and Orchomenos addresses both pigments and plaster composition which finally leads to a better understanding of the manufacturing technique used on the Greek mainland.

Concluding, we want to take the opportunity to thank the organisers of the 10th ICAANE in Vienna for hosting our workshop at this successful event. We are especially grateful to Manfred Bietak and his steady commitment and support for the Tell el-Dabca wall painting project in general and specifically for this workshop. In addition, we would like to thank Barbara Horejs for the initial suggestion to submit a workshop related to the wall paintings of the Eastern Mediterranean. In the process of transforming the workshop contributions into a book we benefitted greatly from the linguistic commentaries and corrections of Roselyn Campbell and the copy editing of Sören Pfeiffer. We would like to thank both for their efforts and work.

References

Ambers 2004

J. C. Ambers, Raman analysis of pigments from the Egyptian Old Kingdom, Journal of Raman Spectroscopy 35, 2004, 768–773.

Angelidis *et al.* in press

P. Angelidis – L. Kalambouki – S. Sotiropoulou – M. Hamaoui, Τα προσχέδια στις τοιχογραφίες του Ακρωτηρίου (The preliminary designs in the Akrotiri wall-paintings), in: A. Vlachopoulos (ed.), ΧΡΩΣΤΗΡΕΣ. PAINT BRUSHES. Wall-Painting and Vase-Painting of the 2nd Millennium BC in Dialogue (Athens in press).

Appadurai 1990

A. Appadurai, Disjuncture and difference in the global economy, Theory, Culture & Society 7, 1990, 295–310.

Appadurai 1996

A. Appadurai, Modernity at Large. Cultural Dimensions of Globalization (Minneapolis 1996).

Asimenos 1978

K. Asimenos, Technological observations on the Thera wall-paintings, in: C. Doumas (ed.), Thera and the Aegean World I. Papers Presented at the Second International Scientific Congress, Santorini, Greece, August 1978 (London 1978) 571–578.

Aslanidou 2007
K. Aslanidou, Some ornamental scenes on the wall paintings from Tell el-Dab^{c}a. Iconography and context, in: M. Bietak – E. Czerny (eds.), The Synchronisation of Civilisations in the Eastern Mediterranean in the Second Millennium B.C. III. Proceedings of the SCIEM 2000 – 2nd EuroConference in Vienna, May 28th – June 1st 2003, Contributions to the Chronology of the Eastern Mediterranean 9, Denkschriften der Gesamtakademie 37 (Vienna 2007) 191–205.

Barker 1955
H. Barker, Examination of fragments of mural paintings from Atchana, in: Woolley 1955, 233–234.

Becker 2016
J. Becker, The large-scale landscape paintings of Tell el-Dab^{c}a/Egypt, in: R. A. Stucky – O. Kaelin – H.-P. Mathys (eds.), Proceedings of the 9th International Congress on the Archaeology of the Ancient Near East, June 9th–13th, 2014, University of Basel Vol. 2 (Wiesbaden 2016) 23–35.

Bietak 2007
M. Bietak, Bronze Age paintings in the Levant. Chronological and cultural considerations, in: M. Bietak – E. Czerny (eds.), The Synchronisation of Civilisations in the Eastern Mediterranean in the Second Millennium B.C. III. Proceedings of the SCIEM 2000 – 2nd EuroConference in Vienna, May 28th – June 1st 2003, Contributions to the Chronology of the Eastern Mediterranean 9, Denkschriften der Gesamtakademie 37 (Vienna 2007) 269–300.

Bietak *et al.* 2000
M. Bietak – N. Marinatos – C. Palyvou, The maze tableau from Tell el-Dab^{c}a, in: Sherratt 2000, 77–90.

Bietak *et al.* 2007
M. Bietak – N. Marinatos – C. Palyvou, Taureador Scenes in Tell el-Dab^{c}a (Avaris) and Knossos, Denkschriften der Gesamtakademie 43, Untersuchungen der Zweigstelle Kairo des Österreichischen Archäologischen Institutes 27 (Vienna 2007).

Blanc 1867
Ch. Blanc, Grammaires des arts du dessin. Architecture, sculpture, peinture (Paris 1867).

Bosanquet 1904
R. C. Bosanquet, The wall-paintings, in: T. D. Atkinson – R. C. Bosanquet – C. C. Edgar – A. J. Evans – D. G. Hogarth – D. MacKenzie – C. Smith – F. B. Welch (eds.), Excavations at Phylakopi in Melos Conducted by the British School at Athens, The Society for the Promotion of Hellenic Studies Supplementary Paper 4 (London 1904) 70–79.

Brecoulaki *et al.* 2008

H. Brecoulaki – C. Zaitoun – S. R. Stocker – J. L. Davis – A. G. Karydas – M. P. Colombini – U. Bartolucci, An archer from the Palace of Nestor. A new wall-painting fragment in the Chora Museum, Hesperia. The Journal of the American School of Classical Studies at Athens 77,3, 2008, 363–397.

Brecoulaki *et al.* 2012

H. Brecoulaki – A. Androetti – I. Bonaduce – M. P. Colombini – A. Lluveras, 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, Journal of Archaeological Science 39, 2012, 2866–2876.

Bryan 2001

B. M. Bryan, Painting techniques and artisan organization in the tomb of Suemniwet, Theban Tomb 92, in: Davies 2001, 63–72.

Brysbaert 2002

A. Brysbaert, Common craftsmanship in the Aegean and East Mediterranean Bronze Age. Preliminary technological evidence with emphasis on the painted plaster from Tell el-Dab^{c}a, Egypt, Egypt and the Levant 12, 2002, 95–107.

Brysbaert 2006

A. Brysbaert, Lapis lazuli in an enigmatic 'purple' pigment from a thirteenth-century BC Greek wall painting, Studies in Conservation 51,4, 2006, 252–266.

Brysbaert 2007a

A. Brysbaert, A technological approach to the painted plaster of Tell el-Dab^{c}a, Egypt. Microscopy and scientific analysis, in: Bietak *et al.* 2007, 151–162.

Brysbaert 2007b

A. Brysbaert, Murex uses in plaster features in the Aegean and Eastern Mediterranean Bronze Age, Mediterranean Archaeology and Archaeometry 7,2, 2007, 29–51.

Brysbaert 2007c

A. Brysbaert, Cross-craft and cross-cultural interactions during the Aegean and Eastern Mediterranean Late Bronze Age, in: S. Antoniadou – A. Pace (eds.), Mediterranean Crossroads (Athens 2007) 325–359.

Brysbaert 2008

A. Brysbaert, The Power of Technology in the Bronze Age Eastern Mediterranean. The Case of the Painted Plaster, Monographs in Mediterranean Archaeology 12 (London 2008).

Cameron 1976

M. A. S. Cameron, A General Study of Minoan Frescoes with Particular Reference to Unpublished Wall Paintings from Knossos (PhD Diss., Newcastle University, Newcastle upon Tyne 1976). Online <http://hdl.handle.net/10443/302> (last access 15 July 2017).

Cameron *et al.* 1977

M. A. S. Cameron – R. E. Jones – S. E. Philippakis, Scientific analyses of Minoan fresco samples from Knossos, Annual of the British School at Athens 72, 1977, 122–184.

Chryssikopoulou *et al.* 2000

E. Chryssikopoulou – V. Kilikoglou – V. Perdikatsis – S. Sotiropoulou – K. Birtacha – M. Zacharioudakis, Making wall paintings. An attempt to reproduce the painting techniques of Bronze Age Thera, in: Sherratt 2000, 119–129.

Clarke 1896

S. Clarke, Of the methods used in making and ornamenting an Egyptian rock tomb, Archaeologia. Or Miscellaneous Tracts Relating to Antiquity 55, 1896, 21–32.

Cline – Yasur-Landau 2013

E. H. Cline – A. Yasur-Landau, Aegeans in Israel. Minoan frescoes at Tel Kabri, Biblical Archaeology Review 39,4, 2013, 37–44, 64.

Cline *et al.* 2011

E. H. Cline – A. Yasur-Landau – N. Goshen, New fragments of Aegean-style painted plaster from Tel Kabri, Israel, American Journal of Archaeology 115, 2011, 245–261.

Colinart 2001

S. Colinart, Analysis of inorganic yellow colour in ancient Egyptian painting, in: Davies 2001, 1–4.

Dandrau 1999

A. Dandrau, La peinture murale minoenne, I. La palette du peintre égéen et égyptien à l'Age du Bronze. Nouvelles données analytiques, Bulletin de Correspondance Hellénique 123,1, 1999, 1–41.

Dandrau 2001

A. Dandrau, La peinture murale minoenne, III. Méthodes et techniques d'exécution, Bulletin de Correspondance Hellénique 125,1, 2001, 41–66.

Daniels *et al.* 2004

V. Daniels – R. Stacey – A. Middleton, The blackening of paint containing Egyptian blue, Studies in Conservation 49,4, 2004, 217–230.

Davies 2001
W. V. Davies (ed.), Colour and Painting in Ancient Egypt (London 2001).

Dobres 2000
M.-A. Dobres, Technology and Social Agency. Outlining a Practice Framework for Archaeology (Oxford 2000).

Downey 2010
G. Downey, 'Practice without theory'. A neuroanthropological perspective on embodied learning, Journal of the Royal Anthropological Institute 16, 2010, 22–40.

von Eickstedt *et al.* 1994
U. von Eickstedt – A. Unger – R. Wartke, Untersuchungen an den Resten bemalten Wandputzes aus Kar Tukulti Ninurta, in: R.-B. Wartke (ed.) Handwerk und Technologie im Alten Orient. Ein Beitrag zur Geschichte der Technik im Altertum. Internationale Tagung Berlin 12–15 März 1991 (Mainz 1994) 17–27.

Evans 1921
A. J. Evans, The Palace of Minos. A Comparative Account of the Successive Stages of the Early Cretan Civilization as Illustrated by the Discoveries at Knossos Vol. I (London 1921).

Evans 1930
A. J. Evans, The Palace of Minos. A Comparative Account of the Successive Stages of the Early Cretan Civilization as Illustrated by the Discoveries at Knossos Vol. III (London 1930).

El Goresy 2000
A. El Goresy, Polychromatic wall painting decorations in monuments of Pharaonic Egypt. Compositions, chronology and painting techniques, in: Sherratt 2000, 49–70.

El Goresy *et al.* 1986
A. El Goresy – H. Jaksch – M. Abdel Razek – K. L. Weiner, Ancient Pigments in Wall Paintings of Egyptian Tombs and Temples. An Archaeometric Project, Heidelberg, Max-Planck-Institut für Kernphysik (1986 unpublished).

De Garis Davies 1917
N. de Garis Davies, Egyptian drawings on limestone flakes, Journal of Egyptian Archaeology 4,4, 1917, 234–240.

Hartwig 2013
M. Hartwig (ed.), The Tomb Chapel of Menna (TT 69). The Art, Culture, and Science of Painting in an Egyptian Tomb, American Research Centre in Egypt Conservation Series 5 (Cairo, New York 2013).

Hatton *et al.* 2008

G. D. Hatton – A. J. Shortland – M. S. Tite, The production technology of Egyptian Blue and green frits from second millennium BC Egypt and Mesopotamia, Journal of Archaeological Science 35, 2008, 1591–1604.

Heywood 2001

A. Heywood, The use of huntite as white pigment in ancient Egypt, in: Davies 2001, 5–9.

Heaton 1911

N. Heaton, Minoan lime-plaster and fresco painting, Journal of the Royal Institute of British Architects 18, 1911, 697–710.

Heaton 1912

N. Heaton, On the nature and method of execution of specimens of painted plaster from the palace of Tiryns, in: Rodenwaldt 1912, 211–216.

Holland 2001

T. A. Holland, Third millennium wall paintings at Tell es-Sweyhat, Syria, in: J.-W. Meyer – M. Novák – A. Pruß (eds.), Beiträge zur Vorderasiatischen Archäologie Winfried Orthmann gewidmet (Frankfurt on Main 2001) 170–179.

Ingold 2011a

T. Ingold, The Perception of the Environment. Essays on Livelihood, Dwelling and Skill (London 2011).

Ingold 2011b

T. Ingold, Tools, Minds and machines. An excursion to the philosophy of technology, in: Ingold 2011a, 295–311.

Ingold 2011c

T. Ingold, Society, nature and the concept of technology, in: Ingold 2011a, 312–322.

Ingold 2011d

T. Ingold, Of string bags and birds' nests. Skill and the construction of artefacts. In: Ingold 2011a, 349–361.

Ingold 2013

T. Ingold, Making. Anthropology, Archaeology, Art and Architecture (London 2013).

Jaksch 1985

H. Jaksch, Farbpigmente aus Wandmalereien altägyptischer Gräber und Tempel. Technologien der Herstellung und mögliche Herkunftsbeziehungen (PhD Diss., University of Heidelberg, Heidelberg 1985).

Jaksch *et al.* 1983
H. Jaksch – W. Seipel – K. L. Weiner – A. El Goresy, Egyptian Blue – Cuprorivaite. A window to ancient Egyptian technology, Die Naturwissenschaften 70, 1983, 525–535.

Jones – Photos-Jones 2005
R. E. Jones – E. Photos-Jones, Technical studies of Aegean Bronze Age wall painting. Methods, results and future prospects, in: L. Morgan (ed.), Aegean Wall Painting. A Tribute to Mark Cameron, British School at Athens Studies 13 (London 2005) 199–228.

Jungfleisch 2016
J. Jungfleisch, When Aegean wall paintings meet Egyptian architecture. Simulations of architecture from 'Palace G' at Tell el-Dab^{c}a/Egypt, in: R. A. Stucky – O. Kaelin – H.-P. Mathys (eds.), Proceedings of the 9th International Congress on the Archaeology of the Ancient Near East, June 9th–13th, 2014, University of Basel Vol. 2 (Wiesbaden 2016) 37–50.

Laboury – Tavier 2010
D. Laboury – H. Tavier, À la recherche des peintres de la nécropole thébaine sous la 18^{e} dynastie. Prolégomènes à une analyse des pratiques picturales dans la tombe d'Amenemopé (TT 29), in: E. Warmenbol – V. Angenot (eds.), Thèbes aux 101 portes. Mélanges à la mémoire de Roland Tefnin, Monumenta Aegyptiaca 12 (Turnhout 2010) 91–106.

Lang 1969
M. L. Lang, The Palace of Nestor at Pylos in Western Messenia II. The Frescoes (Princeton 1969).

Linn *et al.* 2017
R. Linn – E. H. Cline – A. Yasur-Landau, Technological study of Middle Bronze Age painted plaster fragments from the Canaanite palace of Tel Kabri, Israel. Materials and painting techniques, Journal of Archaeological Science. Reports 13, 2017, 466–475.

Di Ludovico – Ramazzotti 2011
A. Di Ludovico – M. Ramazzotti, Design at Ebla. The decorative system of a painted wall decoration, Orientalia 80, 2011, 66–80.

Di Ludovico – Ramazzotti 2012
A. Di Ludovico – M. Ramazzotti, White, red and black. Technical relationships and stylistic perceptions between colours, lights and places in Mesopotamia and Syria during the third millennium BC, in: R. Matthews – J. Curtis (eds.), Proceedings of the 7th International Congress on the Archaeology of the Ancient Near East, 12–16 April 2010, the British Museum and UCL, London Vol. 2 (Wiesbaden 2012) 287–302.

Mackay 1917
E. Mackay, Proportion squares on tomb walls in the Theban Necropolis, Journal of Egyptian Archaeology 4, 1917, 74–85.

Majewski – Reich 1973
L. J. Majewski – M. Reich, Appendix. Technical examination of fresco samples from excavations at Ayia Irini, in: K. Coleman, Frescoes from Ayia Irini, Keos. Part 1, Hesperia 42,3, 1973, 297–300.

Marchand 2010
T. H. J. Marchand, Introduction. Making knowledge. Exploration of the indissoluble relation between mind, body, and environment, in: T. H. J. Marchand (ed.), Making Knowledge. Explorations of the Indissoluble Relation Between Mind, Body and Environment, Journal of the Royal Anthropological Institute Special Issue Book Series 4 (London 2010) 1–21.

Mauss 1973
M. Mauss, Techniques of the body, Economy and Society 2,1, 1973, 70–88.

Middleton – Uprichard 2008
A. Middleton – K. Uprichard (eds.), The Nebamun Wall Paintings. Conservation, Scientific Analysis and Display at the British Museum (London 2008).

Muller 1990
B. Muller, Rapport sur la restauration de peintures murales provenant de la cour 106 du palais de Mari pour le Département des Antiquités orientales du musée du Louvre, CEPMR / ENS (1990 unpublished).

Muller (under the name of Muller-Pierre) 1993
B. Muller-Pierre, Des peintures fragmentaires de la cour 106 du palais de Mari restaurées pour le musée du Louvre, Mari. Annales de Recherches Interdisciplinaires 7, 1993, 355–358.

Niemeier – Niemeier 2000
B. Niemeier – W.-D. Niemeier, Aegean Frescoes in Syria-Palestine. Alalakh and Tel Kabri, in: Sherratt 2000, 763–802.

Pagès-Camagna – Colinart 2003
S. Pagès-Camagna – S. Colinart, The Egyptian green pigment. Its manufacturing process and links to Egyptian blue, Archaeometry 45,4, 2003, 637–658.

Pagès-Camagna *et al.* 2006
S. Pagès-Camagna – I. Reiche – C. Brouder – D. Cabaret – S. Rossano – B. Kanngiesser – A. Erko, New insights into the colour origin of archaeological Egyptian blue and green by XAFS at the Cu K-edge, X-Ray Spectrometry 35,2, 2006, 141–145.

Pagès-Camagna *et al.* 2010

S. Pagès-Camagna – E. Laval – D. Vigears – A. Duran, Non-destructive and in situ analysis of Egyptian wall paintings by X-ray diffraction and X-ray fluorescence portable systems, Applied Physics A. Materials Science & Processing 100,3, 2010, 671–681.

Pappalardo *et al.* 2010

L. Pappalardo – G. Pappalardo – F. Rizzo – F. P. Romano – V. La Rosa, Non-destructive, 'in situ' characterization of pigments in Minoan pottery at the stratigrafical museum of Phaistos (Crete), X-Ray Spectrometry 39,3, 2010, 230–232.

Parrot 1958

A. Parrot, Mission archéologique de Mari 2. Le palais 2. Peintures murales, Bibliothèque archéologique et historique 69 (Paris 1958).

Perdikatsis 1998

V. Perdikatsis, Analysis of Greek Bronze Age wall painting pigments, in: S. Colinart – M. Menu (eds.), La couleur dans la peinture et l'émaillage de l'Égypte ancienne. Actes de la table ronde, Ravello, 20–22 Mars 1997 (Bari 1998) 103–108.

Perdikatsis *et al.* 2000

V. Perdikatsis – V. Kilikoglou – S. Sotiropoulou – E. Chryssikopoulou, Physicochemical characterisation of pigments from Theran wall paintings, in: Sherratt 2000, 103–118.

Photos-Jones *et al.* 2003

E. Photos-Jones – R. E. Jones – A. J. Hall, Appendix 4. Technical report on painted plaster fragments from the Greek-Swedish excavations at Kastelli, Khania, Crete, in: E. Hallager – B. P. Hallager (eds.), The Greek-Swedish Excavations at the Agia Aikaterini Square Kastelli, Khania 1970–1987 and 2001 Vol. III,1. The Late Minoan IIIB:2 Settlement, Acta Instituti Atheniensis Regni Sueciae. Series in Quarto 47,3,1 (Stockholm 2003) 306–320.

Riederer 1974

J. Riederer, Recently identified Egyptian pigments, Archaeometry 16,1, 1974, 102–109.

Robins 1994

G. Robins, Proportion and Style in Ancient Egyptian Art (Austin 1994).

Robins 2001

G. Robins, The use of the squared grid as a technical aid for artists in Eighteenth Dynasty painted Theban tombs, in: Davies 2001, 60–62.

Rodenwaldt 1912
G. Rodenwaldt, Tiryns. Die Ergebnisse der Ausgrabungen des Instituts II. Die Fresken des Palastes (Athens 1912).

Rouchon *et al.* 1990
O. Rouchon – J. Fabre – M.-P. Etcheverry – M. Schvoerer, Pigments d'Égypte. Étude physique de matières colorantes bleue, rouge, blanche, verte et jaune, provenant de Karnak, Revue d'Archéométrie 14, 1990, 87–97.

von Rüden 2011
C. von Rüden, Die Wandmalereien aus Tall Mišrife/Qaṭna im Kontext überregionaler Kommunikation, Qaṭna Studien 2 (Wiesbaden 2011).

von Rüden 2013
C. von Rüden, Beyond the east-west dichotomy in Syrian and Levantine wall paintings, in: B. A. Brown – M. H. Feldman (eds.), Critical Approaches to Ancient Near Eastern Art (Berlin 2013) 55–78.

von Rüden 2015a
C. von Rüden, Approaching ancient techniques. From technology to bodily learning and skill, in: W. Gauß – G. Klebinder-Gauß – C. von Rüden (eds.), The Transmission of Technical Knowledge in the Production of Ancient Mediterranean Pottery. Proceedings of the International Conference at the Austrian Archaeological Institute at Athens, 23rd–25th November 2012, Österreichisches Archäologisches Institut Sonderschriften 54 (Vienna 2015) 35–49.

von Rüden 2015b
C. von Rüden, Transmediterranean knowledge and Minoan style reliefs in Tell el-Dabᶜa. An attempt at paradigm shift, in: S. Cappel – U. Günkel-Maschek – D. Panagiotopoulos (eds.), Minoan Archaeology. Perspectives for the 21st Century. Proceedings of the International PhD and Post-Doc Conference at Heidelberg, 23–27 March 2011 (Louvain 2015) 355–365.

von Rüden 2017
C. von Rüden, From mechanics to embodiment. Some theoretical considerations on techniques, in: P. Eisenach – T. Stöllner – A. Windler (eds.), The RITaK conferences 2013–2014. Raw Materials, Innovation, Technology of Ancient Cultures. RITaK 1, Der Anschnitt. Beiheft 34 (Bochum 2017) 71–79.

von Rüden in press.
C. von Rüden, Reconsidering the Alalakh Frescoes within their Levantine Context, in: A. Yener *et al.* (eds.), Alalakh 15th Anniversary. Conference held at the New Hatay Archaeological Museum, Antakya, Ancient Near Eastern Studies (in press).

von Rüden – Jungfleisch 2017
C. von Rüden – J. Jungfleisch, Incorporating the other. A transcultural perspective on some wall painting fragments from Hattusha, in: A. Schachner (ed.), Innovation versus Beharrung. Was macht den Unterschied des hethitischen Reichs im Anatolien des 2. Jahrtausends v. Chr.? Internationaler Workshop zu Ehren von Jürgen Seeher, Istanbul 23.–24. Mai 2014, Byzas 23 (Istanbul 2017) 61–83.

Seeber 1994
R. Seeber, Minoische Fresken in Ägypten, Restauratorenblätter 14, 1994, 12.

Seeber 2000
R. Seeber, The technique of plaster preparation for the Minoan wall paintings at Tell el-Dab^{c}a, Egypt. Preliminary results, in: Sherratt 2000, 91–102.

Sherratt 2000
S. Sherratt (ed.), Proceedings of the First International Symposium 'The Wall Paintings of Thera', Petros M. Nomikos Conference Centre Thera, Hellas, 30 August – 4 September 1997 (Athens 2000).

Sotiropoulou *et al.* 2012
S. Sotiropoulou – V. Perdikatsis – K. Birtacha – C. Apostolaki – A. Devetzi, Physicochemical characterization and provenance of colouring materials from Akrotiri-Thera in relation to their archaeological context and application, Archaeological and Anthropological Sciences 4,4, 2012, 263–275.

Tomabechi 1980
Y. Tomabechi, Wall-paintings and related color schemes of the Old Babylonian Mari architectures, Sumer. A Journal of Archaology (and History) in Iraq 36, 1980, 139–150.

Tournavitou – Brecoulaki 2015
I. Tournavitou – H. Brecoulaki, The Mycenaean wall paintings from Argos. A preliminary presentation, in: H. Brecoulaki – J. L. Davis – S. R. Stocker (eds.), Mycenaean Wall Painting in Context. New Discoveries, Old Finds Reconsidered. Proceedings of an International Workshop Held February 10–11, 2011 at the National Hellenic Research Foundation, Μελετήματα 72 (Athens 2015) 212–245.

Uda *et al.* 2000
M. Uda – S. Sassa – S. Yoshimura – J. Kondo – M. Nakamura – Y. Ban – H. Adachi, Yellow, red and blue pigments from ancient Egyptian palace painted walls, Nuclear Instruments and Methods in Physics Research B 161–163, 2000, 758–761.

Uda *et al.* 2004
M. Uda – M. Tamada – Y. Nakajima – A. Ishizaki – R. Satoh – K. Okada – S. Yoshimura – J. Kondo – N. Kawai, Analyses of the pigments and plaster. In situ characterization of pigments and plaster in the royal tomb of Amenophis III using X-ray diffractometer, fluorescence spectrometer, and optical microscope, in:

S. Yoshimura – J. Kondo (eds.), Conservation of the Wall Paintings in the Royal Tomb of Amenophis III. First and Second Phases Report. Joint Project of Supreme Council of Antiquities, Ministry of Culture, Arab Republic of Egypt and Institute of Egyptology, Waseda University (Tokyo 2004) 39–82.

Vlachopoulos – Sotiropoulou 2013
A. Vlachopoulos – S. Sotiropoulou, The blue colour on the Akrotiri wall-paintings. From the palette of the Theran painter to the laboratory analysis, in: A. Papadopoulos (ed.), Talanta. Proceedings of the Dutch Archaeological and Historical Society 44/2012, 2013, 245–272.

Weatherhead 2001
F. J. Weatherhead, Recording and conservation of painted plaster from the early excavations at Amarna, in: Davies 2001, 53–59.

Weatherhead 2007
F. J. Weatherhead, Amarna Palace Paintings, Egypt Exploration Society Excavation Memoir 78 (London 2007).

Wendrich 2006
W. Wendrich, Body knowledge. Ethnoarchaeological learning and the interpretation of ancient technology, in: B. Mathieu – D. Meeks –M. Wissa (eds.), L'apport de l'Égypte à l'histoire des techniques (Cairo 2006) 267–275.

Wendrich 2012
W. Wendrich, Archaeology and apprenticeship. Body knowledge, identity, and communities of practice, in: W. Wendrich (ed.), Archaeology and Apprenticeship. Body Knowledge, Identity, and Communities of Practice (Tucson 2012) 1–19.

Westlake *et al.* 2012
P. Westlake – P. Siozos – A. Philippidis – C. Apostolaki – B. Derham – A. Terlixi – V. Perdikatsis – R. Jones, Studying pigments on painted plaster in Minoan, Roman and Early Byzantine Crete. A multi-analytical technique approach, Analytical and Bioanalytical Chemistry 402, 2012, 1413–1432.

Winkels 2007
A. Winkels, Restauratorisch-naturwissenschaftliche Untersuchung von tuthmosidischen Putzen aus ᶜEzbet Helmi / Tell el-Dabᶜa. Ein Beitrag zur Erforschung altägyptischer Kalkputztechnik, Egypt and the Levant 17, 2007, 273–293.

Woolley 1955
L. Woolley, Alalakh. An Account of the Excavations at Tell Atchana in the Hatay, 1937–1949, Reports of the Research Committee of the Society of Antiquaries of London 18 (Oxford 1955).

Western Asia

Wall Painting Techniques in Early Bronze Syria

Clues of Parallelism with the Traditions of the Mediterranean and Mesopotamian Regions

Alessandro Di Ludovico[1] *and Marco Ramazzotti*[2]

Abstract

The excavation of Building FF2 at Ebla provided new important data related to the tradition of wall paintings in Early Bronze Age Syria. This tradition still remains quite poorly known and understood, and the way to an interpretation of the relevant features, meanings and developments is thus mostly made of comparisons with findings from other regions and periods. The main difficulties are here represented by the lack of shared approaches in recording and publishing information on this kind of material witness, in particular in relation to technical and technological aspects. This contribution is based on efforts that point at collecting as many evidences as possible to outline a profile of the Early Syrian wall painting techniques. The main aim is here to find enough evidence supporting the placement of the Ebla wall painting findings within the Early Syrian tradition and its chronological developments, as well as in the context of the artistic and artisan cultures of the ancient Near East and Mediterranean regions.

Keywords: wall paintings; Ebla; Syria and the Near East; 3rd millennium Syria; Early Syrian architectural decoration.

During the excavations in the campaign 2003 at Tell Mardikh-Ebla, in the Area FF, located close to the southwestern slope of the Acropolis, a shrine dating back

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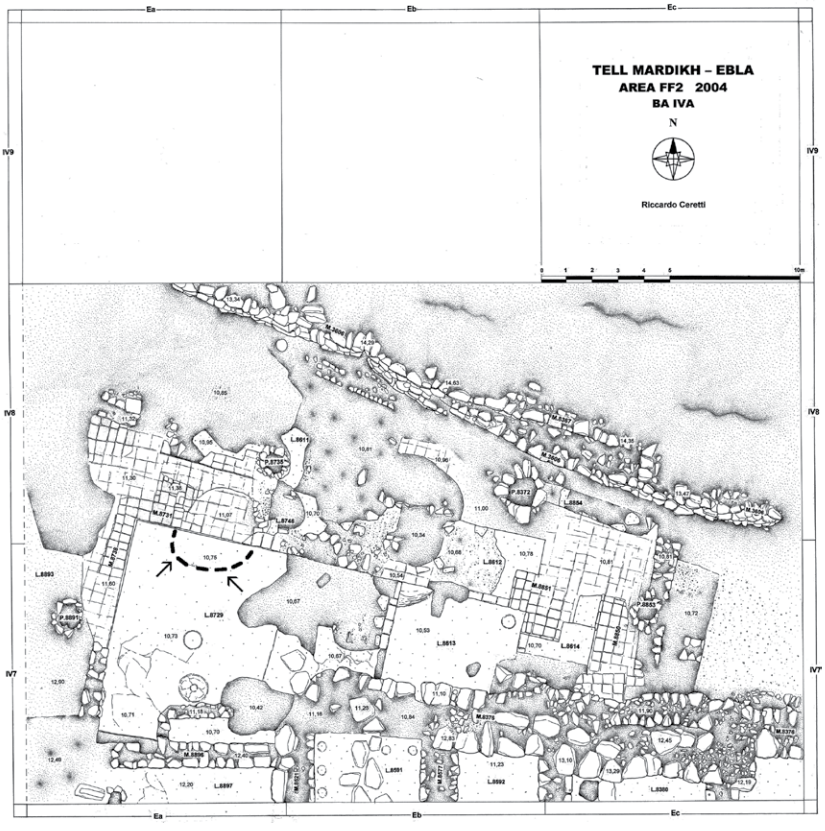
in: J. Becker, J. Jungfleisch and C. von Rüden (eds.) Tracing Technoscapes. The Production of Bronze Age Wall Paintings in the Eastern Mediterranean (Leiden 2018) 29-40.

Fig. 1: Ebla, Area FF: the Old Syrian and later superimpositions on the Early Bronze phases (above) and the findspot of the painted plaster fragments in Building FF2 (below).



to the Early Bronze Age IV was discovered and largely investigated (Fig. 1).[3] Later superimpositions were huge, and they marred deeper levels, deeply damaging the Early Bronze Age layers, but this notwithstanding a large part of this shrine, named Building FF2, could be detected and explored, together with its destruction layer. In a not much extended area, close to the northern wall of room L. 8729, about 350 thick fragments of plaster bearing painted motifs or a white lime coat were recovered.[4] A general look at these fragments soon led to the idea that a quite complex architectural feature had found its place on the northern wall of this room. Such a feature must have had the form of a niche with multiple profiles which hosted a number of painted motifs on its surfaces, and probably emerged from the wall with a thickness of at least three centimetres. The position of the niche was probably quite high on the wall.[5]

1. The Finds

The niche's multiple profiles, which created patterns of lights and shades, were made of concentric frames separated by 2–3 centimetre steps and little rectangular protruding elements resembling (or imitating) the ends of beams (Fig. 2). The underlying clay plaster layer was 6–8 to 12–14 centimeters thick; on it, a slightly polished coat of white lime served as support for the painted motifs (Fig. 3). The latter reproduced geometric shapes, mostly in chains. Those shapes were built with the help of a dense set of thin red guidelines which had been traced on the white lime coat. The guidelines were both parallel and perpendicular to each other, so that they formed a grid which could be easily hidden by the motifs executed on them and was thus not visible once the work was finished. On some fragments it is evident that there was a variation in the placement of such guidelines: the net obtained through them could be not only made of vertical and horizontal lines, but also of a grid oriented according to a 45 degree angle with the horizontal and vertical border bands of the field partitions (Fig. 4).

In general, the guidelines had important functions for the correct execution of the paintings, not just because of the nature of the motifs and their arrangements, but also due to the spatial constraints given by the multiple profiles of the moulded surface. Such physical constraints were actually handled by the craftspeople of the paintings as if they were just accidental features which made the endless motif no more visible, but they did not really affect the overall composition. A solution had thus been adopted to harmonise the ideal boundless repetition of the motifs with the concrete limits of their support: as far as it can be reconstructed through the fragments, by the limits of each portion of the moulded surface which was parallel to the wall, a black stripe had been painted (also with the help of a guideline marking its width). The surface of those profiles which had an orthogonal orientation to the wall (so to speak, the minor sides of the niche's profiles) were, on the other hand,

3 Matthiae 2006, 452–458.
4 Di Ludovico – Ramazzotti 2011, 66–80.
5 Di Ludovico – Ramazzotti 2012, 287–302.

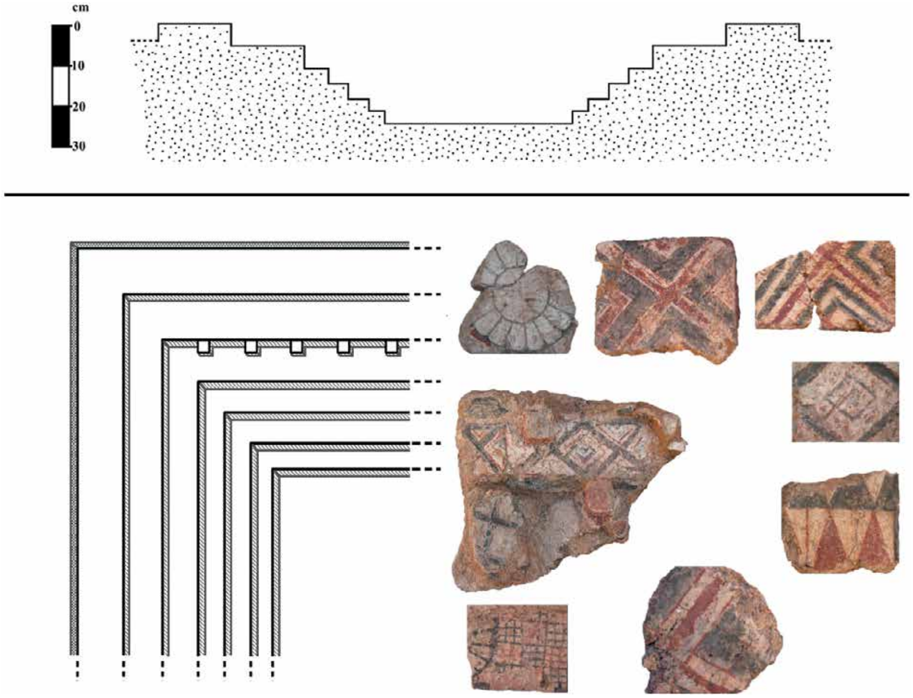


Fig. 2: Reconstruction of profile and front of the niche decorated with the painted motives (above and bottom-left), with samples of the motives (bottom-right). The front of the niche and the motifs' samples are not represented to scale.

Fig. 3: Section of a wall painting fragment: the thickness of the clay plaster substratum and the white lime coat (indicated by arrows) serving as support for the painted motifs is here clearly visible.

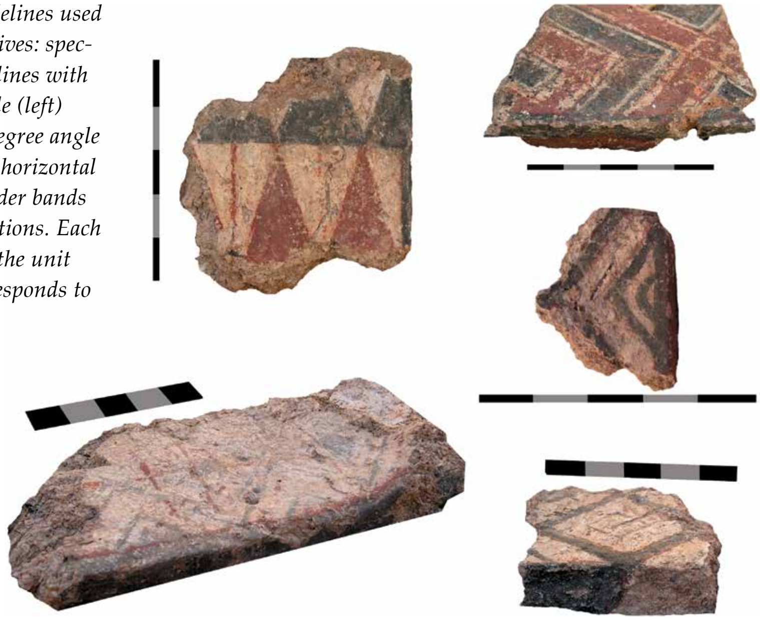
uniformly covered, either with black pigment or with red colour bordered by black stripes as well (Fig. 5).

The colours used to draw the motifs are white, black, and red, to form geometric elements or their chains: meanders, rosettes, squares forming dense nets, different types of diamonds, different types and combinations of triangles. Among them, it was possible to locate a quite systematic metrology in the repetition of some basic measure units and their thirds.[6]

The meaning and the precise arrangement of these motifs have not been properly investigated yet, and they deserve an adequate research work, but the central role of

6 Di Ludovico – Ramazzotti 2011, 67–74; Di Ludovico – Ramazzotti 2012, 290–291.

Fig. 4: Red guidelines used to draw the motives: specimens showing lines with a 90 degree angle (left) and with a 45 degree angle (right) with the horizontal and vertical border bands of the field partitions. Each sub-segment of the unit of measure corresponds to 2 cm.



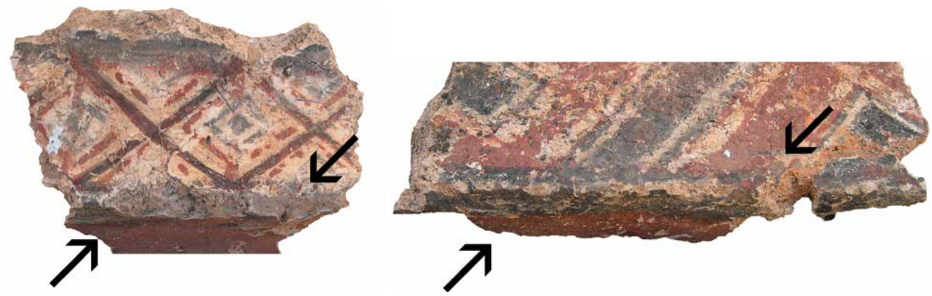


Fig. 5: Borders by the corners of the profiles of the niche: black stripes, red surfaces and guidelines.

the red-black chromatic contrast and the basic rectangular module which served to structure the whole composition and some spatial and geometric connections between the different forms and chains of forms have been identified yet. The rectangle as a reference point is, in fact, evident everywhere: a square basic module was the ideal compositional element through which even the rosettes, round in shape and probably placed in the corners of the niche, had been drawn.[7]

7 The rosettes are clearly drawn on the basis of a unit of length and its submultiples that can be recognized in the motif of the nets inscribed in squares. The squares with the net of lines look very interesting from this viewpoint, since the length of their sides and its thirds seem to be basic units for the drawing of the rosettes: Di Ludovico – Ramazzotti 2011, 73–74.

2. Comparisons

Formal parallels to these motifs can be found in other contemporary visual media from Ebla, including seal impressions,[8] but the use of colours and the types of geometric patterns with the relevant arrangements resemble older representations from other regions of Western Asia. The white plaster moulded structure has also been documented in the Royal Place G, and namely on the surface treatments of the gate of room L. 8495, which was part of an administrative quarter next to court L. 2866.[9] Similar is the analogy between the diamonds in the plastered decoration of a gate from the administrative area of Royal Palace G and those from Building FF2,[10] and another quite conspicuous parallel emerges between the painted rosettes from FF2 and other similar shapes: the golden rosette (TM.03.G.795) from Royal Palace G,[11] the white limestone cover from Temple P2,[12] and the inlay discovered in the same area FF2, in L. 8613,[13] which can also be referred to the same morphometric patterns of the observed recurring proportions.[14]

Considering only the use of geometrical motifs and colours, an interesting non-Eblaite comparison with the paintings from Building FF2 can be located in the wall mosaics in the early historic levels of Eanna, at Uruk.[15]

As for the technique, on the other hand, the use of clay-based support and white lime undercoat also serving as a background can be already observed elsewhere in preceding periods, for instance in the fragments with stylised figures from Early Bronze Raqa'i, Sweyhat (where the motifs were painted with colours similar to those at Ebla), Munbaqa, and Halawa B.[16]

At Halawa a large elliptical figure somehow resembling a human face is surrounded by a wide number of elements, including stylised representations of humans, some of which carrying objects or animals, but also geometric motifs, among which rectangles and triangles seem to be the most basic shapes (Fig. 6).[17] It is not easy, based on the available documentation, to reconstruct possible proportional features or elementary units of measurements, but it would not be surprising if in such a representation compositional mechanisms comparable to those of the FF2 paintings would emerge.

The same holds true for the Mumbaqa paintings, where circles and triangles are the principal components of a rectangular frame (Room 3B level 7). Two anthropomorphic figures can be distinguished within the complex frame, which could reproduce the appearance of a light architecture;[18] the whole representation is made of red and black pigments on a white background.[19] In the fragments from Sweyhat, geometric borders also appear, together with tree branches and human anatomical parts, including styl-

8 Di Ludovico – Ramazzotti 2011, 73–75.
9 Ramazzotti 2010, 596, fig. 8.
10 Matthiae 1985, 61, fig. 21; Di Ludovico – Ramazzotti 2011, 83, pl. III, fig. 3.
11 Di Ludovico – Ramazzotti 2011, 74, fig. 4; Matthiae 2004, 315, fig. 12; 317, fig. 17.
12 Matthiae 1995, 344, 363, n. 139.
13 Ramazzotti 2014, 663, figs. 3a–3b.
14 Di Ludovico – Ramazzotti 2011, 74, fig. 4.
15 Lenzen 1959; Lenzen 1966. See also the discussion in Di Ludovico – Ramazzotti 2011, 75–77.
16 Machule *et al.* 1986; Lüth 1989; Dunham 1993, 127; Holland 1993, 76–80; Holland 1993/1994, 279–281; Holland – Zettler 1994, 140–141; Holland 1994.
17 Lüth 1989, fig. 66.
18 Dunham 1993, 136.
19 Machule *et al.* 1986.

Fig. 6: The wall painting found at Halawa.

ised Medusa-like hair-styles.[20] Unfortunately, nothing can be said at the moment about the similarity in the inner composition and the making of the pigments of any of the mentioned specimens and the ones found in area FF2 at Ebla, although the use of the same (white, red, and black) basic colours in the composition at Sweyhat would permit to establish a particularly strong similarity with the latter.[21]

Besides this, further possible and interesting parallels to the wall paintings of Building FF2 can be established with those from Room A 364 and Corridor A 796 at Arslantepe VI A, which show very similar geometric shapes and chromatic arrangement, but in a very different overall composition. The polygonal elements are there used to form anthropomorphic or animal bodies.[22] Such evidences are still quite faint, but they would point to the inclusion of the paintings from Building FF2 in a northern Syrian/eastern Anatolian tradition.

Remarkable thematic parallels with Mesopotamia cannot be disregarded,[23] but they seem to be comparatively less deep than those mentioned here. What seems to be actually missing in the available documentation from third millennium Mesopotamia, Anatolia and Syria is evidence of strategic parcelling out the surface, similar to those used at Ebla, with the thin parallel and perpendicular red guidelines. Such a technique is, on the contrary, well known and attested in other regions and later periods.[24]

20 Holland 2001, 170–179.

21 Holland reports the data resulting from X-Ray investigation on the pigments from Sweyhat: the substances used to obtain the colours were likely calcite (white), hematite (red) and carbon (black), Holland 1994, 55.

22 Frangipane 1997, 45–73; Frangipane 2002, 123–148.

23 Di Ludovico – Ramazzotti 2011, 75–77; Di Ludovico – Ramazzotti 2012, 292–293.

24 See, for instance, the evidence from late third millennium Egypt, as discussed by Robins 1994, 31–40, 57–63; Robins 2001. The use of guidelines in the Aegean context, and, in general, in the non-Asian eastern Mediterranean has been well explained and exemplified in Bietak – Marinatos 1995, 51, 60; Marinatos 1998, 84–101; Brysbaert 2002, 100–101.

3. Further Features

A less striking piece of evidence which can be observed in few plaster painted fragments from Ebla has been recognized only recently, but it is remarkable, since it seems to hint at a more complex structure of the wall decoration, and to possible indirect comparisons with some of the former Syrian and Mesopotamian traditions documented in the mentioned sites. Round holes of various dimensions are clearly visible in some fragments: there seems to be a clear evidence that they were used to attach three-dimensional clay or stone elements into the wall, some of which were perhaps composite and quite complex. A few fragments bearing similar motifs reveal a certain regularity in the position of these holes (Fig. 7). If, on one hand, these traces recall the decorations recorded in temples at Tell Brak and a number of end fourth/early third millennium Mesopotamian sites,[25] on the other hand, they could represent a composite development of the framed representations found at Sweyhat and Munbaqa: from the two-dimensional to an integrated two- and three-dimensional composition, part of which was carried out using elements inserted in the wall, probably as a substitute of painted motifs.[26] According to the reconstruction so far hypothesised, actually painted frames should have surrounded a series of protruding elements inserted in the wall and other painted motifs; everything was part of a multi-profiled niche, with its shade and light effects.

The painted plaster fragments from the early Syrian Building FF2 at Ebla represent an extremely important source of information on the wall painting techniques in a period and in a region which are, from this point of view, still very poorly known. Evidence of relations and affinities with the preceding centuries and adjacent geographic areas have been located, and the continuity of a northern Syrian tradition in wall paintings can be recognised, both in some technical features and in the representation of some motifs. The preferred spaces for which such paintings had been planned were all probably related to religious cultic activities or to social ceremonies.

This said, it is important to remark here that the overall organisation of the decorated space on the wall of Building FF2 is still not adequately understood. The reconstruction of the niche proposed in the past[27] is only plausible for the general layout, but not completely for the specific arrangements of motifs and other features, like the inserted elements of different materials. To understand the original appearance of the niche and the arrangement of the inserted elements, the only chance which remains attainable is to exploit as much as possible the (huge) available documentation, since the possibility to come back on the original fragments in order to develop a sound virtual reconstruction and refine the observation and recording of specific features is nowadays completely lost. Nonetheless, the hope that archaeological investigation in Syria could be caught up, providing further important information on the use of paintings by ancient Western Asiatic cultures, should never be abandoned. A favourable situation in this direction is much more needed for the Syrian people than for the scientific community.

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25 See, for instance, the rosettes and similar elements placed in the walls of some buildings at Uruk and Tell Brak: Jordan 1931, 33–36; Heinrich 1934, 28–31; Mallowan 1947, 95–96, pl. V.

26 Holland 1994, 55.

27 Di Ludovico – Ramazzotti 2011, 69–71, photo 4; Di Ludovico – Ramazzotti 2012, fig. 2.

Fig. 7: Holes on some fragments of the paintings from Building FF2.

Acknowledgements

All plans and pictures shown here belong to the Archives of the Italian archaeological expedition to Ebla (Missione Archeologica Italiana in Siria). This article originates from a joint effort of both authors, who are equally responsible of its content. Just for academic purposes, we attribute paragraph 1 to A. Di Ludovico, paragraph 2 to M. Ramazzotti, paragraph 3, and introductive and conclusive parts to both.

References

Brysbaert 2002

A. Brysbaert, Common craftsmanship in the Aegean and East Mediterranean Bronze Age. Preliminary technological evidence with emphasis on the painted plaster from Tell el-Dab^{c}a, Egypt, Egypt and the Levant 12, 2002, 95–107.

Bietak – Marinatos 1995

M. Bietak – N. Marinatos, The Minoan Wall Paintings from Avaris, Egypt and the Levant 5, 1995, 49–62.

Dunham 1993

S. Dunham, A wall painting from Tell al-Raqa'i, Levant 25, 1993, 127–143.

Frangipane 1997

M. Frangipane, 4th millennium temple/palace complex at Arslantepe-Malatya. North-South relations and the formation of early state societies in the northern regions of Greater Mesopotamia, Paléorient 23, 1997, 45–73.

Frangipane 2002

M. Frangipane, Non-Uruk developments and Uruk-linked features on the northern borders of Greater Mesopotamia, in: J. N. Postgate (ed.), Artifacts of Complexity. Tracking the Uruk in the Near East (Warminster 2002) 123–148.

Heinrich 1934
E. Heinrich, Arbeiten in Eanna, im Stadtgebiet und im Südbau, in: A. Nöldeke, Fünfter vorläufiger Bericht über die von der Notgemeinschaft der Deutschen Wissenschaft in Uruk unternommenen Ausgrabungen, Abhandlungen der Preußischen Akademie der Wissenschaften, Phil.-Hist. Klasse 5 (Berlin 1934) 5–38.

Holland 1993
T. A. Holland, Tell es-Sweyhat expedition to Syria, in: W. M. Sumner (ed.), The Oriental Institute Annual Report 1991–1992 (Chicago 1993) 74–80.

Holland 1993/1994
T. A. Holland, Tall as-Swēhat. 1989–1992, Archiv für Orientforschung 40–41, 1993/1994, 275–285.

Holland 1994
T. A. Holland, More wall painting fragments from Tell es-Sweyhat, in: W. M. Sumner (ed.), The Oriental Institute Annual Report 1993–1994 (Chicago 1994) 53–61.

Holland 2001
T. A. Holland, Third millennium wall paintings at Tell es-Sweyhat, Syria, in: J.-W. Meyer – M. Novák – A. Pruß (eds.), Beiträge zur Vorderasiatischen Archäologie Winfried Orthmann gewidmet (Frankfurt on Main 2001) 170–179.

Holland – Zettler 1994
T. A. Holland – R. L. Zettler, Sweyhat, American Journal of Archaeology 98, 1994, 139–142.

Jordan 1931
J. Jordan, Zweiter vorläufiger Bericht über die von der Notgemeinschaft der Deutschen Wissenschaft in Uruk unternommenen Ausgrabungen (Berlin 1931).

Lenzen 1959
H. J. Lenzen, XV. vorläufiger Bericht über die von dem Deutschen Archäologischen Institut der Deutschen Orient-Gesellschaft aus Mitteln der Deutschen Forschungsgemeinschaft unternommenen Ausgrabungen in Uruk-Warka, Winter 1956/57, Abhandlungen der Deutschen Orient Gesellschaft 4 (Berlin 1959).

Lenzen 1966
H. J. Lenzen, XXII. vorläufiger Bericht über die von dem Deutschen Archäologischen Institut der Deutschen Orient-Gesellschaft aus Mitteln der Deutschen Forschungsgemeinschaft unternommenen Ausgrabungen in Uruk-Warka, Winter 1963/1964, Abhandlungen der Deutschen Orient Gesellschaft 11 (Berlin 1966).

Di Ludovico – Ramazzotti 2011
A. Di Ludovico – M. Ramazzotti, Design at Ebla. The decorative system of a painted wall decoration, Orientalia 80, 2011, 66–80.

Di Ludovico – Ramazzotti 2012
A. Di Ludovico – Ramazzotti, White, red and black. Technical relationships and stylistic perceptions between colours, lights and places in Mesopotamia and Syria during the third millennium BC, in: R. Matthews – J. Curtis (eds.), Proceedings of the 7th International Congress on the Archaeology of the Ancient Near East, 12–16 April 2010, the British Museum and UCL, London Vol. 2 (Wiesbaden 2012) 287–302.

Lüth 1989
F. Lüth, Tell Halawa B, in: W. Orthman (ed.), Halawa 1980–1986, Saarbrücker Beiträge zur Altertumskunde 52 (Bonn 1989) 85–100.

Machule *et al.* 1986
D. Machule – K. Karstens – H. H. Klapproth – G. Mozer – W. Pape – P. Werner – W. Mayer – R. Mayer-Opficius – M. Mackensen, Ausgrabungen in Tall Munbâqa 1984, Mitteilungen der Deutschen Orient-Gesellschaft zu Berlin 118, 1986, 67–145.

Mallowan 1947
M. E. L. Mallowan, Excavations at Brak and Chagar Bazar, Iraq 9, 1947, 1–259.

Marinatos 1998
N. Marinatos, The Tell el-Dab[c]a paintings. A study in pictorial tradition, Egypt and the Levant 8, 1998, 83–99.

Matthiae 1985
P. Matthiae, I tesori di Ebla, (Rome, Bari 1985).

Matthiae 1995
P. Matthiae, Entry #139. Coperchio circolare a decorazione incisa, in: P. Matthiae – F. Pinnock – G. Scandone Matthiae (eds.), Ebla. Alle origini della civiltà urbana (Milan 1995) 344.

Matthiae 2004
P. Matthiae, Le Palais Méridional dans la ville basse d'Ebla paléosyrienne. Fouilles à Tell Mardikh (2002–2003), Comptes Rendus de l'Académie des Inscriptions et Belles-Lettres 2004, 301–346.

Matthiae 2006
P. Matthiae, Un grande temple de l'époque des archives dans l'Ébla protosyrienne. Fouilles à Tell Mardikh 2004–2005, Comptes Rendus de l'Académie des Inscriptions et Belles-Lettres 2006, 447–493.

Ramazzotti 2010

M. Ramazzotti, The Ebla Archaeological Park. Natural, archaeological and artificial Italian portrait of the ancient Syrian capital, in: P. Matthiae – F. Pinnock – L. Nigro – N. Marchetti (eds.), Proceedings of the 6th International Congress on the Archaeology of the Ancient Near East, May 5th–10th 2008, Sapienza Università di Roma Vol. 2. Excavations, Surveys and Restorations. Reports on Recent Field Archaeology in the Near East (Wiesbaden 2010) 581–597.

Ramazzotti 2014

M. Ramazzotti, Royal administration during the conquest. New archaeological and epigraphic discoveries in the Royal Palace G at Ebla-Tell Mardikh, in: H. Neumann – R. Dittmann – S. Paulus – G. Neumann – A. Schuster-Brandis (eds.), Krieg und Frieden im Alten Vorderasien. Proceedings of the 52e Rencontre d'Assyriologie Internationale, Münster 17.–21. Juli 2006, Alter Orient und Altes Testament 401 (Münster 2014) 651–672.

Robins 1994

G. Robins, Proportion and Style in Ancient Egyptian Art (Austin 1994).

Robins 2001

G. Robins, The use of the squared grid as a technical aid for artists in eighteenth dynasty painted Theban tombs, in: W. V. Davies (ed.), Colour and Painting in Ancient Egypt (London 2001) 60–62.

Contextes techniques et historiques des peintures murales du Grand Palais Royal de Mari

Une mise au point

Béatrice Muller[1]

Abstract

As many studies have been published about the wall paintings of the Royal Palace of Mari since the 1950s, it seems advisable to supplement the information and to sort out past interpretations: the clarification focuses on the technical aspects, *i.e.* on materials and the processes of implementation. These elements play a significant role in fixing the relative chronology of these paintings in the building, and also in bringing answers to the issue of the direction of the influences between the Syro-Mesopotamian basin and the Aegean region.

This is the occasion to sum up the observations and the results – hitherto partly unreleased – of physiochemical analyses carried out in the years 1990–2000, in addition to archaeological discoveries and architectural restitutions which, in association with an iconological study, have once and for all dispelled some doubts and put an end to the controversies of the 1980–1990s.

After broadly outlining the historiography and the historical context of the paintings, the three types of coating (mud plaster, lime plaster and gypsum plaster), systematically laid on a mud backing support, are examined with their chronological implications. The methods of executing (the outlines chiseled with a point, the flat coating technique, the final completion of the plinths) or the links with the building techniques are mentioned. The following part deals with the list of the pigments, together with their composition and the distribution of the use of colours. The final part briefly summarises the revisited approach to the links with the Eastern Mediterranean.

Keywords: wall paintings; Mari; Syria and the Aegean; Bronze Age; technique.

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1 CNRS, Nanterre.

in: J. Becker, J. Jungfleisch and C. von Rüden (eds.) Tracing Technoscapes. The Production of Bronze Age Wall Paintings in the Eastern Mediterranean (Leiden 2018) 41-84.

Fig. 1 : Plan du Palais (© Mission archéologique de Mari, J.-Cl. Margueron, dessin N. Bresch).

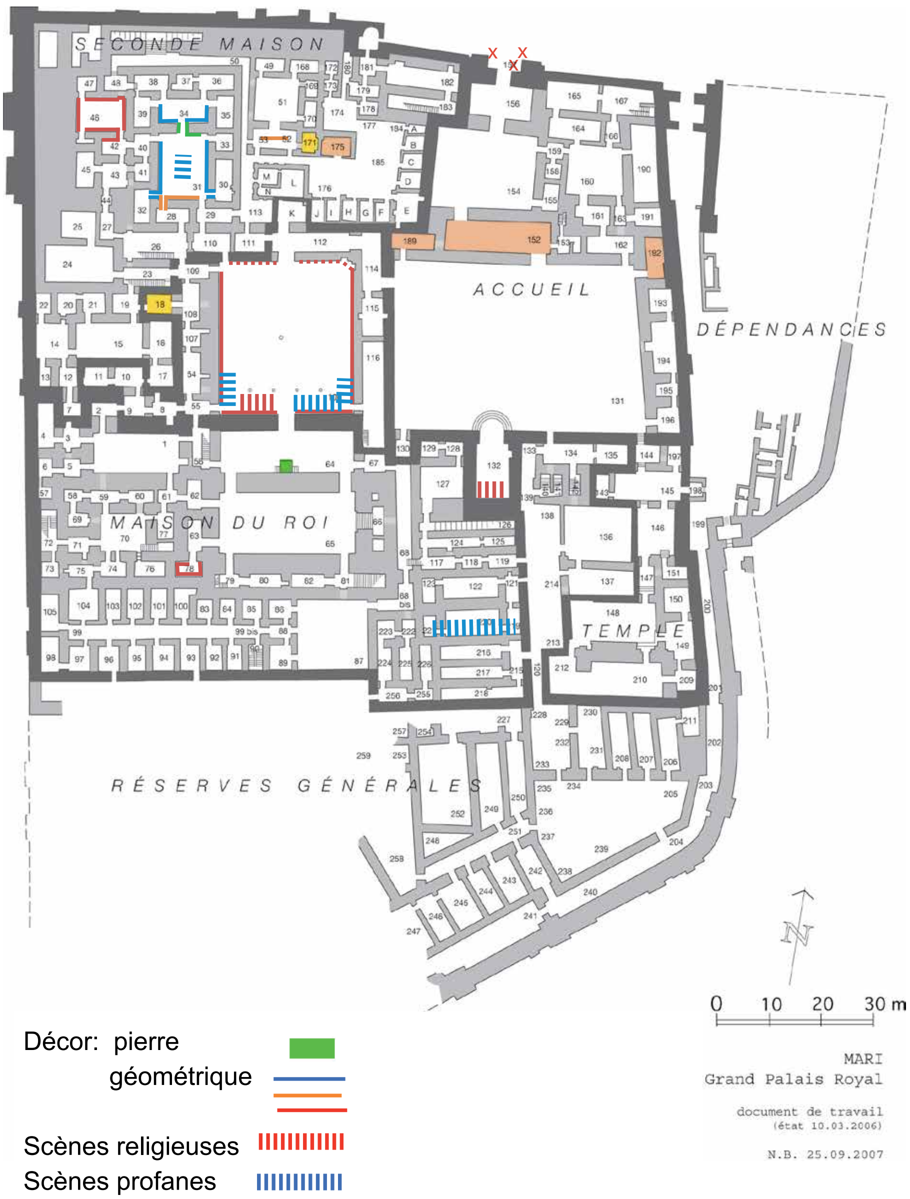
Fig. 1a : Secteurs.

Le Grand Palais Royal de Mari tient sa renommée de son état de conservation exceptionnel et de sa mise au jour presque extensive en cinq campagnes de fouilles.[2] De ce fait, il donne l'idée la plus complète connue à ce jour d'un palais syro-mésopotamien de l'âge du Bronze, tant sur le plan de l'organisation architecturale[3] que sur le plan de la quantité et de la qualité des peintures murales, retrouvées in situ ou, plus souvent, sous forme de fragments.[4] En effet, la hauteur de conservation du bâtiment, qui n'est

2 Mission André Parrot entre 1935 et 1938.

3 Margueron 1982, 209–380, figs. 147–256 ; à compléter ou nuancer par Margueron 1987 ; Margueron 1995a ; et résumés dans Margueron 2004, 367–374, 459–500 ; ou dans Margueron 2014, 113–120, 152–154.

4 Parrot 1958b ; notations dans Parrot 1958a, passim. Rapports préliminaires dans Syria 17–21 (1936–1940).



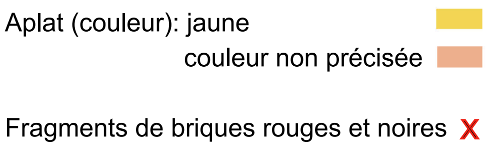


Fig. 1b : Emplacements des peintures murales (B. Muller).

pas égale partout, atteint jusqu'à 6m dans le cœur officiel : ce fait est dû au mode de destruction employé par Hammurabi de Babylone qui, vers 1760, fit détruire au pic le haut des murs de briques crues après avoir incendié le monument ; non seulement les décombres ainsi accumulés avaient protégé la base des murs, mais la brique durcie par le feu s'était solidifiée, résistant ainsi mieux à l'érosion.

En ce qui concerne les peintures murales, une très abondante littérature s'est accumulée depuis les publications préliminaires, puis définitives de l'inventeur du site : la présente contribution est l'occasion de refaire le point à partir des acquis de ces trente dernières années, de rectifier des affirmations erronées et de synthétiser des connaissances ou des observations nouvelles.[5]

Rappelons d'emblée que les peintures du Grand Palais Royal – dit à tort palais de Zimri-Lim, qui n'en fut que le dernier roi – ne sont pas les seules peintures mises au jour à Mari : le Petit Palais Oriental, dit aussi palais des *Shakkanakku*, a révélé les éléments du plafond à caissons, peint en rouge et en jaune, de la salle du Trône, dont le sol était par ailleurs revêtu de *juss* ;[6] quant aux peintures figuratives, le temple de Ninhursag – qui nous fait remonter à l'époque de la Ville II, c'est-à-dire au milieu du III^e^ millénaire – a livré une composition de silhouettes humaines et animales.[7] Ceci conduit alors vers les enjeux sous-jacents au Workshop du 10th ICAANE : les apports respectifs du monde mésopotamien pris au sens large et de la Méditerranée orientale où l'Egypte tient sa part. Se pose l'inévitable question de l'antériorité des uns ou des autres,[8] question particulièrement délicate étant donné les débats chronologiques qui agitent toujours les spécialistes des trois aires culturelles considérées. C'est la chronologie moyenne qui sera retenue ici.

Rappelons encore que Mari n'était pas, dans le monde syro-mésopotamien, une exception au IIe millénaire, comme l'attestent les palais d'Alalakh (niveau VII, vers 1700), Tell Sakka (vers 1700),[9] Qaṭna (XVIe ou XVe–XIVe s.), Nuzi (XIVe s.), Aqarquf (XIVe s.)…[10] Néanmoins, en l'état actuel des connaissances, celui de Mari leur est antérieur.

En préambule, un mot sur la répartition spatiale de ces peintures qui, retrouvées dans 26 espaces sur les quelque 300 que compte le palais au rez-de-chaussée,[11] concentrent les compositions figuratives dans les secteurs clés religieux (chapelle d'Ishtar 132, secteur B), officiel (cour 106 et salle 64, secteur M) et de l'habitat royal (salle 220', Maison du Roi, secteur F ; salle 31 et 34, Maison des Femmes, secteurs I)[12] (Figs. 1a–b).

1. Les grandes lignes du contexte historiographique et historique des peintures murales du Grand Palais Royal de Mari

1.1 Contexte historiographique

Commencée à la seconde campagne, la fouille du Palais s'est opérée selon les méthodes propres à l'époque qui a précédé la Seconde Guerre mondiale, c'est-à-dire avec un nombre considérable d'ouvriers (jusqu'à 300) et peu d'archéologues (en fait un ou

5 Barrelet 1950 ; Moortgat 1952 ; Moortgat 1959 ; Moortgat 1964 ; Moortgat 1967 ; Al Khalesi 1978 ; Tomabechi 1980 ; Parayre 1982 ; Gates 1984 ; Muller (sous le nom de Pierre) 1984 ; Muller 1987 ; Muller (sous le nom de Pierre-Muller) 1990a ; Margueron *et al.* 1990 ; Muller (sous le nom de Muller-Pierre) 1993a ; Muller 1995a ; Muller 1995b ; Muller 2002 ; Muller 2003 ; Muller 2013 ; Muller 2016.

6 Margueron 2004, 362–363. *Juss* : cf. *infra*, § 2.3.3.

7 Parrot 1940, 18–20, fig. 14.

8 Von Rüden 2011, 95–114 ; Brysbaert 2011, 249–250.

9 Datation au Bronze Moyen II par A. F. Taraqji in Aruz *et al.* 2008, 128–129.

10 Références: cf. Muller 1987, 574–576 ; von Rüden 2011.

11 Surface totale : plus de 2,5ha.

12 Dénomination des secteurs selon Margueron 1982, fig. 149.

Fig. 2 : Fragment M. 4587 sur enduit de terre (salle 219, secteur F).

Fig. 2a : Relevé J. Depauw 1965, gouache sur papier Canson (© Mission archéologique de Mari, A. Parrot).

Fig. 2b : Cliché en diapositive couleurs (© Mission archéologique de Mari, A. Parrot).

deux). Dans ce contexte, le dégagement des peintures murales a bénéficié d'une attention particulièrement remarquable : des clichés ont immortalisé le dessinateur Pierre Hamelin, couché sur le dos pour dégager par en dessous, dans une fouille en tunnel, les fragments « tombés régulièrement face contre le sol » et nécessitant « une immédiate consolidation »,[13] de la salle 220 (secteur F), particulièrement fragiles étant donné leur support de terre ;[14] les gisements de ceux-ci ont été soigneusement notés sur un croquis de situation, ce qui a permis une proposition de restitution.[15] De même, les fragments sur *juss* de la cour 106 ont été situés, dans la publication de Parrot, sur des plans partiels qui ont également donné lieu à des hypothèses de remontage.[16] Des protections (masses de terre plaquées contre le mur et tôles ondulées de couverture) ont été ménagées, en tout cas pour la mise au jour des peintures de la salle 132[17] et de *l'Investiture* de la cour 106, cette dernière ayant été déposée en 1936 selon les règles de l'art par M. Pearson, architecte de la mission de Doura Europos.[18] Toutes les peintures ont été relevées, décalquées sur papier cellophane d'abord ;[19] les architectes de la Mission, Paul

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13 Parrot 1940, 25 ; Parrot 1958b, 84 fig. 62.

14 Parrot 1958b, 84–85 ; cf. Muller (sous le nom de Pierre-Muller) 1990a, 499.

15 Muller (sous le nom de Pierre-Muller) 1990a, en particulier 525–528, pls. XXIV–XXXI ; cf. également Margueron *et al.* 1990, en particulier 451 fig. 11 ; reproduite dans Invernizzi 1992, 48 fig. 69 ; Margueron 2004, 427 pl. coul. 63 ; Muller 2005, 36 pl. coul. 40.

16 Parrot 1958b, 19–52 ; Parayre 1982 ; Muller 2002 ; Muller 2013, figs. 10–11.

17 Parrot 1958a, 64–65.

18 Parrot 1958b, 64–66 : dégagement, étude et photogaphies au cours de la 3[e] campagne, qui s'est terminée en mars 1936, et dépose en juillet. La peinture était devenue cassante sous l'effet de l'incendie.

19 Salle 132 : Parrot 1958a, 64 ; cour 106 : Parrot 1958b, 18–19.

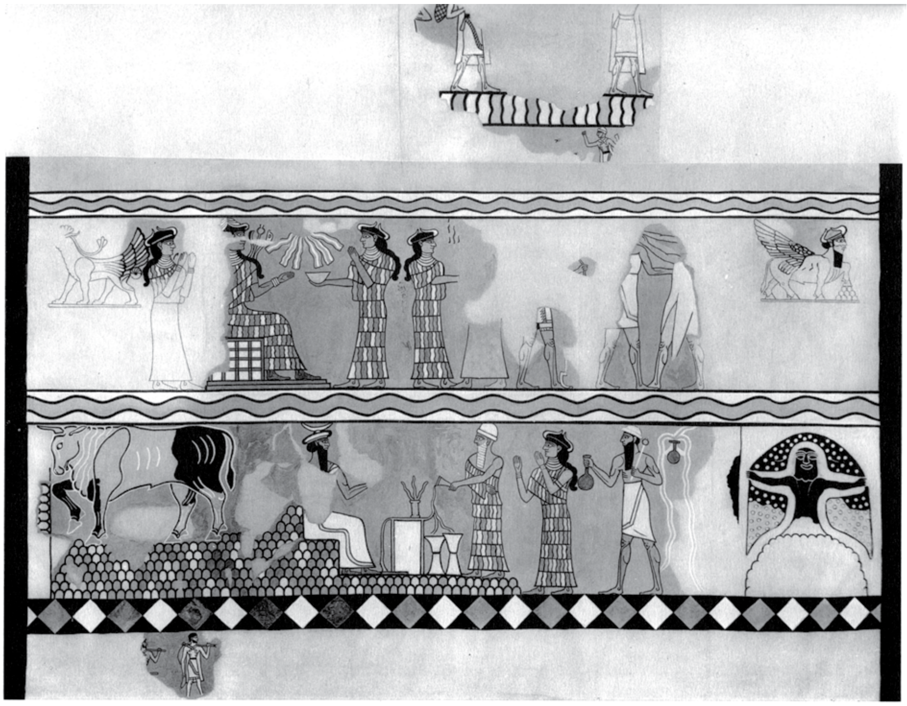


Fig. 3 : Restitution de la composition peinte de la salle 132, sur enduit de terre (Parrot 1958b, pl. XVII).

Fig. 4 : Peinture de l'Investiture de la cour 106 sur enduit de terre avec badigeon de chaux (copie J. Lauffray, Parrot 1958b, pl. A).

François, Raymond Duru, Jean Lauffray et, plus tard, Jacques Depauw, nous ont laissé des copies d'excellente qualité, au trait ou en couleur, qui complètent la documentation photographique[20] (Fig. 2).[21] En effet, la documentation photographique de Mari n'est constituée de diapositives en couleur qu'à partir de 1954 : ainsi les fragments de la salle 132 (Fig. 3) ont été photographiés in situ surtout en noir et blanc[22] et la *peinture de l'Investiture* n'a jamais pu être saisie en couleurs par ce procédé au moment de la découverte ; on peut considérer comme fiable le fac-similé de Jean Lauffray (Fig. 4), plus lisible que tous les clichés faits depuis dans les états successifs de dégradation et de restauration, car la peinture, très noircie par l'incendie qui a mis fin au bâtiment, a subi des repeints exécutés au moment de sa mise en place au musée ou, par la suite, lors de la restauration des alentours de 1985. A ces défauts, reflets de l'époque, s'ajoute le manque d'analyses physico-chimiques systématiques.[23]

Ces lacunes ont été en partie comblées par la suite grâce à des analyses effectuées à l'occasion de restaurations[24] sur des vestiges conservés au musée du Louvre : en 1990 sur 89 fragments provenant des compositions hautes de la cour 106 (sur enduit de *juss*),[25] en 2002–2003 sur la *peinture de l'Investiture*. J'ai moi-même suivi ces restaurations au laboratoire de Soissons, ce qui m'a permis de faire des observations, partiellement publiées.[26]

1.2 Chronologie relative architecturale (cf. tableau 1)

Le découvreur de Mari avait bien écrit que la construction du palais avait été l'œuvre de plusieurs souverains[27] mais avait eu tendance à attribuer les peintures à Zimri-Lim, le dernier roi. Très tôt, des voix s'élevèrent pour distinguer des styles différents, et par conséquent commencer à établir une chronologie relative.[28] Ainsi, la datation d'An-

20 Les relevés sur cellophane des peintures de la salle 132, exécutés en 1936 par Paul François et Raymond Duru, ont été mis au net en 1957 par Pierre Hamelin, dessinateur (Parrot 1958b, 71 n. 3). Les photos publiées en couleur de la *peinture de l'Investiture* sont le plus souvent celles de la copie, exécutée sur calque à la gouache en 1936 à Mari par Jean Lauffray.

21 Sur les conseils de Mme Alix Barbet, alors directrice du CEPMR (Centre d'Etudes des Peintures Murales Romaines) de Soissons, tous ces relevés ont été restaurés en 1990 par l'atelier de Restauration du Cabinet des Estampes de la Bibliothèque Nationale, situé à l'époque rue Richelieu à Paris et dirigé par M. Séveno, après transfert de relevé au feutre indélébile exécuté par moi-même sur feuilles de rhodoïd.

22 Parrot 1937b, 349–350, pl. XLI.1 ; Parrot 1958b, pl. XIV. En effet, Parrot 1958b, 71 et n. 2 : en 1936, « les autochromes n'avaient qu'une efficacité relative » ; voir cependant, en couleurs, Parrot 1960, figs. 342–343.

23 Or Sir Arthur Evans avait, dès 1910, confié un rapport technique à Noël Heaton, qui avait décrit la nature du support et des pigments, d'où la conclusion d'une exécution *a fresco* à Cnossos (Heaton 1910). Sir Leonard Woolley avait fait de même à Alalakh : Barker, à la suite de tests chimiques et spectographiques, avait conclu à l'étroite similitude des peintures de ce site avec celles de Cnossos (Woolley 1955, 233–234). Et, comme Evans, R. Koldewey et W. Andrae n'avaient-ils pas fait analyser chimiquement de façon très précise les couleurs de la glaçure du décor colossal de la porte d'Ishtar à Babylone ? (Koldewey 1970 [1918], 30–31).

24 Restaurations effectuées à Soissons par le Centre d'Etude des Peintures Murales Romaines (CEPMR, Centre National de la Recherche Scientifique / Ecole Normale Supérieure, Paris).

25 Ils ont probablement été apportés au Louvre à l'issue de la mission de 1935–1936, car sinon ils auraient disparu lors de la destruction de la maison de fouille entre 1941 et 1944 (Parrot 1958b, 19).

26 Compositions hautes : Muller 1993b. *Investiture* : Muller 2003 (allusion).

27 Parrot 1965, 199 ; Parrot 1967, 4.

28 Harper 1962 ; Moortgat 1952 ; Moortgat 1959 ; Moortgat 1964 ; Moortgat 1967 ; Abou Assaf 1990 ; Tomabechi 1980.

Epoque	Architecture	Secteurs	N° de loc.	Peintures murales
Ur III = Shakkanakku Construction par Hanun-Dagan ~2000	Construction 1re étape	C		
		D		
		H	52-53	Fragments sous dallage
	Construction 2e étape	B	132	Composition fragmentaire en 5 registres dont 2 à thème religieux
		H		
		O		
		M		
	Construction 3e étape	A		
		I	31	Bandeau torsadé?
		J	42, 43, 46	Triples bandeaux bichromes?
	Réaménagement (*Papahum* ancien 2)	M	64	
Epoque amorrite ancienne Yahdun-Lim 1810–1794	Réaménagement (*Papahum* récent)	M	64	
	Réaménagement (doublement du mur O => rétrécissement des baies 106-112 et 106-64)	M	106	*Peinture de l'Investiture*
	Peintures ?	I	31	Bandeau torsadé ?
		J	42, 43, 46	Triple bandeau bichrome ?
Royaume de Haute Mésopotamie Samsi-Addu 1793–1775 (son fils Yasmah-Addu vice-roi de Mari)	Reconstruction	G		
	Reconstruction	F	219-220	Composition à thèmes profanes en 2 registres à l'étage (–> salle 220')
	Peintures	M	106	**Décor architectural : bandeau et portes** **Décor figuratif : scènes hautes**
		M	64	Podium : **faux marbre**
		I	31	Sol : **aire en faux marbre** (pseudo-jeu de Palets)
		I	31	*Surface murale sous le bandeau*
		I	31-34	Plinthe en **faux marbre**
		J	42, 43, 46	Surface murale sous le bandeau *chaulée* ou **plâtrée de juss** ?

Tab. 1 : Chronologie relative simplifiée des secteurs architecturaux et des peintures murales, cf. Margueron 1982 ; Margueron 1987 ; Margueron 2004 (Caractère normal : enduit de terre; Italiques : chaux; Gras : juss).

ton Moortgat à la IIIe dynastie d'Ur (fin du IIIe millénaire) pour la composition de la salle 132[29] coïncidait-elle avec l'analyse architecturale de Jean-Claude Margueron : différences d'orientation de murs, « nœuds » (c'est-à-dire croisements de murs complexes avec épaississements incompréhensibles), obstructions de portes et autres indices signalent des anomalies par rapport à un projet architectural cohérent, autrement dit

29 Moortgat 1967, 78–79.

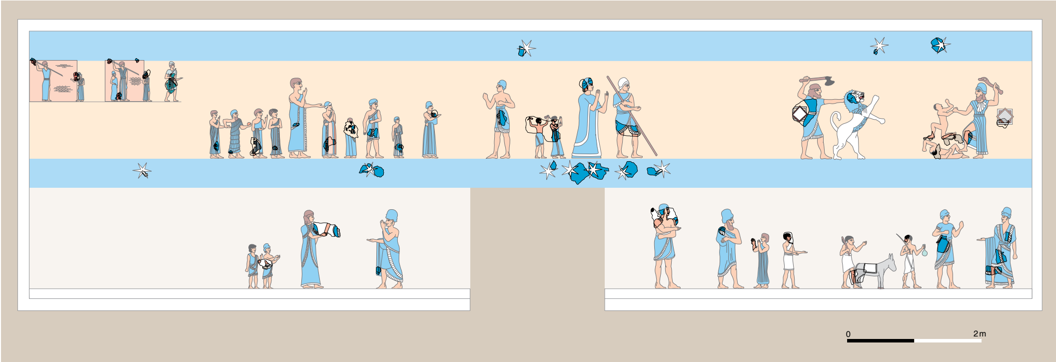


Fig. 5 : Restitution de la composition peinte à l'étage du secteur F (salles 219-220, salle de réception privée des appartements du roi 220') sur enduit de terre. (B. Muller, dessin P. Kimmenaurer, infographie A. Horrenberger, cf. Muller 2005, 38 pl. coul. 4a).

des réfections, des reconstructions qui viennent s'encastrer dans le tissu existant.[30] Mais s'il est relativement aisé de déterminer des réaménagements et leur succession, il est plus difficile d'assigner ceux-ci à tel souverain plutôt qu'à un autre. Si, comme on le verra par la suite, aucune peinture murale ne peut être mise au crédit de Zimri-Lim, le dernier roi, en revanche c'est à son prédécesseur immédiat Samsi-Addu (1792–1775) – un usurpateur dans la séquence de la dynastie amorrite puisque, roi d'Ekâllatum en Haute Mésopotamie, il annexe Mari et mettant à sa tête son fils Iasmah-Addu – qu'il faut imputer de grands travaux architecturaux (construction de l'aile des esclaves G et réaménagement complet des appartements du Roi F) ainsi que les peintures murales figuratives du secteur F (Fig. 5), mais aussi du secteur I (Maison des Femmes), de même que les compositions sur *juss* du secteur M (peintures hautes de la cour 106, probablement aussi podium de la salle 64, Figs. 6 et 7). A partir de là, il faut progressivement remonter dans le temps pour placer le panneau de *l'Investiture* et la composition fragmentaire du temple aux Peintures 132. La construction de ce dernier, remontée très haut dans la chronologie à un moment donné,[31] a été ensuite ramenée aux alentours de 2000 : en effet, dans la séquence chronologique générale du Palais, si la salle aux Piliers du Pseudo-Palais de Ville II est assignée à Naram-Sin (2254–2218),[32] il faut laisser un laps de temps à l'édification, puis à l'arasement total du « Palais-fantôme »[33] à la suite duquel a été bâti le Grand Palais Royal. C'est pourquoi c'est désormais Hanun Dagan, qui a gravé son nom sur la crapaudine de la porte d'entrée du Palais, qui en paraît le constructeur le plus vraisemblable : la séquence dynastique des *Shakkanakku* ("gouverneurs" de Mari mis en place par le pouvoir d'Akkad au XXIII[e] s.), incomplètement fixée, suscite des débats[34] mais, jusqu'à plus ample information, on peut s'en tenir aux alentours de 2000 pour situer la construction du Grand Palais Royal de Mari et ses plus

30 Margueron 1982, 372–376, fig. 248 ; non indiquée dans Muller (sous le nom de Pierre) 1987, 561 et n. 36.

31 Margueron 1982, 372–376, figs. 248, 251–254 ; j'avais repris ces données dans Muller (sous le nom de Pierre) 1987, 556 : c'est le tableau présent qui les remplace.

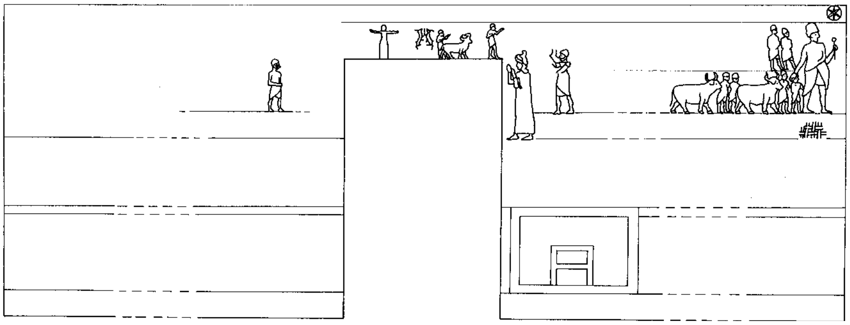
32 Margueron 2004, 311.

33 Margueron 2004, 367–371.

34 Cf. Matthiae *et al.* 2007.

Fig. 6 : *Restitution de la cour 106 (cour du Palmier).*

Fig. 6a : Ensemble architectural (© Mission archéologique de Mari, J.-Cl. Margueron, dessin N. Bresch, infographie A. Horrenberger, cf. Margueron 2004, 425 pl. coul. 68).



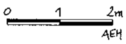


Fig. 6b : Restitution simplifiée provisoire du mur sud (juss) avec, en particulier, les Scènes Sacrificielles B (à droite) et A qui la suit. (© Mission archéologique de Mari, B. Muller, infographie A. Horrenberger).

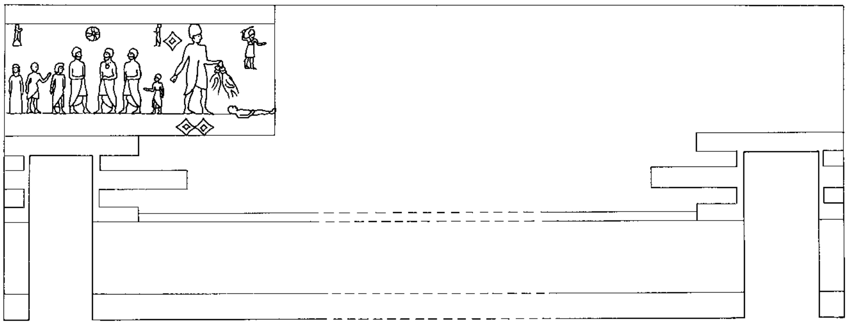


Fig. 6c : Restitution simplifiée provisoire du mur ouest (juss). Couleur bleue du costume du roi victorieux et de certains éléments de son épée (non reproduite ici). (© Mission archéologique de Mari, B. Muller, infographie A. Horrenberger).

Fig. 7 : Le podium de la salle 64.

Fig. 7a : Détail de la maquette de restitution du Palais, vue vers le sud (© Mission archéologique de Mari, J.-Cl. Margueron et musée du Louvre).

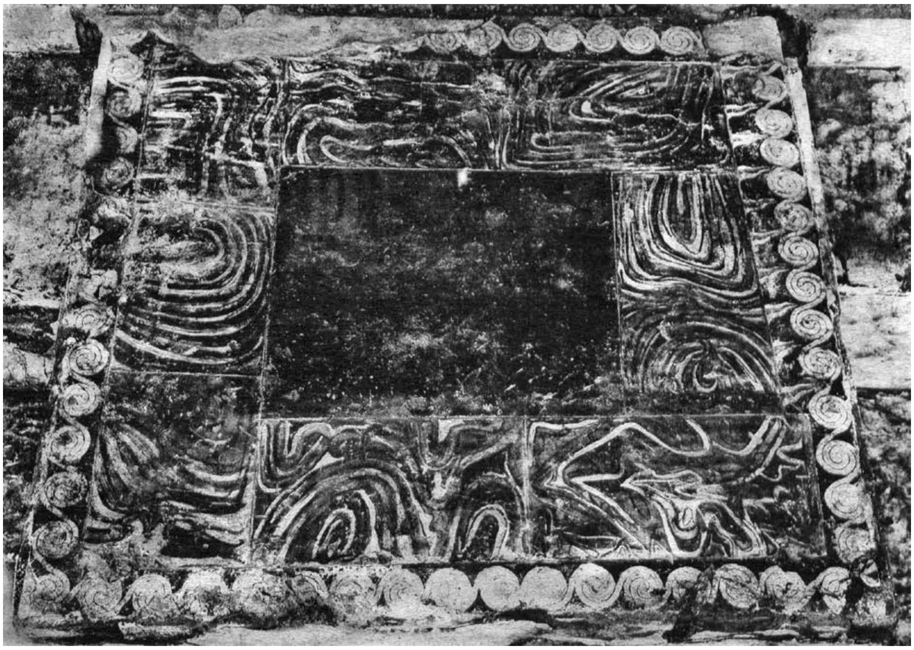


Fig. 7b : Surface peinte en faux marbre sur juss au moment du dégagement (© Mission archéologique de Mari, cl. 1783, Parrot 1958b, pl. XV.2).

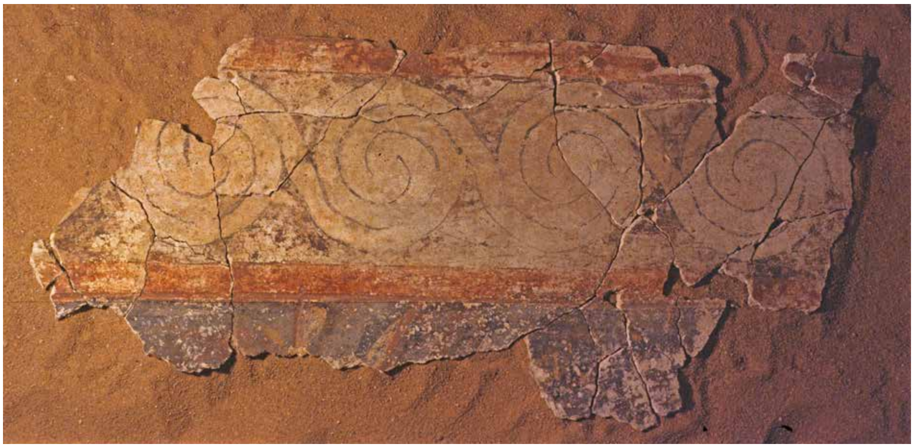


Fig. 7c : Vestige de bordure remise au jour en 2004 (© Mission archéologique de Mari, J.-Cl. Margueron).

anciennes peintures.[35] Le tableau ci-joint donne une vue simplifiée de la question, en lui associant les peintures murales.[36]

Il est bien évident, dès lors, que le moment du réaménagement architectural constitue un terminus post quem, ce qui n'exclut pas que des peintures d'époques différentes se succèdent sur le même mur. C'est là que la nature de l'enduit peut, à condition d'être étudiée à grande échelle, c'est-à-dire sur l'ensemble du palais,[37] fournir un indice de chronologie relative allant même à l'encontre de caractères stylistiques, comme on le verra avec la *peinture de l'Investiture*.

Je ne reprendrai pas ici les inventaires présentés par type d'enduit[38] ou selon un cheminement à l'intérieur du palais[39] (cf. Fig. 1). Je m'attacherai surtout, pour respecter le thème du *workshop*, à faire une mise au point sur les aspects techniques, de façon à bien mettre en lumière les débats dépassés et les affirmations erronées, autrement dit les avancées de la recherche qui ont une incidence sur la chronologie relative des peintures.

2. Support, crépi, enduit

Depuis l'origine des constructions en terre au Proche-Orient (vers 12 000) ont été mises en place les techniques de protection du mur et de support du décor mural qui perdureront durant toute l'Antiquité – et encore actuellement dans l'habitat traditionnel – sous la forme d'enduit de terre argileuse, d'enduit de terre avec badigeon de chaux et d'enduit de « plâtre », mieux dénommé par le terme arabe local de *juss* (produit de la

35 Margueron 2004, 331, 371–373, 459 ; cf. Muller 2005, 40.
36 Ce tableau remplace celui que j'ai publié, Muller (sous le nom de Pierre) 1987, 573.
37 Muller (sous le nom de Pierre) 1984 ; Muller (sous le nom de Pierre) 1987.
38 Muller (sous le nom de Pierre) 1987, 554.
39 Muller 2005, 37–39.

calcination du gypse).[40] Les pigments sont généralement d'origine minérale.[41] Quant à la technique *a fresco*, selon la thèse généralement admise elle n'est attestée qu'à proximité des bordures côtières de la Méditerranée à partir de 1700 environ.[42]

2.1 Support : en général le mur de briques crues (mud brick wall)

Par support, qui peut désigner aussi la couche sur laquelle sont posés les pigments, j'entends le matériau de construction, c'est-à-dire la brique crue (séchée au soleil), à base de terre argileuse, malaxée avec de l'eau et de la paille hachée,[43] avec adjonction de dégraissants divers pouvant aller des gravillons aux galets et aux petits ossements animaux, en passant par les tessons de céramique (pouvant atteindre une dizaine de centimètres de long), ces derniers étant particulièrement présents dans les briques de la Ville III de Mari[44] (module 44 × 44 × 10cm).[45]

Un cas exceptionnel est représenté par le podium de la salle 64 (cf. Fig. 7), en briques crues et recouvert d'une dalle de pierre calcaire (ép. 10 à 15cm), « elle-même masquée par une couche de boue (1cm), enduite finalement de plâtre (1mm à 1,5mm) ».[46]

2.2 Crépi (enduit de sous-couche = backing support)

Cette couche préparatoire[47] désigne la couverte appliquée directement sur le parement du mur et qui est d'une composition très voisine de celle de la brique, mais plus liquide.[48] Elle peut être appliquée en deux couches, comme cela a été observé dans la cour 106 (ép. respective 2,5 à 4,0cm et 3,0 à 4,0cm), la première (contre le mur) rainurée, la seconde piquetée pour faciliter l'adhérence de la couche suivante.[49] Tout cela est courant et connu : un mur de briques crues ne peut pas se concevoir sans ce revêtement protecteur, qui peut aussi être appliqué sur le sol ou le toit.

2.3 Enduits (couche de finition = plaster ou coating)

Le Grand Palais Royal connaissait les trois types d'enduits supra, § 2, préférés tour à tour selon les époques, et aussi selon le type d'espace considéré. C'est sur cette préparation semi-liquide que sont étalés les pigments dilués. Il ne sera pas tenu compte ici des revêtements bitumés (sols et plinthes), parce qu'ils jouaient un rôle non pas décoratif mais utilitaire d'étanchéité, particulièrement dans les salles d'eau.[50]

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40 Cf. Muller 2012, 99–100, 105 : enduit de terre dès 10 000, enduit de chaux peut-être déjà vers 12 000, *juss* à partir de 10 000.

41 Cf. Nunn 1988, en particulier 25–29, tableau 3 ; Muller 2012, 100.

42 Alalakh, cf. Woolley 1955 ; Tel Kabri, cf. Kempinski 1990 ; Kempinski 1992 ; Kempinski 1994 ; Niemeier – Niemeier 2000; mais les peintures murales de Tell el-Burak (Sader 2009) dateraient du XIXe s.

43 Il n'y a pas eu d'analyses pour déceler la présence d'éventuelles déjections animales.

44 Margueron 1995b, 82–83, 88–89.

45 Peu de notations de formats de briques chez André Parrot, voir Parrot 1958a, 86, 108.

46 Parrot 1958a, 106. Pour la terminologie, cf. ci-dessous § 2.2 et 2.3.1.

47 Je préfère ne pas l'appeler « mortier » comme le font couramment les spécialistes de la fresque gallo-romaine.

48 C'est pourquoi André Parrot emploie le terme de « boue », qui néanmoins n'est pas approprié. Pour tous ces termes, cf. Aurenche 1977.

49 Parrot 1958a, 86–87, repris dans Muller (sous le nom de Pierre) 1984, 224–225.

50 Pour le détail des enduits non peints, cf. Muller (sous le nom de Pierre) 1987, 554–560.

2.3.1 Simple enduit de terre

C'est ce qu'André Parrot dénomme – improprement et de façon récurrente – la « couche de boue », qui évoque la consistance relativement liquide de la couverte au moment de la pose et suggère son constituant argileux, mais non ses autres composants éventuels ; la paille hachée y est mentionnée à l'occasion,[51] et se trouve d'ailleurs être aussi une composante des enduits de *juss* : il en a été observé d'infimes vestiges ou des empreintes au revers de certains fragments des peintures hautes de la cour 106.

- Salle 132 (chapelle d'Ishtar dite aussi temple aux Peintures, secteur B)[52]
  Recueillie en fragments tombés pêle-mêle, cette peinture, relevée sur cellophane et reproduite partiellement à la gouache sur plastique, a été restituée en cinq registres.[53] Des détails de la restitution sont à revoir et l'emplacement originel est à discuter. Il n'est pas nécessaire de revenir sur la datation vers 2000 (*supra*, § 1.2) que conforte la similitude avec les fragments suivants (salle 52-53).[54]

- Salle 52-53 (secteur H)[55]
  En effet, deux fragments, recueillis cette fois « en contrebas » du dallage de *tabuk* (dalles de terre cuite)[56], témoignent de l'état primitif, ultérieurement modifié. Enduit (terre), facture (cerne épais), couleurs en nombre limité (noir, blanc et ocre rouge) et motifs (damier) sont comparables à ceux de la salle 132.[57] Le motif à volutes, qui évoque de loin un palmier, témoigne de la monumentalité de la composition originelle (l. restituée 71cm). En outre il a été rapproché d'une peinture, datée par Evans, du Premier Palais de Cnossos.[58]

- Salles 219 et 220 (= salle 220' à l'étage, secteur F, cf. Fig. 5)[59]
  Stratigraphiquement prouvée, la provenance depuis l'étage a permis de restituer la composition,[60] répartie sur deux registres figuratifs, l'un à fond ocre (enduit de terre brut), l'autre à fond blanc (enduit de terre badigeonné de chaux) ; leur séparation par la bande étoilée à fond bleu est hypothétique et leur position respective a été dictée par les emplacements de chute ainsi que le contact entre une zone de couleur bleue et un fragment d'appareil de briques.[61] Le module des personnages est incontestable et leur position par rapport à la longueur du mur a été dictée

51 Parrot 1958a, 63 ; Parrot 1958b, 3. Le sol de la salle 132, en terre battue, était revêtu d'une couche d'argile verte.
52 Parrot 1958b, 70–82 ; Margueron 2004, 407–409, fig. 398, 462–463, fig. 468.
53 Dimensions restituées (certainement non représentatives de la composition originelle) : l. 3,36m ; h. 2,78m.
54 Muller (sous le nom de Pierre) 1987, 555–556, 560–561.
55 Parrot 1958b, 10–13, figs. 9–11 ; Muller 1995a, 51, 57 fig. 2.
56 Parrot 1958a, 41 pour ce qui est du contexte et du support. Parrot 1958b, 10–13, figs. 9–11. Muller (sous le nom de Pierre) 1987, 555 et n. 18 pour la datation ; mention dans Muller 2005, 39 et n. 21.
57 Muller (sous le nom de Pierre) 1987, 556, 558 fig. 1.
58 Muller 1995b, 57, fig. 2 d'après Smith 1965, fig. 53. Cf. *infra*, § 7.2.
59 Parrot 1958b, 83–106 ; Muller (sous le nom de Pierre-Muller) 1990 ; Margueron *et al.*1990.
60 L. 14,70m ; h. 3,50m.
61 Muller sous le nom de Pierre-Muller 1990, 502, 504, 549 pl. XXIII.2. Les fragments à fond blanc, majoritairement retrouvés haut en fouille, sont présumés provenir des zones inférieures du mur.

par le plan de chute des fragments.[62] Dans le détail, mes restitutions, inspirées par de nombreux documents iconographiques, de préférence contemporains, comportent évidemment une part d'hypothèse, ce qui n'empêche pas de considérer comme acquis le thème général de la glorification du roi dans son action profane.

A ma connaissance, c'est le seul exemple proche-oriental à avoir mis en œuvre – avant la Crète – le procédé minoen, particulièrement perceptible au palais de Cnossos, de différenciation des registres par la couleur du fond ; l'exemple comparatif le plus adéquat est la *fresque aux Pliants* qui met en scène la fameuse *Parisienne*[63] : en effet, la séparation y est rectiligne, au contraire de la plupart des autres exemples, comme celui de la *fresque à la Procession*. Comme le corps de bâtiment F fait partie de la dernière phase de reconstruction, la peinture est imputable à Samsi-Addu (1793–1775) pour des raisons stylistiques,[64] et d'ailleurs la prédominance de la couleur bleue, qui y a été remarquée va dans le sens de la marque « paléo-assyrienne »,[65] c'est-à-dire du royaume de Haute Mésopotamie qui mit la main sur Mari.

- Salles 31, 34 (secteur I), peintures figuratives[66]
  Recueillies sous la forme d'une demi-douzaine de fragments, de la même veine (étoile, type de costume) que ceux provenant de la salle 220', je ne m'y attarderai pas ici : techniquement et chronologiquement, ils appartiennent à la même série.

2.3.2 Enduit de terre couvert d'un badigeon de chaux

Ce n'est finalement qu'une variante améliorée de la formule précédente, avec laquelle elle peut d'ailleurs se combiner, et que l'on rencontre aussi bien dans les cas de scènes figuratives (registre inférieur de la salle 220'),[67] que de décors géométriques (*infra*, § 3).

2.3.3 Enduit de « plâtre » (*juss*)

- Décor non figuratif
  Si plusieurs espaces étaient revêtus de ce matériau, laissé dans sa teinte brute blanchâtre,[68] un décor non figuratif l'agrémente en plinthe veinée de rouge dans le passage 31-34. En outre, deux aires en plan horizontal s'ornaient d'un décor en faux marbre : la plus célèbre supportait, sur le podium de la salle 64 (secteur M, cf. Fig. 7), la fameuse statue de la Déesse aux eaux jaillissantes; la seconde, située sur le sol de l'espace 31 immédiatement à l'est du passage vers 34, avait moins attiré

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62 Parrot 1958b, 84 fig. 63, complété avec les trouvailles de 1966 par Muller (sous le nom Pierre-Muller) 1990, 537 pl. XI.

63 Cf. Platon 1959, pl. ΛΓ. Cf. Muller 2005, n. 59.

64 Margueron 1982, 375, n. 643 ; Pierre-Muller 1990, 529–530. Indirectement Moortgat 1964, 87 ; Moortgat 1967, 75–78 (ressemblance des personnages de 31-34 et de 106). L'organisation du secteur F à l'étage est semblable à celle du secteur I-J (Margueron *et al.* 1990, 450).

65 Spycket 1988, 300.

66 Parrot 1958b, 8–10 ne précise pas la nature du support, auquel il fait allusion dans Parrot 1958a, 165. Parrot 1958b, 8–9, figs. 6–8.

67 Muller (sous le nom de Pierre-Muller) 1990a, 550 pl. XXIV, 555 pl. XXIX, 557 pl. XXXI ; résumé et reproduction en couleur dans Muller 2005, 36, 38–39.

68 Muller (sous le nom de Pierre) 1987, 554.

l'attention parce qu'elle avait été interprétée par André Parrot comme une aire de jeu (*jeu de Palets*) destinée à tromper l'ennui des sentinelles (Fig. 8).

Le podium de la salle 64[69] mérite qu'on s'y arrête pour plusieurs raisons. De par son emplacement même, il est imprégné d'une haute charge symbolique : en effet, la salle 64 est une sorte de sas entre le vaste espace ouvert de la cour 106, propice aux grands rassemblements à l'occasion de banquets, et la salle du Trône où était reçue une élite soumise à une étiquette rigoureuse (cf. Fig. 6). La configuration architecturale, qui la privait de fenêtres, la confinait dans une relative obscurité, propice à une intronisation placée sous la protection divine. La peinture alliait l'aspect précieux du faux marbre à la promesse de fertilité liée à la spirale courante de l'encadrement assortie, de surcroît, de flammes du côté occidental. Qui plus est, ce podium à degrés latéraux était posé comme sur un tapis de *juss* alors que le reste de la salle se contentait de terre battue. Distinction supplémentaire : la peinture masquait une pierre réelle, la dalle de calcaire surmontant la construction de briques crues. Etant donné la rareté de la pierre dans les régions de vallées et de plaine mésopotamiennes, son usage est limité et l'ajout de peinture sur un tel matériau y est exceptionnel, sinon unique, ce qui n'est pas le cas à Alalakh, ni en Crète.[70] La nature du revêtement et le motif du décor, que l'on retrouve dans le secteur I, font penser que c'est aussi, vraisemblablement, Iasmah-Addu qui avait commandé cette œuvre. Ne serait-ce pas alors, si de récentes trouvailles dans le monde égéen ne me contredisent pas, le faux marbre le plus ancien que l'on connaisse ?[71]

Le choix d'un tel décor, qui paraît absolument nouveau pour l'époque, avait certainement une signification profonde, à laquelle n'échappait pas le mal dénommé *jeu de Palets* de l'espace 31 qui, à mon sens, lui est contemporain. L'ensemble architectural 31-34, qui reproduit un plan traditionnel de salle de réception contiguë à un espace central,[72] est en quelque sorte le pendant en symétrique de 106-64 ; or l'accent n'a jamais été mis sur l'emplacement de l'aire[73] peinte sur le sol de l'espace 34, à droite de la porte vers 31[74] comme *l'Investiture* l'était sur le mur de la cour 106. Comme le podium de la salle 64, les dalles de faux marbre sont peintes sur enduit de *juss*, lequel revêt tout le sol de l'espace 31. Signalons ici une remarque intéressante des fouilleurs,[75] qui sera discutée ci-après : pour en raviver les couleurs avant de prendre les photographies, ils ont mouillé la peinture et souligné sa résistance à l'eau, ce qui les conduit (à tort) à la conclusion d'une exécution *a fresco*.

- Décor figuratif

Or la restauration en 1990, par le CEPMR de Soissons sous la direction de Mme Alix Barbet, de 89 fragments de *juss* peints, recueillis au pied du mur méridional de la cour 106 et entreposés depuis leur découverte dans les réserves du musée du

69 Surface peinte : 2,33m × 2,11m ; ép. de l'enduit de *juss* : 1,0 à 1,5mm sur crépi de terre ép. 1,0cm. Parrrot 1958b, 67 ; mention dans Muller 2005, 39.

70 Muller (sous le nom de Pierre) 1987, 572, avec références.

71 Muller sous presse, § I-1-a.

72 Margueron 1982, 237 (« plan babylonien ») ; Margueron 2004, 467–468.

73 2,60m × 1,62m.

74 Parrot 1958a, 165–167, figs. 186–187.

75 Parrot 1958a, 166–167.

Fig. 8 : Peintures en faux marbre sur juss de l'espace 31.

Fig. 8a : Aire peinte sur le sol de l'espace 31, vue vers le nord-ouest, dite à tort jeu de Palets (Parrot 1958a, pl. 39a).

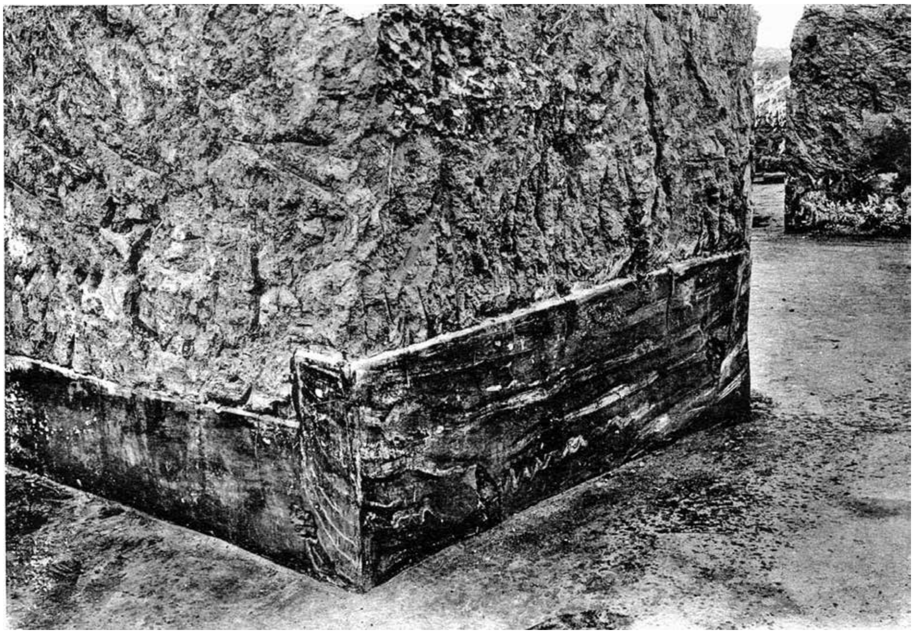

Fig. 8b : Plinthe veinée de rouge du passage 31-34, vue vers le nord-ouest (Parrot 1958a, pl. 39b).

Louvre,[76] a bien montré que les pigments n'auraient pas résisté au lavage à grande eau comme le font les fresques habituellement traitées dans ce Centre.[77] En principe, la carbonatation, qui fixe les pigments posés sur l'enduit de chaux encore humide et les fait migrer à l'intérieur, ce qui est la caractéristique de la fresque et assure sa solidité et sa pérennité, n'affecte pas le gypse. Or les analyses du Laboratoire de Recherche des Musées de France effectuées à l'époque ont bien confirmé que le *juss* était le produit de la calcination du gypse ($CaSO_4 \cdot 2\,H_2O$)[78] : il ne s'agit donc en aucun cas de fresque. Comment expliquer alors cette résistance à l'eau du faux marbre peint sur le sol de l'espace 31 ? D'abord, les fouilleurs ont peut-être simplement vaporisé un peu d'eau, ce que l'on fait parfois sur la brique crue qui a trop séché, pour en percevoir à nouveau les joints. Mais c'est là aussi qu'il convient de faire intervenir l'expérience de praticiens de la fresque et de nuancer les catégories trop tranchées qu'affectionnent les archéologues : il est possible, au moment de la confection d'un revêtement de *juss*, « de ralentir son temps de prise », ce qui le durcit et « augmente la bonne tenue à l'eau des couleurs » ; on peut même « lustrer (serrer) des stucs de gypse et sable ou de gypse et chaux ».[79] Le contour du triple cadre avait été gravé à la pointe,[80] nécessairement dans le matériau encore humide.[81]

Ces procédés particuliers n'avaient pas été employés pour les compositions hautes de la cour 106 : le nettoyage a dû être réalisé très précautionneusement à sec avant fixage des couleurs au Paraloïd B 72.[82] Les cassures ont permis d'observer des épaisseurs variables du *juss*, de 1 à 3mm, parfois sur plusieurs couches. André Parrot avait noté une épaisseur de 1,0 à 1,5cm sur les murs est et ouest et sans doute davantage sur le mur sud où l'épaisseur totale, couches de crépi comprises, atteignait 20cm.[83] Sur le revers d'un fragment représentant un profil de personnage a été observée l'empreinte colorée d'une partie de disque flammé ; ceci permet d'envisager la trace d'une réfection :[84] D'après les observations portées sur l'avers des fragments restaurés, la surface peut avoir un aspect soit lisse, soit boursouflé, soit d'une texture plus grossière (Figs. 9 et 10).

La restauration s'est accompagnée d'un dispositif de présentation en sept panneaux, formés d'une plaque d'Aérolam et sur lesquels les fragments peints ont été encastrés dans un mortier synthétique recouvert, pour l'effet esthétique, de sable fin, puis de poudre de marbre. Pour en faciliter la compréhension, certains ont été

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76 Muller (sous le nom de Muller-Pierre) 1993a ; Muller 2013, 1, 4–5.

77 Cf. Muller 2005, 41.

78 Muller 1993a, 355, n. 7 ; Muller 2005, 40. Le rapport de 2004 de cet organisme, devenu C2RMF (Centre de Recherche et de Restauration des Musées de France), résumé par Béatrice Amadei, évoque du sulfate de calcium dans la bande bleue du triple bandeau, dont un petit segment a été déposé avec la *peinture de l'Investiture*.

79 Je remercie bien vivement Jean-François Gavoty, artiste plasticien, professeur à la Haute Ecole des arts du Rhin, Strasbourg, d'avoir répondu à mes questions par courriel à la suite d'un stage technique organisé en décembre 2015 dans le cadre de l'exposition *Ana Ziqquratim* (Strasbourg, avril–juin 2016).

80 Parrot 1958a, 166.

81 Communication par courriel du 13 novembre 2016 de Jean-François Gavoty.

82 Par les soins de Florence Monier (ingénieur de recherche au CNRS, AOROC, UMR 8546, CNRS / ENS) et Agnès Schmidt (restauratrice).

83 Parrot 1958a, 86–87, repris par Muller (sous le nom de Pierre) 1984, 225.

84 Muller 1993a, 255 et n. 6.

Fig. 9 : Revers et tranches de fragments peints sur juss provenant des zones hautes de la cour 106 (© A. Barbet, CEPMR / ENS).

Fig. 9a : Fragments 66v et 66r.

Fig. 9b : Fragments divers 66 et 67.

Fig. 10 : Avers de fragments peints sur juss provenant des zones hautes de la cour 106, pour la suface picturale et les couleurs (© CEPMR / ENS, cl. F. Monier).

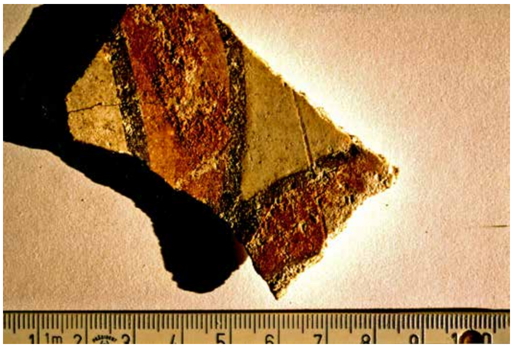

Fig. 10a : Fragment 66r (motif géométrique) en lumière rasante.

Fig. 10b : Fragments 47 et 66p.

Fig. 10c : Fragments 22 (pied ocre rouge) et 17 (patte animale rose foncé).

Fig. 10d : Fragments 66 : remarquer les rouges et le gris.

Fig. 11 : Exemples de panneaux de présentation (restauration CEPMR 1990) des fragments sur juss provenant des zones hautes de la cour 106.

Fig. 11a : Profils masculins, collier et main. Mur ouest, dignitaires de module 2 (h. restituée 1,10m) (© CEPMR / ENS, cl. A. Barbet).

Fig. 11b : Dame coiffée d'un turban et vêtue de riches drapés à franges. Mur ouest, module 6 (h. restituée 45cm).

complétés par un contour au trait exécuté par mes soins. Cet ensemble a été montré pour la première fois au public en 2013–2014 au musée du Louvre[85] (Fig. 11).

A l'évidence, le *juss* avait été choisi par Iasmah-Addu, sur ces murs de la cour 106, pour offrir une meilleure résistance en espace ouvert. Néanmoins, contrairement à ce que j'ai affirmé naguère,[86] les restaurations ont montré que ces peintures avaient besoin d'une protection par un toit[87] : les bases de colonnes de l'auvent mises au jour lors de la campagne de 1984 ont donné raison à la certitude de Jean-Claude Margueron[88] et ont définitivement balayé l'hypothèse de Y. Tomabechi qui, en l'absence de vestiges dans les zones septentrionales de la cour, pensait que les compositions hautes étaient inachevées[89] ; en réalité celles-ci ne faisaient pas le tour de la cour sans protection d'un auvent comme je l'ai cru moi-même un temps,[90]

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85 Muller 2013. Ce « feuillet » pour grand public est en ligne sur le site internet Grands Sites Archéologiques du Ministère de la Culture et de la Communication (http://archeologie.culture.fr/mari).

86 Muller (sous le nom de Pierre) 1984, 241–242.

87 C'est d'ailleurs ce que suggérait déjà Parrot 1937a, 71, mais avec l'idée d'un dispositif mobile qu'il n'y a pas lieu de retenir.

88 Margueron 1987, en particulier 470 : « […] j'estimais indispendable de prévoir une protection efficace ».

89 Tomabechi 1980, 143.

90 Muller (sous le nom de Pierre) 1984, 241–243.

mais s'étendaient seulement sur le mur sud[91] et sur une extension de près de 5m des murs est et ouest.[92] Le choix du *juss* pour le podium de la salle 64 peut se justifier techniquement par le fait qu'il supportait la *déesse aux Eaux jaillissantes,* laquelle pouvait fonctionner réellement comme une fontaine. Quant à l'aire de faux marbre de l'espace 31, sa situation sur un sol, près d'un passage, nécessitait qu'elle possédât une certaine résistance, qui n'était pas requise pour les peintures murales figuratives, recueillies en 31 et 34 sous forme de fragments sur enduit de terre. Il y a une hésitation sur les fragments mis au jour dans la pièce E : sur enduit de *juss* ou de terre ?

3. Enduits et techniques d'exécution : cas complexes ou litigieux

3.1 Secteurs I et J : peintures purement décoratives

3.1.1 Salles 42, 43 et 46 (secteur J)

Chaux ou « très légère couche de plâtre » sur l'enduit de terre des murs[93] ; ce n'est pas qu'il y a un doute sur l'identification, mais en salle 43 le *juss* est venu en 3^{e} phase.

Le décor se caractérise principalement par un triple bandeau (noir, ocre rouge, noir) sur enduit de terre, « le revêtement chaulé ne commençant, on ne sait trop pourquoi, qu'en-dessous ».[94] A cela s'ajoute la plinthe de *juss*[95] (Fig. 12) : ce revêtement hétérogène ne peut être dû qu'à une exécution échelonnée dans le temps. A mon sens le revêtement de *juss* ou de chaux date de l'époque de Samsi-Addu ; cette présomption est confortée par une situation décorative similaire de l'espace 31.

3.1.2 Salle 31 (secteur I)[96] (cf. Parrot 1958b, pl. I.1, II.1)

Ici, le bandeau est constitué d'une double torsade où se combinent le bleu et le noir,[97] d'où le nom de « cour bleue » donné à cet espace par son inventeur ; elle était posée sur enduit de terre, le revêtement chaulé ne commençant qu'en dessous ;[98] à ces deux étapes décoratives pour les murs[99] s'ajoute celle de faux marbre du sol (pseudo-jeu de palets) et de la plinthe en *juss* (*supra*, § 2.3.3), qui peut avoir été contemporaine du

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91 L. 25m ; h. env. 3,0m à 3,5m au-dessus du sol environ.

92 Muller 2002 ; Muller 2005, 38.

93 Parrot 1958b, 3.

94 Parrot 1936, 19. Cette phrase est claire mais en contradiction avec le croquis (ici Fig. 12) qui note du plâtre, et d'ailleurs la description de la publication définitive (Parrot 1958b, 3 : chaux ou très légère couche de plâtre sur l'enduit de terre des murs) introduit un doute sur la nature du revêtement de la zone qui s'étend sous le bandeau (cf. Nunn 1988, 9).

95 Parrot 1958b, 3–5, fig. 3 ; cf. Muller (sous le nom de Pierre) 1987, 556–557, 562 fig. 2.

96 Parrot 1958a, 105, pls. XXXVIII.1–2 ; Parrot 1958b, 1–3, figs. 1–2, pls. I.1; II.1. Margueron 2004, fig. 502. Cf. aussi *infra*, § 4.3.

97 A une hauteur de 1,80m excepté sur le mur sud, au pied duquel a été recueilli le fragment d'une torsade différente dans son orientation comme dans ses couleurs. Des fragments de torsade bleue ont été recueillis également dans la salle de réception 34 (Parrot 1958b, 3).

98 Parrot 1958b, 2.

99 Eventuellement même trois étapes, si la torsade blanche et orange fait partie d'un programme différent de la bleue.

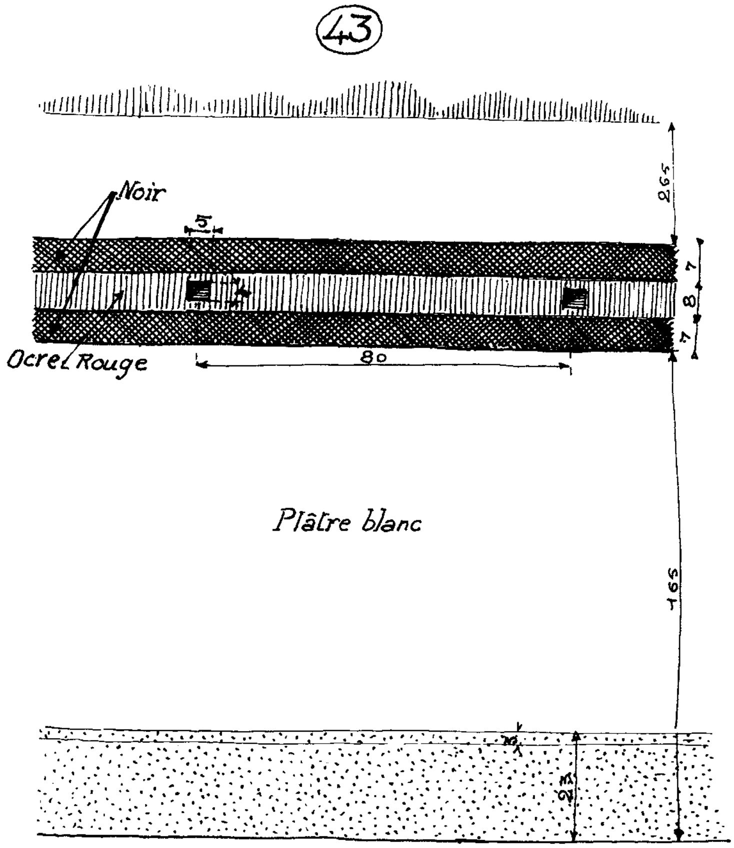

Fig. 12 : Salle 43 (secteur J, Maison des Femmes) : décor de triple bandeau sur enduit de terre alors qu'en dessous le revêtement est chaulé (plutôt qu'en juss).

chaulage : Samsi-Addu aurait donc, comme dans la cour 106, réservé un décor ancien sur enduit de terre pour y adjoindre une décoration nouvelle.

3.2 Peinture de l'Investiture[100] (cf. Fig. 4)

Le seul fait que ce tableau[101] ait été exécuté sur enduit de terre (ép. 5 à 6mm, lissé et poli)[102] alors que tout le reste de la cour (sol, plinthe et murs) était revêtu de *juss*, pose la question de la chronologie relative de ce qui apparaît comme deux programmes iconographiques distincts. André Parrot n'envisageait que l'époque de Zimri-Lim mais Prudence Harper avait émis, sur des critères techniques (enduit de terre et tracé à la pointe), l'hypothèse qu'elle puisse être plus ancienne que les peintures sur *juss.*[103] Anton Moortgat avait tranché sur des critères stylistiques (le véritable profil de l'épaule ainsi que l'absence de ceinture des vêtements, particularité ouest-sémitique) pour l'affirmer

100 L'état de la question, brossé par Muller (sous le nom de Pierre) 1987, en particulier 560–561, est revu ici à la lumière d'observations plus récentes. Pour la description et l'interprétation, voir dans Muller 2005, 38 le résumé de Parrot 1958b ; Barrelet 1950.

101 L. 2,50m ; h. 1,75m.

102 Barrelet 1950, 9.

103 Harper 1962, 203–204 ; Parrot 1958b, 54, précise : « [...] les contours en avaient été tracés à la pointe, avec une très grande sûreté de main ».

comme contemporaine de Hammurabi de Babylone c'est-à-dire, comme Parrot, des dernières années de la vie du Palais. Ne nous attardons pas sur la prétendue réfection de la peinture[104] ni sur l'interprétation – remise en cause[105] et à considérer comme dépassée – d'un texte qui laissait supposer que Hammurabi de Babylone avait remporté deux victoires successives sur Mari à deux ans d'intervalle pendant lesquels Zimri-Lim se serait hâté de rasseoir l'image de son pouvoir.[106] Entre les années 1950 et 1990, la balance penchait pour l'époque de Zimri-Lim, thèse à laquelle j'ai moi-même souscrit.[107] Le débat a été relancé par Jean-Claude Margueron,[108] qui a reconsidéré la question sous l'angle technique précisément, arguant qu'il est difficilement imaginable de plaquer une peinture sur enduit de terre par-dessus un revêtement de *juss*, à la fois techniquement et idéologiquement, parce qu'on ne recouvre pas une œuvre de haute qualité par un matériau moins noble : pour lui, la *peinture de l'Investiture* était plus ancienne et avait été conservée lors des réfections de Samsi-Addu. Il faut bien dire que toutes les observations que j'ai pu faire après la restauration des années 1985 se sont avérées vaines, car on ne décèle rien à l'endroit du raccord entre terre et gypse, particulièrement bien conservé sur la bordure verticale droite.

Les analyses par diffraction de rayons X[109] sur des prélèvements effectués au moment de la restauration de 2001–2003 au CEPMR de Soissons[110] ont réservé une surprise : une base de carbonate de calcium avec un peu de quartz, autrement dit un badigeon de chaux dont il n'avait jamais été question jusque là.[111] « On relève la présence de carbonate de calcium, mêlé aux pigments », ce qui a amené la restauratrice à se demander s'il s'agissait de fresque et, dans ce cas, « de la plus ancienne peinture murale exécutée dans cette technique ».[112]

Relativisons cette découverte. D'abord, les phénomènes observés ont pu se produire non pas au moment de l'exécution de la peinture, mais dans la terre d'enfouissement[113] pour peu qu'elle fût humide, ce qui est généralement le cas en Mésopotamie. D'autre part, le badigeon de chaux – c'est-à-dire une couche fine appliquée sans l'intention de travailler *a fresco* – « produit aussi une carbonatation en séchant, qui peut être dure si les conditions d'application sont bonnes (humidité etc.) ».[114] Ainsi deux raisons pour-

104 Discussion développée dans Muller (sous le nom de Pierre) 1984, 234–235.

105 Cf. Margueron 1990a, 423–431.

106 Hypothèse de François Thureau-Dangin, reprise par Ursula Seidl in Orthmann 1975, 303 et par Tomabechi 1980.

107 Barrelet 1950, 9 : se contente des « débuts du II^{e} millénaire » ; cf. Parrot 1958b, 64 ; Moortgat 1964 ; Moortgat 1967 ; Tomabechi 1980 ; Muller (sous le nom de Pierre) 1984, 234–236.

108 Margueron 1990b ; Tomabechi 1980, 143 s'était déjà étonné qu'aucune trace de l'enduit de plâtre n'ait été retrouvée sous *l'Investiture*.

109 Analyses effectuées par le Centre de Recherche et de Restauration des Musées de France (C2RMF).

110 Restauration que j'ai pu suivre dans sa phase terminale, effectuée par Béatrice Amadei qui m'a commuiqué le rapport du C2RMF (2004) ainsi qu'un extrait de son propre rapport de restauration. Selon les échantillons, toutes les techniques classiques ont été mises en œuvre : observations sous loupe binoculaire, coupes stratigraphqiues, tests microchimiques, microscopie optique et microscopie électronqiue à balayage (MEB), diffraction des rayons X, spectrométrie à infrarouge transformée de Fourier, microspectrométrie RAMAN.

111 La thèse unanimement admise était que les couleurs étaient appliquées à même l'enduit de boue du revêtement mural : Parrot 1958b, 53 ; repris par Muller (sous le nom de Pierre) 1984, 234.

112 Extrait du rapport de restauration de B. Amadei, Rapport de restauration, 2007 (inédit).

113 Mes remerciements vont à Alix Barbet (communication personnelle). Cf. Poursat 2008, 192.

114 Jean-François Gavoty, communication personnelle (courriel du 10 décembre 2015).

Fig. 13 : Zoom sur une vue du mur sud de la cour 106 : remarquer la tranche rectiligne de l'enduit de juss dans le passage 106-64 et l'absence de celui-ci dans la zone de la peinture de l'Investiture (© Mission archéologique de Mari, A. Parrot, cl. numérisé AP200_2009, cf. Parrot 1958b, fig. 46).

raient faire de cette éventuelle « fresque » un phénomène accidentel, dû au hasard. Le tracé à la pointe des contours des figures[115] ainsi que des bandes de l'encadrement central et extérieur droit conservé[116] n'est pas une preuve que les artistes ont travaillé sur badigeon humide, puisque celui-ci reste tendre une fois séché.[117] Quant aux couleurs, sur lesquelles nous reviendrons (*infra*, § 5.), elles sont décrites comme « non pas posées au pinceau, mais placées en léger relief, comme une marqueterie… »[118] : un empâtement obtenu par mélange, dans une coupelle, de beaucoup de pigment avec l'enduit n'est pas incompatible avec la technique d'exécution *a fresco* et donne des couleurs vives et denses qui tiennent bien.[119] Ainsi ces deux dernières caractéristiques techniques (contours et couleurs) ne sont pas décisives pour ou contre une exécution *a fresco*.

Tout ceci n'apporte pas non plus la preuve absolue que la peinture n'avait pas été posée sur le revêtement de gypse. Seuls quelques clichés pris au moment de la découverte pouvaient apporter des informations[120] mais les reproductions de la publication, malgré la qualité de l'héliogravure, ou même les tirages originaux, n'étaient pas assez lisibles pour laisser déceler les détails. La récente numérisation des plaques de verre et des négatifs souples des archives de la Mission Parrot[121] permettent enfin de lever le doute. En effet, en faisant un zoom sur l'image (Fig. 13), on y voit que :

115 Parrot 1958b, 57.
116 Muller (sous le nom de Pierre) 1984, 234.
117 Jean-François Gavoty, communication personnelle (courriel du 13 novembre 2016) ; exécuter de tels contours à la pointe sur badigeon sec n'est toutefois pas une pratique courante.
118 Parrot 1958b, 58.
119 Jean-François Gavoty, communication personnelle (courriel du 13 novembre 2016).
120 Parrot 1958b, fig. 46 (cl. AP203_2009) ; Parrot 1958a, pl. XXVII.1 (cl. AP203_2007).
121 Numérisation réalisée grâce au soutien financier du Labex de Paris Ouest Nanterre *Les Passés dans le Présent* et à la logistique du service des archives de la Maison de l'Archéologie et de l'Ethnologie René Ginouvès de Nanterre.

– conformément aux descriptions du texte, mais en désaccord avec les annotations portées sur un cliché d'ensemble,[122] la peinture est effectivement placée tout à fait en bordure du montant occidental de la porte 106-64 ;
– l'épais revêtement de *juss* de la jouée (passage qui correspond à l'épaisseur du mur) apparaît, à l'arête angulaire de la tête de mur, non pas comme cassé mais avec sa tranche nettement rectiligne sans amorce de retour angulaire du côté de la cour 106 ;
– le tableau de *l'Investiture*, mal conservé dans sa partie supérieure sur son côté gauche, ne laisse voir aucune trace d'un revêtement de *juss* sous-jacent ; qui plus est, il se trouve sur l'arrière-plan de l'enduit de terre par rapport à l'avant-plan de celui de *juss* du passage 106-64.

Par conséquent on peut considérer désormais comme indubitablement acquis que la *peinture de l'Investiture* a été réservée, c'est-à-dire laissée en place tandis que tout le revêtement de *juss* a été plaqué autour. Il n'y avait pas eu à proprement parler de raccord à faire du côté de la porte 106-64, sinon à faire coïncider le bord du cadre peint avec la face interne du placage de juss de la porte ; quant à son bord du côté droit, les clichés que je viens de revoir tout comme la réalité scrutée naguère attestent un rattrapage parfait entre le plan vertical ancien de la peinture et le plan nouveau du placage de *juss.*[123] L'antériorité de *l'Investiture* par rapport à celui-ci se trouve ainsi confirmée.[124]

4. Particularités d'exécution

Comme dans toute la peinture antique jusqu'à l'époque hellénistique, les couleurs sont toujours posées en aplat, sans dégradés, et généralement cernées d'un trait noir. Quelques particularités vont être passées en revue concernant les techniques préparatoires ou de finitions.

4.1 Contours et remplissages

4.1.1 Ligne-guides

Les triples bandeaux décoratifs horizontaux, qui courent dans certains espaces à une hauteur oscillant entre 2,00m (cour 106) et environ 1,50m en moyenne (salles 42, 43, 46 du secteur I) sont dépourvus de trait de démarcation. En l'absence de marques de claquage à la ficelle[125] (procédé qui ne peut se pratiquer que sur enduit humide), sur quels repères se guidaient les peintres pour tirer des lignes droites ? On peut se demander si la ligne rouge repérée dans la salle 78 sur l'enduit de terre[126] ne témoignerait pas de la technique similaire appliquée sur enduit sec : la ficelle est alors trempée dans de la peinture rouge. Ce procédé est bien connu en Egypte[127] et il est hautement probable qu'il ait servi à Mari pour les bandeaux, les bandes séparatrices de registres ou les lignes de sol séparatrices de sous-registres.

122 Parrot 1937a, 235, fig. 7.
123 Cf. Muller (sous le nom de Pierre) 1984, 235–236.
124 Cf. Margueron 1990b, 124–125.
125 Cf. Muller 2005, 41.
126 Sur les murs est et ouest, à 1,67m et 1,50m du sol carrelé, cf. Parrot 1958a, 156.
127 Goyon *et al.* 2004, 365 ; cf. Brysbaert 2011, 257.

4.1.2 Contour gravé

Il a déjà été question des contours, tracés préalablement à la pointe, repérés pour la délimitation des dalles de faux marbre du pseudo-*jeu de palets* de l'espace 31[128] et des cadres de la *peinture de l'Investiture,*[129] de même que des figures du double tableau central de cette dernière, lesquelles « témoignent d'un effort remarquable dans le sens de l'exactitude. Les costumes, en particulier, ont été tracés avec un étonnant souci du détail… ».[130] Le procédé n'était pas exceptionnel, apparemment : j'en ai observé un exemple sur le fragment sur *juss* n° 59 de la cour 106. « D'une facture assez grossière » en revanche, mentionnons ici les graffiti encore en place dans la salle 52, gravés là aussi sur l'enduit de plâtre.[131]

4.1.3 Contour peint

Noirs en général, les contours soulignent également certains détails anatomiques : de l'oreille, par exemple, ou de la musculature. Un personnage mythologique représenté de face fait exception à cette règle : le « Gardien de l'Océan céleste », replacé à l'extrémité droite du registre 4 de la peinture de la salle 132, noir sur fond noir à points blancs, est cerné de rouge et en outre mis en valeur par « une espèce d'auréole jaunâtre ».[132]

4.1.4 Remplissage

C'est le moment d'évoquer le mode d'exécution, apparemment particulier, de la partie centrale de la *peinture de l'Investiture* : « les couleurs ont été non pas posées au pinceau, mais placées en léger relief, comme une marqueterie, encastrées dans le logement ménagé entre les lignes creusées à la pointe. On risque cette fois d'avoir utilisé un couteau pour étendre la pâte. Cet aspect de la technique est assez curieux pour qu'on doive le signaler tout spécialement puisqu'on ne le rencontre pas ailleurs, non seulement dans les parties extrêmes de la peinture, mais dans le reste de l'ornementation picturale du Palais. ».[133]

4.2 Plinthes : transitions et finitions (cf. Fig. 8)

La finition biseautée a été remarquée pour les plinthes de *juss* de la cour 106 et de l'espace 31,[134] cette dernière soulignée en outre d'un trait de peinture noire.[135] Haute de 50cm en moyenne dans la cour 106, elle comptait 42cm dans l'espace 31 et 64 cm dans le passage 31-34 : manière, en plus du faux marbre, d'annoncer l'importance de la salle vers laquelle la porte introduisait, puisque la plinthe n'était pas ainsi surhaussée dans tous les passages. Dans la cour 106, la hauteur de la plinthe n'est pas accentuée dans les portes, et ce n'est que du côté de la pièce contiguë, après un retour d'angle, que se fait l'ajustement – à angle droit – avec la hauteur moindre. A cet élément minimal de décor – qui a un lien, rappelons-le, avec la structure architectonique[136] – avait donc présidé beaucoup de soin.

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128 Parrot 1958a, 166 : ces traits « incisés dans la masse » sont en outre soulignés de noir.
129 Parrot 1958a, 166 ; Parrot 1958b, 57.
130 Parrot 1958b, 57.
131 Parrot 1958b, 13–15, figs. 13–15 ; Parrot 1958a, 41.
132 Parrot 1958b, 79.
133 Parrot 1958b, 58.
134 Muller (sous le nom de Pierre) 1984, 224–225 : ép. 4cm dans la cour 106.
135 En tout cas dans l'espace 31, cf. Parrot 1958a, 165.
136 Muller (sous le nom de Pierre) 1984, 231.

4.3 Peinture décorative et encastrements

Mentionnons, pour mémoire, l'origine architectonique du décor des portes de la cour 106 (cf. Fig. 6a), imité du renforcement en pans de bois de la tête de mur ajoutée au piédroit occidental de la porte 106-112.[137]. Dans les salles 43 et 46, l'emplacement du triple bandeau bichrome n'est pas non plus le fait du hasard (cf. Fig. 12) puisqu'il pouvait être associé à des perforations d'accrochage.[138] La situation la plus intéressante est offerte par la double torsade bleue de l'espace 31 qui, « de part et d'autre d'une moulure en creux », « n'avait subsisté que sur une partie de la paroi nord et spécialement à l'angle nord-ouest »[139] (cf. Fig. 13).

5. Couleurs et pigments

Malgré le nombre restreint d'analyses par rapport à la quantité des peintures, en réunissant les informations tirées des publications avec celles des analyses de 1990 (peintures hautes de la cour 106, sur *juss*)[140] et de 2004 (*Investiture*, peinture sur terre),[141] il est possible d'exposer des données sinon complètes, du moins cohérentes. Excepté le noir (carbone) et le bleu égyptien (matière de synthèse), les pigments sont d'origine minérale.[142]

Puisque ces peintures s'avèrent ne pas être de la fresque, la question des liants a été inévitablement posée. Marie-Thérèse Barrelet[143] suggérait pour la *peinture de l'Investiture* qu'un liant (œuf ou gomme adhésive) avait contribué à fixer les couleurs, tandis qu'André Parrot[144] rapporte l'avis de M. Goulinat, alors chef de l'atelier de restauration du Louvre, qui évoque une « fresque retouchée à la caséine ou [une] peinture retouchée à la caséine ». Les analyses de 2004 n'ont pas pu apporter de réponse, car la peinture était masquée par les vernis de restauration et les liants ne se conservent pas.

Dresser ici la liste exhaustive des couleurs répertoriées n'aurait pas de sens : on se contentera de donner la composition des pigments lorsqu'elle est connue et de proposer quelques réflexions d'ensemble sur l'utilisation des couleurs, en attendant la publication complète en préparation, qui s'attachera de façon précise à leur répartition et à leur symbolique.[145]

5.1 Palette de base

5.1.1 Le blanc

Le blanc n'est généralement pas considéré comme une couleur, puisqu'il s'agit – excepté pour 132 et le registre inférieur de 220' – de la teinte de fond, provenant soit du badigeon de chaux posé sur l'enduit de terre, soit du *juss* même. Cependant il sert

137 Muller (sous le nom de Pierre) 1984, 227–230.
138 Muller (sous le nom de Pierre) 1984, 226–227 ; cf. Muller 2005, 41.
139 Parrot 1958b, 1, 3, 4.
140 Muller 1990b; Muller 1993a.
141 Compte rendu d'étude C2RMF n° Z 3252, 2004 (inédit). B. Amadei, Rapport de restauration, 2007 (inédit).
142 Cf. note 110.
143 Barrelet 1950, 10.
144 Parrot 1958b, 58, mentionné dans Muller 1995b, 133, n. 14.
145 Le tableau fort utile dressé par Nunn 1988, 20–21 est trop général pour ce qui nous occupe ici.

souvent, par contraste, soit par rapport au fond ocre (salle 220', *peinture de l'Investiture*), soit par rapport à une bordure noire épaisse (salle 132) ou à une teinte sombre (torsade bleue et noire de l'espace 31, fond ocre rouge sombre de la spirale encadrant le faux marbre du podium de la salle 64), à éclairer une composition. C'est ainsi que l'on peut comprendre les languettes ondulées blanches dans la robe multicolore des déesses de la salle 132.

La valeur de « brillant » et, de là, le rendu de métaux précieux, en est une conséquence : le blanc de l'extrémité des cornes du taureau de la *Scène Sacrificielle* A (cour 106, cf. Fig. 16) ainsi que le croissant qui décore son front sont interprétés, à la lumière d'un texte recueilli dans la salle 79 du palais, comme devant représenter de l'or ou de l'argent.[146] Il en va de même pour les cornes des tiares divines, les bijoux, ou les branches de l'étoile flammée[147] qui surmontait vraisemblablement la *Scène Sacrificielle* B. De même qu'en grec *leukos* veut dire blanc brillant, de même en Mésopotamie l'éclat était plus important que le coloris.[148]

Contrairement aux conventions égyptiennes ou égéennes, la distinction entre la carnation féminine – blanche – et la carnation masculine – rouge – n'apparaît pas du tout à Mari (cf. Fig. 11).[149]

5.1.2 Le noir

Les analyses n'ont rien révélé d'autre que du noir de carbone pour ce qui, là non plus, n'est pas réellement considéré comme une couleur. Outre son emploi systématique pour les contours, il est, par convention, la couleur des chevelures et des barbes, mais aussi de certains instruments.[150] Plus étonnants, il est aussi utilisé pour le pelage du taureau ou le personnage mythologique, déjà signalé ici, de la salle 132. Il faut noter aussi, devant la façade d'entrée du bâtiment, « au pied des pilastres d'angle, […] un nombre important de carreaux, peints sur la tranche, en noir généralement, quelquefois en rouge, certains en noir et rouge ».[151]

5.1.3 Le gris

Son emploi appuyé en 132,[152] discret mais généralisé par ailleurs, et la texture épaisse de sa surface (jugulaire du fragment n° 55 de la cour 106)[153] écartent l'éventualité qu'il puisse s'agir de noir pâli.

5.1.4 Les rouges

Il n'est pas surprenant que les rouges des fragments sur *juss* de la cour 106 relèvent des oxydes de fer : l'examen des clichés effectués à la loupe binoculaire n'a pas permis

146 Parrot 1958b, 19, n. 1.
147 Parrot 1958b, 34, pl. C.2. Autre exemple : Parrot 1958b, 47, fig. 41 (fragment n° 68).
148 Cassin 1968, 115–116.
149 Dans le cas du visage de cadavre (fragment n° 63 de la cour 106), le blanc a une signification ; dans d'autres cas, ce peut être une disparition du pigment (Muller – Piver sous presse).
150 Sorte de bâton du fragment n° 1 de la cour 106 (Parrot 1958b, pl. C.1) ; harpê d'Ishtar dans la salle 132 (Parrot 1958b, 73).
151 Parrot 1958a, 9–10.
152 Parrot 1958b, 72–82 et pl. E.
153 Observation inédite faite lors de la restauration par le CEPMR de Soissons, cf. Parrot 1958b, 44 et fig. 37.

Fig. 14 : Compositions hautes sur juss de la cour 106 : vues à la loupe binoculaire.

Fig. 14a : Fragment 66s bis : pigment rouge et pigment noir.

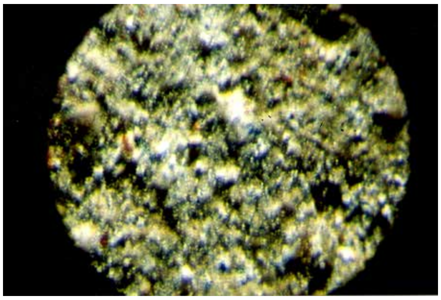

Fig. 14b : Grains de bleu égyptien dans les pigments rouges de la patte animale du fragment 17, pour obtenir du rose foncé (© CEPMR / ENS, cl. H. Ghisdal).

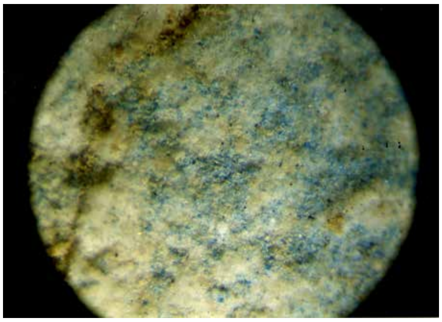

Fig. 15 : Compositions hautes sur juss de la cour 106 : fragment 47 (cf. Fig. 10b) vu à la loupe binoculaire et montrant le pigment de bleu égyptien (© CEPMR / ENS, cl. H. Ghisdal).

à M. Vincent Guichard, alors conservateur au musée de Roanne, de se prononcer formellement pour identifier des hématites,[154] mais la composition des pigments antiques comporte tellement peu d'exceptions pour les ocres que poursuivre des investigations coûteuses sur ces derniers ne se justifierait pas réellement.[155] Dans *l'Investiture*, les rouges et les oranges ont été identifiés comme des ocres potassiques mélangés à de l'oxyde de fer, avec présence de silice et de carbonate de calcium.

Les descriptions des publications d'une part et les observations que j'ai pu conduire sur les fragments de la cour 106 d'autre part, concordent pour distinguer trois types de rouges :

– un rouge orangé plus ou moins soutenu, pouvant aller de la terre d'ombre brûlée ou brique foncé jusqu'au rouge de Venise pâli ; c'est le plus courant ; il présente, à l'œil nu et plus encore au microscope binoculaire, une granulométrie grossière et souvent ses lacunes ont un aspect de piquetage blanc (Fig. 14a) ;
– un rouge sombre où semble être incorporé du noir, observé sur un petit nombre de fragments ;
– un rose à granulométrie fine, très couvrant, délayé ou au contraire d'apparence très épaisse, observé en particulier sur les pattes d'animaux ; à la loupe binoculaire, on aperçoit des petits grains de carbone disséminés sur le pigment rose. C'est un mé-

154 Cf. Muller 2005, 41, n. 37.
155 Muller 1995b, 133 et n. 11.

Fig. 16 : Cour 106, peintures hautes sur juss : éléments de la Scène Sacrificielle.

Fig. 16a : Scène Sacrificielle A : copie sur calque J. Lauffray, couleurs à la gouache (© Mission archéologique de Mari, A. Parrot).

Fig. 16b : Scène Sacrificielle B : restitution exposée au musée du Louvre (© CEPMR / ENS, cl. A. Barbet).

lange avec du bleu égyptien qui a été pratiqué sur la patte animale n° 17 (Fig. 14b) ainsi que sur les fragments n° 66t et 67j.[156]

L'examen à la loupe binoculaire montre que des fonds apparemment blancs avaient été colorés d'un rouge très pâli.

156 Observation faite lors de la restauration par le CEPMR de Soissons: Muller (sous le nom de Muller-Pierre) 1993, 355; cf. Parrot 1958b, 30–31 et fig. 25 ; 47 et fig. 39.

Il est probable que, statistiquement, le rouge serait majoritaire par rapport aux autres couleurs.

5.1.5 Les ocres jaunes

Bien moins fréquents que les rouges, les ocres jaunes n'avaient sans doute pas bénéficié d'adjonctions d'oxydes de fer. Leur signification au sein des peintures de Mari reste à étudier.

5.2 Couleurs complémentaires

5.2.1 Les bleus purs

Les publications de la mission de Mari, lorsqu'elles donnent une précision sur le bleu, font état de « bleu de cobalt ». Cette expression peut désigner aussi bien le pigment que, plus simplement, une tonalité franche, moins violacée que le bleu outremer. La précision « cobalt » n'est pas systématique et il n'est pas certain que sa présence ou son absence signifient une différence de tonalité. Les descriptions des publications insistent sur la texture très fine du pigment et une extrême fragilité. Ainsi, à propos des torsades bleues du double bandeau de l'espace 31 : « [...] très peu de temps après le dégagement, la poudre de bleu de cobalt s'effondrait, malgré de notre part plusieurs essais de fixation ».[157] Ce bleu « de cobalt » concerne en outre, sur enduit de *juss*, le triple bandeau de la cour 106 et les fragments 28 et 53 et, sur enduit de terre, les peintures figuratives fragmentaires des salles 220' et 34 et de l'espace 31.[158]

Les observations à la loupe binoculaire et les analyses faites en 1990 sur les fragments sur *juss* de la cour 106 ont établi, par diffraction de rayons X, que les pigments bleus sont constitués de silicates de cuivre et de calcium (bleu égyptien) : il s'agit bien de la matière de synthèse obtenue par traitement thermique à haute température de silice, de sel de cuivre et de sel de calcium (Fig. 15).[159] Les analyses de 2004 sur la *peinture de l'Investiture* ont donné le même résultat. Cette donnée fait remonter de plus d'un siècle l'utilisation de ce procédé dans le bassin syro-mésopotamien : jusque là, Alalakh VII en avait été considéré comme le précurseur.[160]

Malheureusement aucun recoupement n'a pu être fait entre la mention du bleu « de cobalt » et une analyse physico-chimique : y avait-il réellement, pour le bleu, deux compositions de pigments différentes à Mari, ou bien ne faut-il pas plutôt considérer, en ne prenant pas à la lettre les notations d'André Parrot, que toutes les teintes de bleu provenaient d'un seul pigment, le bleu égyptien ?

5.2.2 Les bleus mélangés

- Bleu-gris

  Outre la plinthe de *juss* de la cour 106, cette teinte a été donnée à la bande médiane des torsades du mur sud de l'espace 31 (bleu cendré)[161] et à deux éléments

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157 Parrot 1958b, 2.

158 Parrot 1958b, respectivement 8–9, 16, 34, 42–43, 83–106. Salle 220': ici Figs. 2 et 5.

159 Muller (sous le nom de Muller-Pierre) 1993b, 355 et n. 7, repris dans Muller 1995b, 133, n. 10 ; Muller 2005, 41.

160 Nunn 1988, 27.

161 Parrot 1958b, 3.

de vêtements de la cour 106 (n° 55). Il est probable que ces derniers ont bénéficié de l'adjonction de bleu égyptien.

- Rose : cf. *supra*, § 5.1.4 et Fig. 14b.
- Bleu verdâtre
  C'est la teinte indiquée par André Parrot pour les veines de certains rectangles périphériques du faux marbre du podium de la salle 64.[162] Cette peinture, malheureusement laissée en place, a été remise au jour en 2004;[163] elle atteste plutôt une teinte bleu sombre (Fig. 7c).

5.2.3 Le vert

Lors de la restauration au CEPMR des fragments sur *juss* provenant de la cour 106, la présence de couleur verte n'a été détectée que par un point accidentel sur le fragment n° 71b ; D. Parayre n'en recense que deux exemples (n° 7 et 8),[164] qui n'ont pas pu être observés car ils ne faisaient pas partie du lot. Il faut leur ajouter le n° 4, où les imbrications de la montagne sont jaune clair, ocre rouge et vertes.[165]

Dans la salle 220', un personnage se distingue par la teinte bleu-vert de son vêtement drapé : c'est l'archer M.4596.[166]

Enfin, le feuillage du palmier de la *peinture de l'Investiture* a été bien remarqué au moment de la découverte,[167] mais le pigment n'a pas pu en être analysé. En revanche, un élément apparaissant bleu-vert vif a révélé un peu de bleu égyptien associé à des pigments blancs et orange (sous une surface de restauration jaunâtre et translucide).

6. Répartition et symbolique des couleurs : quelques pistes

En attendant l'étude complète et plus approfondie en préparation, résumons les grandes lignes des tendances qui se dessinent concernant les couleurs des peintures murales du Grand Palais Royal de Mari. Il apparaît que chacune des compositions peintes se caractérise par l'emploi d'une gamme de teintes privilégiées.

Ainsi en est-il de l'ocre rouge dans la salle 132 ; il s'y s'ajoute le gris, peu prisé ailleurs ; la couleur naturelle de l'enduit (ocre brun clair ou beige) domine puisqu'il s'agit de la teinte du fond. Le blanc, utilisé par touches fréquentes pour les vêtements et le décor, y ressort particulièrement. Le noir, habituel pour l'emploi des contours et du rendu de la musculature, sert ici aussi pour le remplissage de certaines figures (taureau et figure mythologique du registre 4, cf. Fig. 3).

La *peinture de l'Investiture*, également sur enduit de terre, utilise la palette la plus diversifiée, en particulier pour les vêtements multicolores des déesses *Lamassu*. En plus d'un bleu pâle, étalé sur de grandes surfaces (ciel ?, oiseau)[168], cette palette relève de touches d'un bleu-vert extrêmement lumineux les plantes des vases aux eaux jaillissantes ainsi qu'un détail du griffon à queue hélicoïdale, et colore d'un vert plus foncé

162 Parrot 1958b, 67 ; cf. Muller 1995b, 134.
163 Margueron *et al.* 2015, 198.
164 Parayre 1982, 47.
165 Parrot 1958b, 27.
166 Muller (sous le nom de Muller-Pierre) 1990a, 484, 485 fig. centrale.
167 Parrot 1958b, 60.
168 Parrot 1958b, 61.

le feuillage des palmiers. Le noir y est quasi-absent, excepté pour la spirale du cadre et, naturellement, pour les contours des figures.

Les peintures hautes de la cour 106, sur enduit de *juss* blanc, font dominer l'ocre rouge pour les vêtements ; s'y ajoute l'orange de motifs géométriques (mur ouest) ; le vert y est rare, de même que le bleu. Mais ceci peut être dû aux aléas de la conservation : en effet, le fragment au poignard n° 53, très vraisemblablement la figure répétée du roi (cf. Fig. 6c), porte, en plus d'éléments rouges, un costume bleu à festons blancs ; de plus, la pomme de la poignée de l'épée est notée en bleu de lapis et le fourreau en bleu de cobalt.[169] En accord avec des données textuelles, qui indiquent que « dans l'étiquette vestimentaire des prêtres mésopotamiens, la couleur rouge était de rigueur »,[170] il se pourrait que la couleur du costume royal soit différente en contexte religieux (*Scène sacrificielle*, rouge) et en contexte profane (bleu) : ce fragment bleu appartient à une figure de roi vainqueur et rappelle la couleur dominante des peintures de la salle 220'.

Les peintures de la salle 220' (salle de réception des appartements privés du roi à l'étage du secteur F), sur deux registres différenciés par la couleur du fond (blanc et ocre, cf. Fig. 5), privilégient presque exclusivement le bleu (auquel s'associent des détails blancs) pour les costumes : d'emblée, la connotation exclusivement profane de l'iconographie y avait été remarquée.[171] En plus du parti pris esthétique déjà suggéré pour le bleu,[172] Samsi-Addu se conformait aux conventions religieuses en se revêtant de rouge dans sa fonction de conducteur de la procession sacrificielle (cour 106) et en bleu dans sa fonction de roi vainqueur recevant les produits de sa victoire mais, si l'on en croit Elena Cassin, « entre deux objets de couleurs aussi fortement différenciées pour nous que le rouge et le bleu existait un lien qui était pour les Accadiens assurément plus important que leur diversité chromatique ».[173]

L'ornementation purement décorative ignore le vert, mais utilise couramment l'ocre rouge et le bleu pour les bandeaux, et ce à des époques différentes si l'on admet que la torsade bleue de l'espace 31 est antérieure au décor sur *juss* de la plinthe et du sol.

7. Conclusion

Les analyses physico-chimiques ont apporté deux révélations capitales : le badigeon de chaux (au lieu d'un simple enduit de terre) sous la *peinture de l'Investiture* et l'emploi de bleu égyptien ; ce dernier fait de Mari – dans l'état actuel des connaissances – le plus ancien site syro-mésopotamien où ce matériau est employé comme pigment.

Les questions de techniques d'exécution sont particulièrement importantes, puisqu'elles aident à fixer la chronologie relative des peintures murales du Grand Palais Royal de Mari. Celle-ci est complexe : comme je l'ai déjà fait remarquer, aucun des espaces peints du palais ne présentait un revêtement homogène;[174] d'autre part, deux états successifs n'indiquent pas le laps de temps écoulé entre eux.

169 Parrot 1958b, 42–43, figs. 35–36.
170 Cassin 1968, 104.
171 Parrot 1958b, 105 ; Muller (sous le nom de Pierre-Muller) 1990, 529–530.
172 *Supra*, n. 65.
173 Cassin 1968, 115.
174 Muller (sous le nom de Pierre) 1987, 554–555.

7.1 Récapitulation des acquis concernant Mari

7.1.1 Etat de la question sur les acquis nouveaux et les problèmes dépassés

- Salle 132 : il n'y a pas de raison de remettre en cause la datation haute de Moortgat, qui est en accord avec la date de construction du palais sous Hanun-Dagan aux alentours de 2000.[175] Les fragments de la salle 52, recueillis sous un dallage antérieur au dernier sol (en terre battue sur un remblai) sont sans doute de la même époque : le secteur H figure parmi les plus anciens.
- *Peinture de l'Investiture* : en établissant que la peinture avait été posée sur un badigeon de chaux, les analyses du C2RMF ont définitivement levé le doute sur l'éventualité d'une couche de *juss* sous-jacente – ce que confirme l'examen au zoom de photos d'archives numérisées – et ont rendu indiscutable le raisonnement selon lequel ce tableau était antérieur à tout le décor sur *juss* du reste de la cour.[176] Son emplacement contre l'arête angulaire du montant ouest de la porte 106-64 le situe dans la chronologie architecturale comme postérieure à un important remaniement de la cour.[177] En tout cas, il faut abandonner l'idée, soutenue par Moortgat pour des raisons stylistiques,[178] que la *peinture de l'Investiture* était l'œuvre de Zimri-Lim et considérer qu'il n'y a plus de controverse sur cette question.[179] L'époque la plus plausible, intermédiaire entre la construction du palais et les grands travaux de Samsi-Addu, serait le règne de Yahdun-Lim (1810–1774).[180]
- Compositions hautes de la cour 106 sur *juss* : là, il n'y a pas de problème, on peut rester sur l'analyse de Moortgat comme cela est le plus communément admis et attribuer ces peintures à Samsi-Addu (1793–1775), ou plutôt à son fils Yasmah-Addu. La découverte des bases de colonnes de l'auvent ainsi que l'observation et les restaurations des fragments conservés au Louvre ont apporté la preuve que ces peintures, qui nécessitaient une protection, ne s'étendaient pas sur tout le pourtour de la cour.
- Compositions figuratives fragmentaires de la salle 220' et des espaces 31 et 34 : il n'y a pas lieu de revenir sur les rapprochements stylistiques qui ont été faits avec les compositions hautes de la cour 106. Ainsi l'époque de Samsi-Addu peut être considérée comme certaine. Je me demande si le choix de l'enduit (terre) n'est pas justifié par le fait que ces peintures se trouvaient non seulement en intérieur, mais à l'étage.
- L'utilisation massive du *juss*, du moins dans les secteurs à l'air libre (cour 106) ou considérés comme importants (salle 64, espace 31) me conduit à proposer que les décors de faux marbre (64, 31-34) datent aussi de Samsi-Addu. Et si la nature de l'enduit est effectivement un marqueur chronologique, alors les bandeaux dé-

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175 Moortgat 1964, 72 sqq ; Moortgat 1967, 77 sqq ; cf. Muller (sous le nom de Pierre) 1982, 551–552 ; Margueron 2004, 407. L'argument de Tomabechi 1980 sur de la durée de vie possible d'un bâtiment de briques crues, qu'il limite à un siècle, n'est pas valable si le bâtiment est entretenu.

176 Margueron 1990b.

177 Ajout de la tête de mur occidentale des montants des portes 106-112 et 106-64 à la suite de l'élargissement (doublement) du mur ouest : Margueron 1987, en particulier 476 fig. 7 ; (à peine suggéré dans Margueron 2004, 373).

178 Idée que j'ai défendue aussi, cf. Muller (sous le nom de Pierre) 1987, 561.

179 Controverse soulevée par Margueron 1990b, et mentionnée dans Muller 2005, 40.

180 Ceci a des conséquences sur l'histoire de l'art (début de la représentation de plein profil) qu'il n'y a pas lieu de développer ici (cf. Margueron 1990b, 124–125).

coratifs des secteurs I (espace 31) et J (salles 42, 43, 46) seraient antérieurs à ce souverain et auraient, comme la *peinture de l'Investiture*, été conservés alors que le reste de la salle avait été refait en *juss*.

7.1.2 Questions en suspens

Plus de quatre-vingts ans après la découverte, il reste encore des questions en suspens ou non résolues. Concernant les restitutions – ce qui dépasse le cadre de cet article –, celle de la cour 106 est provisoire et celle de la salle 132 doit être reprise, avec la question de son emplacement originel. L'enduit de chaux et la présomption que la *peinture de l'Investiture* ait été peinte *a fresco* méritera peut-être une réflexion approfondie : quelques pistes seront lancées au § 2.

7.2 Mari et le bassin égéen

Je ne prétends ici que résumer les principaux points de comparaison qui entrent, de façon plus générale, dans le vieux débat[181] – peut-être stérile – sur le sens des influences – ou des transferts – entre la peinture syro-mésopotamienne et la peinture égéenne, et je laisse de côté pour le moment tout l'apport de la splendide peinture égyptienne. Tout en sachant que l'architecture monumentale proche-orientale préexiste à celle de la Crète et l'inspire incontestablement, j'ai plutôt parlé, en ce qui concerne les organisations décoratives (subdivision de la surface pariétale, emplacements respectifs des décors figuratifs et non décoratifs)[182] et en ce qui concerne le rôle de la peinture murale comme révélateur de la structure architectonique ou comme substitut de matériaux (bois, pierre et textile), de *koinê*.[183] C'était sans réellement prendre en considération la longue tradition qui, depuis Çatal Hüyük (Anatolie, VII^e^ millénaire) et plus encore Dja'dé (Syrie, vers 9000),[184] habillait les murs de motifs géométriques colorés évoquant ceux des kilims. Alors que la figure humaine apparaît en peinture, pour la première fois semble-t-il, sur un sol à Tell Halula (Syrie, VIII^e^ millénaire),[185] jusqu'à plus ample information les Premiers Palais crétois, contemporains de celui de Mari, ne connaissent que l'ornementation géométrique.[186]

La différenciation de deux registres d'une composition par la couleur de fond apparaît comme une caractéristique crétoise, et pourtant Mari la met en œuvre.[187] J'ai par ailleurs amplement récusé le faux problème de l'origine de la spirale et de la torsade, cette dernière remontant (sur d'autres supports que la peinture) au Néolithique. Du motif de fût à volutes de Cnossos ou de celui de Mari,[188] lequel des deux a inspiré l'autre ? S'il s'agit d'un palmier, son berceau serait plutôt le Pays des Deux Fleuves que la patrie de Minos et ce, d'autant plus si la datation d'Evans a été abaissée.[189] Et que dire du faux marbre ? Les peintures de Samsi-Addu – dont les relations avec l'Ouest s'étaient scellées par le mariage de son fils Yasmah-Addu avec la fille du roi de Qaṭna[190] – s'ins-

181 Débat déjà évoqué par André Parrot cf. Muller 1995a, 49 ; Muller 2005, 37.
182 Muller (sous le nom de Pierre) 1987, 561–567 ; Muller 2005, 42.
183 Muller (sous le nom de Pierre) 1987, 569–572, 574 ; Muller 1995a, 53–54. Muller 2005, 41–42, n. 49.
184 Nunn 1988, 34–54 ; cf. Coqueugniot 2011 ; Muller 2012, 102, 107, fig. 2.
185 Cf. Molist 1998 ; Muller 2012, 102.
186 Cf. entre autres Poursat 2008, 106.
187 Muller 1995a, 52.
188 Cf. Muller 1995a, 51, fig. 2 d'après Smith 1965, fig. 53.
189 Cf. la discussion de Collon 2000, 290, 292, fig. 12. Cf. Poursat 2008, 177.
190 Cf. Margueron 2004, 439.

pirent-elles d'une réalité, inconnue en Mésopotamie, ou d'un modèle décoratif ?[191] En effet, les dallages de pierre à joints colorés (*mosaïko*)[192] commencent à apparaître dans les Premiers Palais crétois ; leur vogue atteindra un siècle plus tard – mais sans dalles de pierre réelles – le Levant[193] : là, la prééminence penche du côté de l'Egée.[194]

Et c'est bien, en principe, sur le plan technique, et plus précisément celui de la peinture *a fresco*, que le monde égéen apparaît comme précurseur et que la fresque se répandra au Proche-Orient à partir de l'époque des Seconds Palais, mais dans les limites des bordures de la Méditerranée.[195] La présomption de peinture *a fresco* de la *peinture de l'Investiture* me paraît bien fragile pour bouleverser ce schéma : même en admettant qu'il s'agisse d'un essai voulu, il serait, à Mari, resté un essai sans lendemain, comme on l'a vu avec les œuvres picturales qui l'ont suivie. D'ailleurs, comme cela a été constaté au cours du colloque *Stucs d'Orient*, les régions de l'Euphrate ne sont pas – à l'époque classique – des régions à chaux (comme l'est par exemple la Syrie du Sud) favorables au développement de la fresque, mais des régions à gypse.[196] En outre, les Mésopotamiens resteront, souvent même encore à l'époque assyrienne (Nimrud, Khorsabad),[197] fidèles à leurs revêtements muraux de terre.

La récente découverte de Tell el-Burak (Liban) viendrait, si elle se confirme, semer le trouble dans le schéma : le bâtiment, du Bronze Moyen II, plus précisément du XIX^{e} s. d'après une analyse de ^{14}C, renferme une salle à compositions murales égyptisantes peintes *a fresco*, alors que les traits culturels égéens y paraissent par ailleurs absents.[198] Si l'on y ajoute celles de Tell Sakka (Bronze Moyen II, 1800–1600), cela rend plus brûlante encore la question : les décorations murales des Premiers Palais étaient-elles des fresques ?[199]

Bibliographie

Abou Assaf 1990

A. Abou Assaf, Zur Datierung des Wandgemäldes von Saal 132 im Palast von Mari, in: P. Matthiae – M. N. Van Loon – H. Weiss (éds.), Resurrecting the Past. A Joint Tribute to Adnan Bounni, Publications de l'Institut historique et archéologique néerlandais de Stamboul 67 (Istanbul 1990) 1–4.

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191 Cf. Muller sous presse.

192 Blakolmer 1997, 97–98 (avec références) ; cf. Poursat 2008, 106.

193 Tel Kabri : Kempinski 1990 ; Kempinski 1992 ; Kempinski 1994 ; Niemeier – Niemeier 2000, 773–776, figs. 5–8.

194 Cf. Blakolmer 1997, 98. Il n'y a pas lieu de développer ici les arguments, qui paraissent indiscutables.

195 Muller 1995a, 56 ; Brysbaert 2011, 249.

196 *Stucs d'Orient, contacts entre les traditions orientales et les cultures hellénisées de la Méditerranée orientale à travers les revêtements stuqués architecturaux d'époque gréco-romaine*, Actes du premier colloque international MAE René-Ginouvès, Nanterre, 21 et 22 novembre 2013, organisé par A. Guimier-Sorbets et J. Dentzer-Feydy. Il n'est pas exclu que les peintures de Tell Sakka (Damascène), sur badigeon de chaux, aient été peintes *a fresco*.

197 Nunn 1988, 9.

198 Sader 2009, en particulier 181, 183, vs. Julia Bertsch dans ce volume.

199 Je n'ai pas trouvé de réponse nette dans des ouvrages généraux et m'en remets aux spécialistes du Bassin égéen.

Al Khalesi 1978

Y. M. Al Khalesi, The Court of the Palms. A functional interpretation of the Mari Palace, Bibliotheca Mesopotamica 8 (Malibu 1978).

Aruz *et al.* 2008

J. Aruz – K. Benzel – J. M. Evans (éds.), Beyond Babylon. Art, Trade, and Diplomacy in the Second Millennium B.C. Catalog of an Exhibition at the Metropolitan Museum of Art, New York, Nov. 18, 2008 – Mar. 15, 2009 (New Haven, Londres 2008).

Aurenche 1977

O. Aurenche, Dictionnaire illustré multilingue de l'architecture du Proche Orient ancien, Collection de la Maison de l'Orient méditerranéen ancien n° 3, série archéologique 2, Institut français d'archéologie de Beyrouth (Liban), publication hors série, (Lyon 1977).

Blakolmer 1997

F. Blakolmer, Minoan wall paintings. The transformation of a craft into an art form, in: R. Laffineur – Philip Betancourt (éds), TEXNH. Craftsmen, Craftswomen and Craftsmanship in the Aegean Bronze Age. Proccedings of the 6th International Aegean Conference, Philadelphia Temple University, 18th–21st April 1996, Aegaeum 16 (Liège 1997) Vol. 1, 95–105.

Barrelet 1950

M.-Th. Barrelet, Une peinture de la cour 106 du palais de Mari, in: A. Parrot (éd.), Studia Mariana, Documenta et Monumenta Orientis Antiqui 4 (Leyde 1950) 9–35.

Bietak 1999

M. Bietak, Une citadelle royale à Avaris de la première moitié de la XVIIIe dynastie et ses liens avec le monde minoen, in: A. Caubet (éd.), L'acrobate au taureau. Les découvertes de Tell el-Dabca (Égypte) et l'archéologie de la Méditerranée orientale (188–1400 av. J.-C.). Actes du colloque organisé au musée du Louvre par le service culturel le 3 décembre 1994 (Paris 1999) 29–81.

Brysbaert 2011

A. Brysbaert, The painted plaster from Qaṭna. A technological study, in: von Rüden 2011, 249–269.

Cassin 1968

E. Cassin, La splendeur divine. Introduction à l'étude de la mentalité mésopotamienne (Paris, La Haye 1968).

Collon 2000

D. Collon, Syrian glyptic and the Thera wall paintings, in: Sherratt 2000, 283–294.

Coqueugniot 2011
E. Coqueugniot, Des peintures dans un bâtiment communautaire du Néolithique précéramique (vers 9000 av. J.-C.) à Dja'de (Syrie). Nature, insertion dans l'architecture et tentative d'interprétation, Pré-actes du XXIV Valcamonica Symposium á Capo di Ponte July 13th–18th 2011 (Valcamonica 2011).

Durand 1987
J.-M. Durand, L'organisation de l'espace dans le palais de Mari. Le témoignage des textes, in: E. Levy (éd.), Le système palatial en Orient, en Grèce et à Rome. Actes du colloque de Strasbourg 19–22 juin 1985, Travaux du Centre de Recherche sur le Proche Orient et la Grèce Antiques 9 (Leyde 1987) 39–110.

Gates 1984
M. H. Gates, The Palace of Zimri-Lim at Mari, Biblical Archaeologist 47,2, 1984, 70–87.

Goyon *et al.* 2004
J.-Cl. Goyon – J.-Cl. Golvin – Cl. Simon-Boidot – G. Martinet, La construction pharaonique, du Moyen Empire à l'époque gréco-romaine. Contextes et principes technologiques (Paris 2004).

Harper 1962
P. O. Harper, Review. Mission archéologique de Mari II. Le palais. Architecture, Peinture murales, American Journal of Archaeology 66, 1962, 203–204.

Heaton 1910
N. Heaton, The mural paintings of Knossos, Journal of the Royal Society of Arts 58, 1910, 206–212.

Invernizzi 1992
A. Invernizzi, Dal Tigri all'Eufrate II. Babilonesi e Assiri, Studi e Materiali di Archeologia 6 (Florence 1992).

Kempinski 1990
A. Kempinski (éd.), Excavations at Kabri. Preliminary Report of 1989 Season 4 (Tel Aviv 1990).

Kempinski 1992
A. Kempinski (éd.), Excavations at Kabri. Preliminary Report of 1991 Season 6 (Tel Aviv 1992).

Kempinski 1994
A. Kempinski, An integrated plan of the palace in the light of the excavations in Areas D and F, in: A. Kempinski – W.-D. Niemeier (éds.), Excavations at Kabri 7–8. Preliminary Reports of 1992–1993 Seasons (Tel Aviv 1994).

Koldewey 1970 [1918]

R. Koldewey, Das Ischtar-Tor in Babylon. Nach den Ausgrabungen durch die Deutsche Orient-Gesellschaft, Ausgrabungen der Deutschen Orient-Gesellschaft in Babylon 2, Wissenschaftliche Veröffentlichungen der Deutschen Orient-Gesellschaft, 32 (Osnabrück 1970 [1918]).

Margueron 1982

J.-Cl. Margueron, Recherches sur les palais mésopotamiens de l'âge du Bronze, Bibliothèque archéologique et historique 107 (Paris 1982).

Margueron 1987

J.-Cl. Margueron, Du nouveau sur la Cour du Palmier, Mari. Annales de Recherches Interdisciplinaires 5, 1987, 463–482.

Margueron 1990a

J.-Cl. Margueron, La ruine du palais de Mari, Mari. Annales de Recherches Interdisciplinaires 6, 1990, 423–431.

Margueron 1990b

J.-Cl. Margueron, La peinture de l'Investiture et l'histoire de la cour 106, in: Ö. Tunca (éd.), De la Babylonie à la Syrie en passant par Mari. Mélanges offerts à J. R. Kupper à l'occasion de son 70e anniversaire (Liège 1990) 114–125.

Margueron 1995a

J.-Cl. Margueron, Mari. A portrait in art, in: J. M. Sasson (éd.), Civilizations of the Ancient Near East Vol. 2 (New York 1995) 885–900.

Margueron 1995b

J.-Cl. Margueron, Notes d'archéologie et d'architecture orientales, Syria 72, 1995, 55–103.

Margueron 2004

J.-Cl. Margueron, Mari. Métropole de l'Euphrate au IIIe et au début du IIe millénaire av. J.-C. (Paris 2004).

Margueron 2014

J.-Cl. Margueron, Mari. Capital of Northern Mesopotamia in the Third Millennium. The Archaeology of Tell Hariri on the Euphrates (Oxford, Philadelphie 2014).

Margueron *et al.* 1990

J.-Cl. Margueron – B. Pierre-Muller – M. Renisio, Les appartements royaux situés à l'étage du Grand Palais Royal de Mari, Mari. Annales de Recherches Interdisciplinaires 6, 1990, 433–451.

Margueron *et al.* 2015

J.-Cl. Margueron – D. Beyer – P. Butterlin – J.-O. Gransard-Desmond – B. Muller – M. Schneider, Mari. Rapport préliminaire sur la 41e campagne (2004), in: J.-Cl. Margueron – O. Rouault – P. Butterlin – P. Lombard (éds), Akh Purattim 3 (Lyon 2015) 181.

Matthiae *et al.* 2007

P. Matthiae – F. Pinnock – L. Nigro – L. Peyronel (éds), Proceedings of the International Colloquium ‚From Relative Chronology to Absolute Chronology‘. The Second Millennium BC in Syria-Palestine‘, Rome, 29th November – 1st December 2001 (Rome 2007).

Molist 1998

M. Molist, Des représentations humaines peintes au IXe millénaire BP sur le site de Tell Halula (vallée de l'Euphrate, Syrie), Paléorient 24,1, 1998, 81–87.

Moortgat 1952

A. Moortgat, Teppich und Malerei zur Zeit Hammurabis. Bemerkungen zum großen Wandgemälde aus Mari, Bibliotheca Orientalis 9, 1952, 92–93.

Moortgat 1959

A. Moortgat, Die altvorderasiatische Malerei (Berlin 1959).

Moortgat 1964

A. Moortgat, Die Wandgemälde im Palaste zu Mari und ihre historische Einordnung, Baghdader Mitteilungen 3, 1964, 68–74.

Moortgat 1967

A. Moortgat, Die Kunst des alten Mesopotamien. Die klassische Kunst Vorderasiens (Cologne 1967).

Muller (sous le nom de Pierre) 1984

B. Pierre, Décor peint à Mari et au Proche-Orient I. La cour 106 du palais de Mari. Les enjeux de la technique, Mari. Annales de Recherches Interdisciplinaires 3, 1984, 223–254.

Muller (sous le nom de Pierre) 1987

B. Pierre, Décor peint à Mari et au Proche Orient II. Chronologie, contexte, significations, Mari. Annales de Recherches Interdisciplinaires 5, 1987, 551–576.

Muller (sous le nom de Pierre-Muller) 1990a

B. Pierre-Muller, Une grande peinture des appartements royaux du palais de Mari (salles 219-220), Mari. Annales de Recherches Interdisciplinaires 6, 1990, 463–558.

Muller 1990b

B. Muller, Rapport sur la restauration de peintures murales provenant de la cour 106 du palais de Mari pour le Département des Antiquités orientales du musée du Louvre, CEPMR / ENS (1990 inédit).

Muller (sous le nom de Muller-Pierre) 1993a

B. Muller-Pierre, Des peintures fragmentaires de la cour 106 du palais de Mari restaurées pour le musée du Louvre, Mari. Annales de Recherches Interdisciplinaires 7, 1993, 355–358.

Muller 1993b

B. Muller, La peinture murale. Une voie ouverte à la fresque minoenne et au bas-relief assyrien, Le Grand Atlas de l'Art I (Paris 1993) 64–65.

Muller 1995a

B. Muller, De l'Euphrate à la Méditerranée. Les peintures murales – des conceptions communes ?, Sources, travaux historiques 36–37, 1995, 49–60.

Muller 1995b

B. Muller, Aspects de la peinture murale proche-orientale au II^e^ millénaire av. J.-C., Actes du 13^e^ séminaire de l'AFPMA (Association française pour la peinture murale antique), Narbonne 21–22 septembre 1991, Revue Archéologique de Picardie Numéro spécial 10, 1995, 131–140.

Muller 2002

B. Muller, Hommes et dieux dans les peintures du palais de Mari, Orient-Express 2002/2003, 82–88.

Muller 2003

B. Muller, La restauration de l'Investiture, Dossiers d'Archéologie 288, novembre 2003, 42–43.

Muller 2005

B. Muller, De Mari à l'Egée. La peinture proche-orientale au II^e^ millénaire, in: A. Villing (éd.), The Greeks in the East. Proceedings of the 21^st^ British Museum Classical Colloquium, 9–10 December 1997 (Londres 2005) 37–45.

Muller 2012

B. Muller, Mutations vers la ville, mutations dans l'art. La peinture murale, in: J.-L. Montero Fenollós (éd.), Du village néolithique à la ville syro-mésopotamienne, Bibliotheca Euphratica I (Ferrol 2012) 99–116.

Muller 2013

B. Muller, Architecture et décor peint. La peinture murale du Grand Palais royal de Mari. Le roi et les dieux, bannières explicatives pour l'exposition. Le Grand Palais Royal de Mari (2000–1760 av. J.-C.), Actualité du département des Antiquités orientales 21 (4 décembre 2013–2 juin 2014) (Paris 2013). Textes reproduits avec adaptations pour le «mini-site» Mari du site web Grands Sites Archéologiques du Ministère de la Culture et de la Communication.

Muller 2016

B. Muller, Elements of war iconography at Mari, in: L. Battini (éd.), Making Pictures of War. Realia et Imaginaria in the Iconology of the Ancient Near East (Oxford 2016) 13–28.

Muller sous presse

B. Muller, Les antécédents orientaux des stucs architecturaux, in: C. Delplace – J. Dentzer-Feydy – A. Guimier-Sorbets (éds.), Stucs d'Orient. Contacts entre les traditions orientales et les cultures hellénisées de la Méditerranée orientale à travers les revêtements stuqués architecturaux d'époque gréco-romaine. Actes du premier colloque international MAE René-Ginouvès, Nanterre, 21–22 novembre 2013, sous presse.

Muller – Piver sous presse

B. Muller – C. Piver, La carnation dans les peintures murales du Grand Palais Royal de Mari, in: A. Nunn – H. Piening – R. Gebhard (éds.), Mesopotamian Sculpture in Colour, sous presse.

Niemeier – Niemeier 2000

B. Niemeier – W.-D. Niemeier, Aegean frescoes in Syria-Palestine. Alalakh und Tel Kabri, in: Sherratt 2000, 763–802.

Nunn 1988

A. Nunn, Die Wandmalerei und der glasierte Wandschmuck im alten Orient, Handbuch der Orientalistik 7, 1, 2, B, 6 (Leyde, Copenhague 1988).

Orthmann 1975

W. Orthmann (éd.), Der alte Orient. Propyläen Kunstgeschichte, Band 14 (Berlin 1975).

Parayre 1982

D. Parayre, Les peintures non en place du palais de Mari. Nouveau regard, Mari. Annales de Recherches Interdisciplinaires 1, 1982, 31–78.

Parrot 1936

A. Parrot, Les fouilles de Mari. Deuxième campagne (hiver 1934–1935), Syria 17, 1936, 1–39.

Parrot 1937a
A. Parrot, Les fouilles de Mari. Troisième campagne (hiver 1935–1936), Syria 18,1, 1937, 54–84.

Parrot 1937b
A. Parrot, Les peintures du palais de Mari, Syria 18,4, 1937, 325–354.

Parrot 1940
A. Parrot, Les fouilles de Mari. Sixième campagne (automne 1938), Syria 21, 1940, 1–28.

Parrot 1958a
A. Parrot, Mission archéologique de Mari 2. Le palais 1. Architecture, Bibliothèque archéologique et historique 68 (Paris 1958).

Parrot 1958b
A. Parrot, Mission archéologique de Mari 2. Le palais 2. Peintures murales, Bibliothèque archéologique et historique 69 (Paris 1958).

Parrot 1960
A. Parrot, Sumer, L'univers des formes 1 (Paris 1960).

Parrot 1965
A. Parrot, Les fouilles de Mari. Quatorzième campagne (printemps 1964), Syria 42, 1965, 1–24.

Parrot 1967
A. Parrot, Les fouilles de Mari. Seizième campagne (printemps 1966), Syria 44, 1967, 1–26.

Platon 1959
N. Platon, Συμβολή εις την σπουδήν της μινωικής τοιχογραφίας, Kretika Chronika 13, 1959, 317–345.

Poursat 2008
J.-Cl. Poursat, L'art égéen. 1. Grèce, Cyclades, Crète jusqu'au milieu du IIe millénaire av. J.-C. (Paris 2008).

von Rüden 2011
C. von Rüden, Die Wandmalereien aus Tall Mišrife/Qaṭna im Kontext überregionaler Kommunikation, Qaṭna Studien 2 (Wiesbaden 2011).

Sader 2009

H. Sader, Palace architecture in Tell el-Burak-Lebanon. Some evidence for Egyptian-Mesopotamian-Levantine interconnections, in: Ministère de la Culture, Direction Générale des Antiquités (éd.), Interconnections in the Eastern Mediterranean. Lebanon in the Bronze and Iron Ages. Proceedings oft he International Symposium Beirut 2008, Baal Hors Série 6, 2009, 177–185.

Sherratt 2000

S. Sherratt (éd.), Proceedings of the First International Symposium 'The Wall Paintings of Thera', Petros M. Nomikos Conference Centre Thera, Hellas, 30 August – 4 September 1997 (Athènes 2000).

Smith 1965

W. S. Smith, Interconnections in the Ancient Near East. A Study of the Relationship between the Arts of the Egypt, Aegean and Western Asia (New Haven, Londres 1965).

Spycket 1988

A. Spycket, Malerei, in: D. O. Edzard (éd.), Reallexikon der Assyriologie und Vorderasiatischen Archäologie 7, 3/4 (Berlin 1988) 287–300.

Tomabechi 1980

Y. Tomabechi, Wall-paintings and related color schemes of the Old Babylonian Mari architectures, Sumer 36, 1980, 139–150.

Woolley 1955

L. Woolley, Alalakh. An Account of the Excavations at Tell Atchana in the Hatay, 1937–1949, Reports of the Research Committee of the Society of Antiquaries of London 18 (Oxford 1955).

Preliminary Remarks on the Technical and Iconographical Aspects of the Middle Bronze Age Wall Paintings from Tell el-Burak (Lebanon) in Relation to the Aegean and Egypt

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Abstract

The excavations at the site of Tell el-Burak (Lebanon), carried out by a joint German-Lebanese Team from the University of Tübingen and the American University of Beirut, revealed a representational mudbrick building dating to the beginning of the Middle Bronze Age (MBA I). In one room of this building, the remains of polychrome wall paintings were found which are still preserved on the walls in situ and have been investigated during several seasons since 2005. The depicted figural and ornamental motifs exhibit distinct Egyptianising elements besides local or so far unknown traits. Examinations of the different pigments and the painting surface comprising several layers of lime plaster show that a preliminary drawing consisting of thin red outlines was applied on the wet plaster. This fact might indicate an early step towards the development of the fresco technique generally associated with the Aegean. Thus, the wall paintings from Tell el-Burak include several different aspects which point towards connections to the neighbouring regions in the Eastern Mediterranean.

This article presents an overview on the technological and iconographical analyses of the wall paintings from Tell el-Burak and gives a preliminary assessment of the various possible cultural interrelations they attest to.

Keywords: wall paintings; fresco-technique; Eastern Mediterranean; interconnections; Lebanon; Middle Bronze Age.

1. Overview

Tell el-Burak is situated in the south of Lebanon, approx. 9km south of Sidon, directly on the coast and close to the ancient site of Sarepta. Excavations have been

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in: J. Becker, J. Jungfleisch and C. von Rüden (eds.) Tracing Technoscapes. The Production of Bronze Age Wall Paintings in the Eastern Mediterranean (Leiden 2018) 85-100.

carried out in a joint German-Lebanese project since 2001[2] and have revealed remains of three major occupation phases belonging to the Middle Bronze Age, the Iron Age and the Ottoman Period.[3] The main feature of the Middle Bronze Age is a monumental mudbrick building which was constructed on top of an artificial mound.[4] This artificial hill was surrounded by a revetment wall in the southeast and strengthened by a monumental stone and pebble glacis on the northwestern slope. The building consists of a central courtyard surrounded by rooms of different sizes (Fig. 1). Its stratigraphy can be separated into two major building phases and several sub-phases. Originally, in phase 1, the northwestern part of the building was situated on a lower level than the courtyard and the remaining rooms. However, the walls of these lower, northwestern rooms were not stable and started to bend towards the northwestern slope. In order to prevent a complete collapse, the rooms of this part of the building had to be backfilled probably rather shortly after its construction while the doorways were blocked up with mudbricks. Then, in phase 2a, new floors were put on top of the fill, more or less on the same level now as the southeastern rooms. As the northwestern rooms were completely emptied before they were filled and there are no rising walls but only foundations left in the southeastern part of the building, the archaeological evidence shows a general lack of installations and finds. Therefore, the exact function of the building remains unclear.

The radiocarbon dates which have been analysed most recently imply a date early in Middle Bronze Age I for the construction of the building and phase 1.[5] The samples which stem from six different contexts show that the highest probability for the construction date centres around 1900 BC, while the total duration of use of the building amounts to a maximum of 150 years but probably did not last that long.[6]

2. The Wall Paintings

One of the main results of the excavations at Tell el-Burak is the discovery of Middle Bronze Age mural paintings which were found in room 10, the biggest room of the building (6,5 × 14,0m). The room is situated in the northwestern part of the building which originally had a lower floor level in phase 1 and which was filled later due to instability. Due to this backfill the polychrome paintings which were applied on a lime plaster surface were preserved on the walls in situ. The painted walls were investigated during the 2005, 2008, 2009 and 2010 seasons of excavations.[7] So far, the room has

2 The project has been directed by the American University of Beirut (Hélène Sader) and the University of Tübingen (Jens Kamlah) in cooperation with the German Archaeological Institute (Margarete van Ess) since 2001. The University of Mainz (Aaron Schmitt) joined the team in 2013.

3 For an overview on the excavation results cf. Kamlah – Sader 2010a; Kamlah – Sader 2010b; Kamlah *et al.* 2016.

4 Cf. Kamlah – Sader forthcoming.

5 Höflmayer *et al.* 2016.

6 Höflmayer *et al.* 2016, 64.

7 The conservation and technical analyses of the wall paintings in Tell el-Burak as well as the interpretation of the results were conducted by Daniela Arnold and Janka Verhey, funded by the German Archaeological Institute.

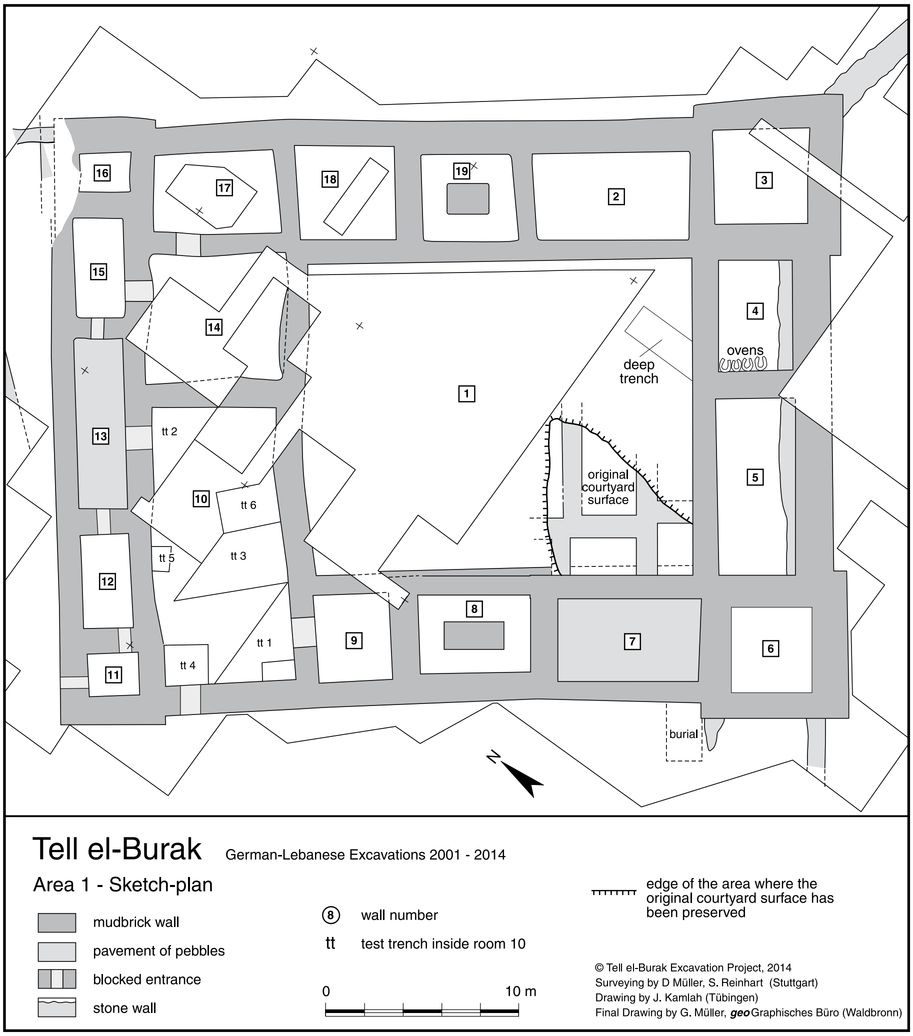

Fig. 1: Plan of the Middle Bronze Age mudbrick building at Tell el-Burak (© Tell el-Burak Excavation Project; final drawing: G. Müller).

not been excavated completely. Six trenches of different sizes were dug to investigate the structure of the room, expose the walls and enable work on the paintings. The fill in the room consists of alternating layers of pebbles and muddy clay soil. Therefore, the state of preservation of the wall surface and the methods applied for conservation vary; in some parts the pebbles were pressed into the plaster, damaging and disfiguring the paintings (Fig. 2), and in the areas with mud layers the soil was often difficult to remove from the walls. The paintings showing the best state of preservation, so far, were uncovered on the southeastern wall, in the southern corner and, to a lesser extent, in the western corner of the room. In addition, several plaster fragments which may belong to a painted floor were uncovered in both corners.

2.1 Iconography

On the southeastern and southwestern walls several figural and ornamental motifs could be identified and partly reconstructed (Pls. 1–2).[8] The first ornamental feature is a band of two parallel red stripes, each approx. 5cm wide, which imitates a kind of socle on the southeastern, southwestern and – hardly traceable – on the northwestern wall. These two stripes also frame the blocked doorway in the southeastern wall leading to room 9 and the one in the southwestern wall leading out of the building (Fig. 3) Thin red lines parallel to the two stripes which frame the door in the southeastern wall, as well as traces of brown, blue and yellow pigment in between and next to the stripes, indicate an originally more complex door frame.[9]

The second geometric element is a frieze that separates two registers of figural scenes on the southwestern wall, each register being roughly 1.5m high. This frieze continues south of the doorway on a higher level and could be traced on the southwestern wall as well. It consists of two multicoloured bands that are composed of blue, red and brown rectangles separated from each other by three vertical black stripes. A row of rhombs which are surrounded by linear circles was placed in between the two bands (Fig. 4).

In the upper register of the southwestern wall a hunting scene is depicted (Pl. 1). Two dogs chase several gazelles towards a person that can be interpreted as a hunter holding a weapon. In the lower register at least three persons heading south and forming a procession could be traced. Behind them, several patches of yellow-orange pigment are visible. Here, other people of different skin colour might have been depicted originally, however the state of preservation did not allow for a definite interpretation. The adjoining southern lower part of the scene has not been excavated yet.

South of the door and in the southeastern corner of the room the remains of a curved tree or bush were found (Pl. 2). It is placed on top of a three-dimensional mountain, formed by the supposed floor of the room which rises in the corner. On its left side the outlines of a blue-coloured animal, probably a caprid, could be traced standing on its hind legs, putting its front legs into the tree, grazing.

The paintings on the southwestern wall are not as well preserved and it was not possible to identify certain features (Pl. 2). Additionally, the trench in the southwestern corner revealed a continuation of the two parallel red framing lines and a big area of yellow pigment; however, no distinctive features were identifiable.

The few possible floor fragments in the southeastern and southwestern corner show red stripes combined with depictions of plants, like various twigs with oval-shaped leaves in light red, dark red and black colour (Fig. 5).

Given the existence of different wall decoration traditions in the Eastern Mediterranean during the Middle and Late Bronze Age, along with the varying degrees of influence they may have had over each other, the paintings at Tell el-Burak have to be viewed both in their local background and in the light of this interregional network

8 I would like to thank the directors of the project for entrusting me with the iconographical investigation of the wall paintings from Tell el-Burak. For a more detailed description and analysis of the iconography of the paintings cf. Bertsch forthcoming. Preliminary reports on the wall paintings were also published in Kamlah – Sader 2010a, 136–138; Kamlah – Sader 2010b, 108–111.

9 Arnold 2005, 14–15.

Fig. 2: Remains of the pebble fill in room 10 pressed into the wall surface and demolishing the painted plaster (photo: D. Arnold, DAI Orientabteilung).

Fig. 3: Red stripes framing the doorway in the southeastern wall of room 10 (photo: D. Arnold, DAI Orientabteilung).

Fig. 4: Detail of the multi-coloured frieze: encircled rhomb (photo: D. Arnold, DAI Orientabteilung).

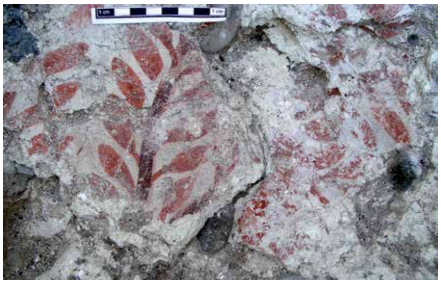

Fig. 5: Possible floor fragments with red twigs in the southeastern corner of room 10 (photo: D. Arnold, DAI Orientabteilung).

of exchange. Thus, in order to further identify and analyse the depicted motifs, parallels from the Near East, Egypt and the Aegean were considered.

For example, multi-coloured bands consisting of alternating coloured rectangles separated by two or three vertical black stripes are a well-known feature in Egyptian paintings from the Old Kingdom onwards.[10] Yet, in Egypt, these bands were not normally used to separate two registers, but framed whole walls or doors.[11] Also the combination with the row of rhombs is highly unusual and offers no close comparison. Imitations of these typical Egyptian multi-coloured stripes also decorated other Egyptianising objects from the Levant such as a rectangular pendant from the tomb of king Ip-shemu-abi at Byblos.[12]

The closest parallels for the hunting scene are the reliefs and paintings in Egyptian private tombs which show hunters or the tomb owner himself accompanied by his dogs, hunting animals of the desert.[13] The gazelles can be identified as Dorcas Gazelles which were often depicted in Egypt in a similar manner.[14] However, in Egyptian hunting scenes of the Old and Middle Kingdom, the dogs are normally shown in front of the hunter and follow his walking direction; they never herd the caprids towards the hunter as in Tell el-Burak.[15]

The caprid and tree motif is a very old and common Ancient Near Eastern motif which is already attested during the Uruk- and Proto-Elamic Period[16] and is also part of the motif repertoire of other Near Eastern palace wall paintings such as Mari or Tell Sakka.[17] Usually, there are two caprids flanking the tree in antithetical composition. Goats at trees are also known from scenes of everyday life in Egyptian private tombs of the Old and Middle Kingdom.[18] However, here the general context and the setting of the motif differ significantly from the Ancient Near East and the motif mostly lacks the heraldic Near Eastern character. Additionally, the blue colour of the goat is a really un-Egyptian feature, as Egyptians usually used naturalistic colours. Another is the fact that the motif continues from one wall to the other, which is unusual for Egyptian principles of iconographical composition. The third is the mountain on which the tree was placed, an element that does not exist in the Egyptian version of the motif and is basically Mesopotamian. The three-dimensional execution of the mountain is, however, a unique feature so far.

All these parallels considered, it is possible to identify several iconographical Egyptian elements which were incorporated but reinterpreted and used in a different way at Tell el-Burak. Other features are of Near Eastern origin and some cannot be identified clearly so far and may be unique, foreign or a local peculiarity. Also, no distinct Aegean features are detectable. Therefore, the iconographical analysis so far suggests that the paintings were not carried out by foreigners but by local people and can be referred to as Levantine or 'Sidonian'.

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10 Fořtová-Šámalová – Vilímková 1963, pl. 59, nos. 189–194.
11 Dziobek 1992, Taf. 16; Kanawati – Woods 2010, 54–57, figs. 46–53, photos 3–5, 8–9, 17–19, 149.
12 Jidéjian 1968, fig. 50.
13 Newberry 1893, pl. XIII; Blackman 1914, pls. VI–VIII; Decker – Herb 1994, 297–352, Taf. CXXXII–CLXXXVI.
14 Strandberg 2009, 9–10.
15 Cf. note 10.
16 Amiet 1961, pl. 34, no. 537; pl. 43, no. 636-B; pl. 48bis, G; Boehmer 1991, 57, Abb. 7a, c.
17 Andrae 1923, Taf. 2; Parrot 1958, 28, fig. 23; Aruz *et al.* 2008, 129, cat. no. 70b.
18 Mohr 1943, 51, fig. 21; Moussa – Altenmüller 1971, pl. 18; Moussa – Altenmüller 1977, Taf. 21, Abb. 8; Shedid 1994, 80, Abb. 132; Kanawati – Woods 2010, photos 179–181.

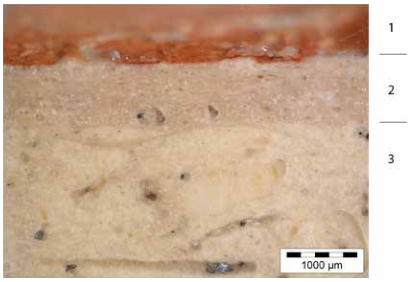

Fig. 6: Thin section of coloured plaster fragment: 1) red paint, 2) layer of fine plaster, 3) layer of coarse plaster (© Prof. Dr. Steffen Laue, Fachhochschule Potsdam, Studiengang Konservierung und Restaurierung).

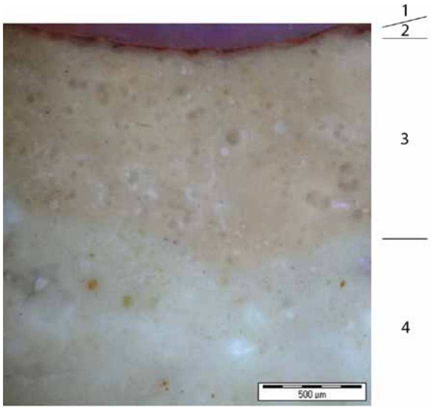

Fig. 7: Thin section of coloured floor fragment after UV-excitation: 1) red paint, 2) very thin layer of lime wash, 3) layer of fine plaster, 4) layer of coarse plaster (© Prof. Dr. Steffen Laue, Fachhochschule Potsdam, Studiengang Konservierung und Restaurierung).

2.2 Technical Aspects

Due to the conservation in situ and the subsequent analyses of plaster and pigment samples from several excavation seasons, certain technical characteristics of the wall paintings at Tell el-Burak could be ascertained.[19]

The plaster which covers the mudbrick walls is 1.0–1.2cm thick and consists of lime plaster with several inclusions. The samples from both the walls and the possible floor in the southeastern corner show a general similarity in composition. In general two different layers are visible, a coarser plaster as a base and a finer plaster on top (Fig. 6). The lower layer is approx. 1cm thick and consists of lime (calcium carbonate), with limestone inclusions and a low percentage of quartz particles being used as fillers. It was applied directly onto the mudbricks and probably served to smooth the surface of the walls.[20] The top layer is approx. 1–2mm thick and is slightly darker, much harder, more homogenous and was completely smoothed. It consists of lime and contains chalk inclusions (fossil calcium carbonate) as fillers.[21] This second layer was probably applied while the lower layer was still partly wet, as they are tightly bonded and it was not always possible to detect a clearly defined dividing line.[22] On top of the smoothed second layer the paint was applied. However, the floor samples from the southeastern corner of the room show an additional third and very thin layer of lime wash on top of the other two plaster layers which was visible only after UV-excitation. It probably served as a coating on which the paint was applied (Fig. 7). This third layer was difficult to differentiate in the plaster samples from the walls.[23]

Several different colour pigments could be identified: natural iron oxide (iron oxide red, iron oxide hydroxide yellow), lime white, carbon black and Egyptian blue (calci-

19 The samples were analysed by Christoph Herm (FH Dresden) (colour pigments) and Steffen Laue (FH Potsdam) (plaster). For a principal overview on damage assessment, conservation techniques and analyses of the paintings and the plaster cf. Arnold 2005; van Ess forthcoming; Verhey forthcoming.

20 Arnold 2005, 10, 20; Verhey forthcoming.

21 Arnold 2005, 11, 20; Verhey forthcoming.

22 Arnold 2005, 20; Verhey forthcoming.

23 Arnold 2005, 20.

um copper silicate). The colours that were still traceable are light red, dark red, blue, black, brown, yellow and orange.[24]

A preliminary drawing of thin red lines was observed in all excavated areas which includes horizontal and vertical framing lines for the doors, the socle lines, and the frieze as well as outlines for all figural motifs. These thin red lines are still clearly visible in most parts and there is evidence for their pigments clearly penetrating into the plaster. Therefore, it is assumed that the lines of the preliminary drawing were most probably painted *al fresco* while the plaster surface was still partly wet, using very thin brushes.[25]

The multicoloured paintings which were executed afterwards are by contrast in a much worse condition than the preliminary drawing. The pigments are preserved only very fragmentarily. Also, there is no evidence for any penetration of pigment into the plaster. Presumably, these principal paintings were added *al secco*, using an organic binder which could not be attested so far because it has most likely disintegrated.[26]

As a final step, some of the motifs – such as the frieze and the animals – were additionally outlined with thin black lines executed with thin brushes and covering the red preliminary drawing.[27]

The assumption that the preliminary drawing was applied *al fresco* on a partly wet surface, whereas the principal paintings and the final drawing were later added *al secco,* could explain both the different state of preservation and the difference in pigment penetration between preliminary drawing and paintings. However, both differences might also partly be due to divergent physical characteristics of different pigment particles.[28]

In addition, the regularity of the circles of the rhomb frieze suggests the use of a compass or some kind of template, as they all have the exact same diameter of 5cm. Yet, no traces, like puncture marks, could be found.[29] Furthermore, strings or rulers might have been used to produce straight lines, but no string impressions, as typical for the Aegean fresco technique, could be documented so far, and there is also no evidence for an Egyptian grid system.[30]

3. Summary

The analyses of the painting technique show that several different specific features are discernible in the wall paintings in Tell el-Burak.

In addition to several iconographical features, the red preliminary drawing might point to a further connection to Egypt, as red lines were used for the same purpose in Egyptian wall paintings.[31] Yet, preliminary drawings consisting of red lines were also used in the Aegean and at sites such as Qaṭna (Syria) and, consequently, cannot pro-

24 Arnold 2005, 20–21.
25 Arnold 2005, 21; van Ess forthcoming; Verhey forthcoming.
26 Arnold 2005, 24; van Ess forthcoming; Verhey forthcoming.
27 Arnold 2005, 23; Verhey forthcoming.
28 Jones – Photos-Jones 2005, 219–222.
29 Arnold 2005, 21; Verhey forthcoming.
30 van Ess forthcoming.
31 Cf. Madden – Tavier this volume.

vide sufficient evidence for an Egyptian connection by themselves.[32] Also, the painting on a still wet lime plaster surface is generally assumed to have originated in, and be connected with, the Aegean. With the exception of the Aegean-style wall paintings at Tell el-Dab^ca[33], this technique was not usually used in Egypt. Here, mud plaster surfaces were painted *al secco*.[34] The same is thought to be typical for the Near East.[35] However, the technique used in Tell el-Burak can hardly count as a fully-developed fresco-technique as most of the drawings were probably executed *al secco*. The application of pigments on the at least partially wet lime plaster surface can only be presumed with some certainty for the preliminary drawing so far. In addition, no traces of other features typical for Aegean fresco painting, like string impressions, were found.[36]

Furthermore, it is difficult to compare the paintings from Tell el-Burak directly to Aegean paintings because, according to the ^{14}C dates[37], they predate the earliest well-preserved Minoan frescoes by roughly 200 years depending on which chronology system is used. Therefore, the evidence from Tell el-Burak rather constitutes an early step towards fresco painting. As yet, it remains unclear whether this step was somehow triggered by an early Minoan influence or if the painting technique at Tell el-Burak is part of a completely independent Levantine development which subsequently may or may not have influenced the art of wall painting in the eastern Mediterranean. The case of Tell el-Burak may then represent an early forerunner of later fresco paintings in the eastern Mediterranean region, which also includes Alalakh and Tell Kabri.[38]

The iconographical analyses of the motifs so far provide mixed results as well, but they show that the wall paintings at Tell el-Burak were most probably the work of local artists who included several Egyptianising and originally foreign elements. They represent expressions of the local Middle Bronze Age culture and have to be understood as Levantine art. Similar cases can be found when looking at Old Syrian seals, the wall paintings from Tell Sakka or various objects from the tombs of Byblos.[39]

In summary, both iconography and technology exhibit a mix of different features which are usually assumed to belong to separate wall painting traditions. The paintings at Tell el-Burak show that the region was part of a broader network system that covered the whole area of the eastern Mediterranean, where ideas such as motifs and technological knowledge were exchanged.

Yet, these are only preliminary results. The next step the project wants to undertake and which is already in preparation is the complete excavation of the painted room. This will hopefully lead to a more thorough understanding of the painting technique, the iconography and the meaning of Room 10 as a whole.

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32 Cf. von Rüden 2011, 92.

33 Cf. Becker this volume; Jungfleisch this volume; Morgan this volume; von Rüden – Skowronek this volume.

34 Cf. Madden – Tavier this volume.

35 For an overview on assumed wall painting “traditions” in the Near East, Egypt and the Aegean cf. e.g. Bietak 2007; von Rüden 2013.

36 Brysbaert 2008, 112–120; van Ess forthcoming.

37 Höflmayer *et al.* 2016.

38 Woolley 1955, 228–234, pls. 36–39; Niemeier – Niemeier 2000; Niemeier – Niemeier 2002; Cline *et al.* 2011; von Rüden 2011; von Rüden 2013.

39 Eder 1995; Aruz *et al.* 2008, 57–58, cat. no. 29; 128, cat. no. 70a.

References

Amiet 1961

P. Amiet, La glyptique mésopotamienne archaïque (Paris 1961).

Andrae 1923

W. Andrae, Farbige Keramik aus Assur und ihre Vorstufen in altassyrischen Wandmalereien (Berlin 1923).

Arnold 2005

D. Arnold, Dokumentation zur Untersuchung des Bestandes und Zustandes einer mittelbronzezeitlichen Wandmalerei in Tell el-Burak (Libanon), Konservierungskonzeption und Restaurierungsmaßnahmen. Unpublished.

Aruz *et al.* 2008

J. Aruz – K. Benzel – J. M. Evans (eds.), Beyond Babylon. Art, Trade, and Diplomacy in the Second Millennium B.C. Catalog of an Exhibition at the Metropolitan Museum of Art, New York, Nov. 18, 2008 – Mar. 15, 2009 (New Haven, London 2008).

Bertsch forthcoming

J. Bertsch, Preliminary report on the iconography of the wall paintings at Tell el-Burak, in: Kamlah – Sader forthcoming.

Bietak 2007

M. Bietak, Bronze Age paintings in the Levant. Chronological and cultural considerations, in: M. Bietak – E. Czerny (eds.), The Synchronisation of Civilisations in the Eastern Mediterranean in the Second Millennium B.C. III. Proceedings of the SCIEM 2000 – 2nd EuroConference in Vienna, May 28th – June 1st 2003, Contributions to the Chronology of the Eastern Mediterranean 9, Denkschriften der Gesamtakademie 37 (Vienna 2007) 269–300.

Blackman 1914

A. M. Blackman, The Rock Tombs of Meir 1. The Tomb-Chapel of Ukh-Ḥotp's Son Senbi, Archaeological Survey of Egypt Memoir 22 (London 1914).

Boehmer 1991

R. M. Boehmer, Gebel-el-Arak- und Gebel-el-Tarif-Griff. Keine Fälschungen, Mitteilungen des Deutschen Archäologischen Instituts Abteilung Kairo 47 (Festschrift für Werner Kaiser), 1991, 51–60.

Brysbaert 2008

A. Brysbaert, The Power of Technology in the Bronze Age Eastern Mediterranean. The Case of the Painted Plaster, Monographs in Mediterranean Archaeology 12 (London 2008).

Cline *et al.* 2011
E. H. Cline – A. Yasur-Landau – N. Goshen, New fragments of Aegean-style painted plaster from Tel Kabri, Israel, American Journal of Archaeology 115, 2011, 245–261.

Decker – Herb 1994
W. Decker – M. Herb, Bildatlas zum Sport im alten Ägypten. Corpus der bildlichen Quellen zu Leibesübungen, Spiel, Jagd, Tanz und verwandten Themen, Handbuch der Orientalistik, Erste Abteilung, der Nahe und Mittlere Osten 14 (Leiden, New York 1994).

Dziobek 1992
E. Dziobek, Das Grab des Ineni, Theben Nr. 81, Archäologische Veröffentlichungen 68 (Mainz 1992).

Eder 1995
C. Eder, Die ägyptischen Motive in der Glyptik des östlichen Mittelmeerraums zu Anfang des 2. Jts. v. Chr., Orientalia Lovaniensia Analecta 71 (Leuven 1995).

van Ess forthcoming
M. van Ess, The Middle Bronze Age wall paintings at Tell el-Burak, in: Kamlah – Sader forthcoming.

Fořtová-Šámalová – Vilímková 1963
P. Fořtová-Šámalová – M. Vilímková, Das ägyptische Ornament (Hanau 1963).

Höflmayer *et al.* 2016
F. Höflmayer – J. Kamlah – H. Sader – M. W. Dee – W. Kutschera – E. M. Wild – S. Riehl, New evidence for Middle Bronze Age chronology and synchronisms in the Levant. Radiocarbon dates from Tell el-Burak, Tell el-Dabʿa, and Tel Ifshar compared, Bulletin of the American Schools of Oriental Research 375, 2016, 53–76.

Jidéjian 1968
N. Jidéjian, Byblos through the Ages (Beirut 1968).

Jones – Photos-Jones 2005
R. E. Jones – E. Photos-Jones, Technical studies of Aegean Bronze Age wall painting. Methods, results and future prospects, in: L. Morgan (ed.), Aegean Wall Painting. A Tribute to Mark Cameron, British School at Athens Studies 13 (London 2005) 199–228.

Kamlah – Sader 2010a
J. Kamlah – H. Sader, Tell el-Burak. A new Middle Bronze Age site from Lebanon, Near Eastern Archaeology 73,2–3, 2010, 130–141.

Kamlah – Sader 2010b
J. Kamlah – H. Sader, Deutsch-libanesische Ausgrabungen auf Tell el-Burak südlich von Sidon. Vorbericht nach Abschluss der siebten Kampagne 2010, Zeitschrift des Deutsch-Palästina Vereins 126, 2010, 93–115.

Kamlah *et al.* 2016
J. Kamlah – H. Sader – A. Schmitt, The Tell el-Burak Archaeological Project. Preliminary report on the 2011, 2013 and 2014 seasons in Area 3, BAAL. Bulletin d'Archéologie et d'Architecture Libanaises 16, 2016, 79–130.

Kamlah – Sader forthcoming
J. Kamlah – H. Sader, Tell el-Burak 1. The Middle Bronze Age. With Chapters Related to the Site and the Late Mediaeval Age, Abhandlungen des Deutschen Palästina-Vereins 43 (Wiesbaden forthcoming).

Kanawati – Woods 2010
N. Kanawati – A. Woods, Beni Hassan. Art and Daily Life in an Egyptian Province (Cairo 2010).

Mohr 1943
H. T. Mohr, The Maṣṭaba of Hetep-Her-Akhti. Study on an Egyptian Tomb Chapel in the Museum of Antiquities, Leiden, Mededeelingen en Verhandelingen van het Voor-Aziatisch Egyptisch Gezelschap «Ex oriente lux» 5 (Leiden 1943).

Moussa – Altenmüller 1971
A. M. Moussa – H. Altenmüller, The Tomb of Nefer and Ka-hay, Archäologische Veröffentlichungen 5 (Mainz 1971).

Moussa – Altenmüller 1977
M. Moussa – H. Altenmüller, Das Grab des Nianchchnum und Chnumhotep, Archäologische Veröffentlichungen 21 (Mainz 1977).

Newberry 1893
P. E. Newberry, Beni Hasan 1, Archaeological Survey of Egypt Memoir 1 (London 1893).

Niemeier – Niemeier 2000
B. Niemeier – W.-D. Niemeier, Aegean frescoes in Syria-Palestine. Alalakh and Tel Kabri, in: S. Sherratt (ed.), Proceedings of the First International Symposium 'The Wall Paintings of Thera', Petros M. Nomikos Conference Centre Thera, Hellas, 30 August – 4 September 1997 (Athens 2000) 763–803.

Niemeier – Niemeier 2002
B. Niemeier – W.-D. Niemeier, The frescoes in the Middle Bronze Age palace, in: A. Kempinski – N. Scheftelowitz – R. Oren (eds.), Tel Kabri. The 1986–1993 Excavation Seasons, Monograph Series of the Institute of Archaeology, Tel Aviv University 20 (Tel Aviv 2002) 254–298.

Parrot 1958
A. Parrot, Mission archéologique de Mari 2. Le palais 2. Peintures murales, Bibliothèque archéologique et historique 69 (Paris 1958).

von Rüden 2011
C. von Rüden, Die Wandmalereien aus Tall Mišrife/Qaṭna im Kontext überregionaler Kommunikation, Qaṭna Studien 2 (Wiesbaden 2011).

von Rüden 2013
C. von Rüden, Beyond the east-west dichotomy in Syrian and Levantine wall paintings, in: B. A. Brown – M. H. Feldman (eds.), Critical Approaches to Ancient Near Eastern Art (Berlin 2013) 55–78.

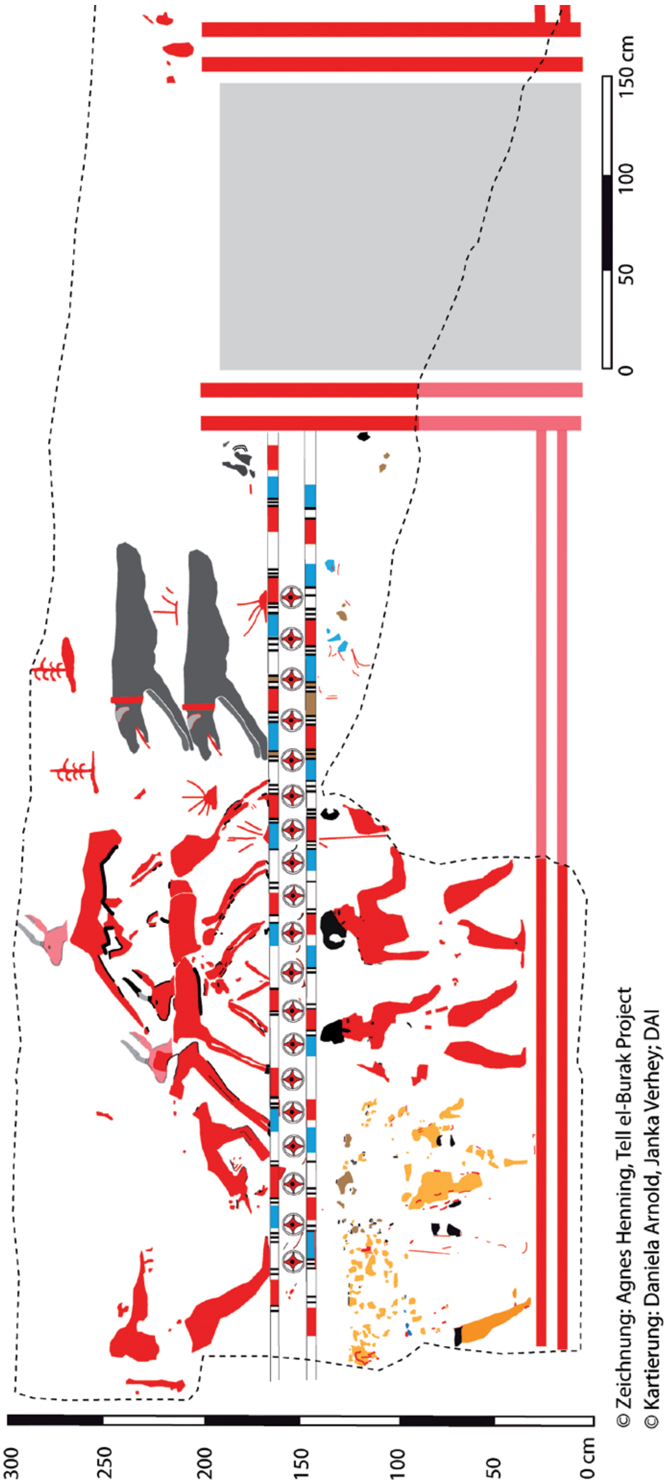
Shedid 1994
A. G. Shedid, Die Felsgräber von Beni Hassan in Mittelägypten, Zaberns Bildbände zur Archäologie 16 (Mainz 1994).

Strandberg 2009
Å Strandberg, The Gazelle in Ancient Egyptian Art. Image and Meaning, Uppsala studies in Egyptology 6 (Uppsala 2009).

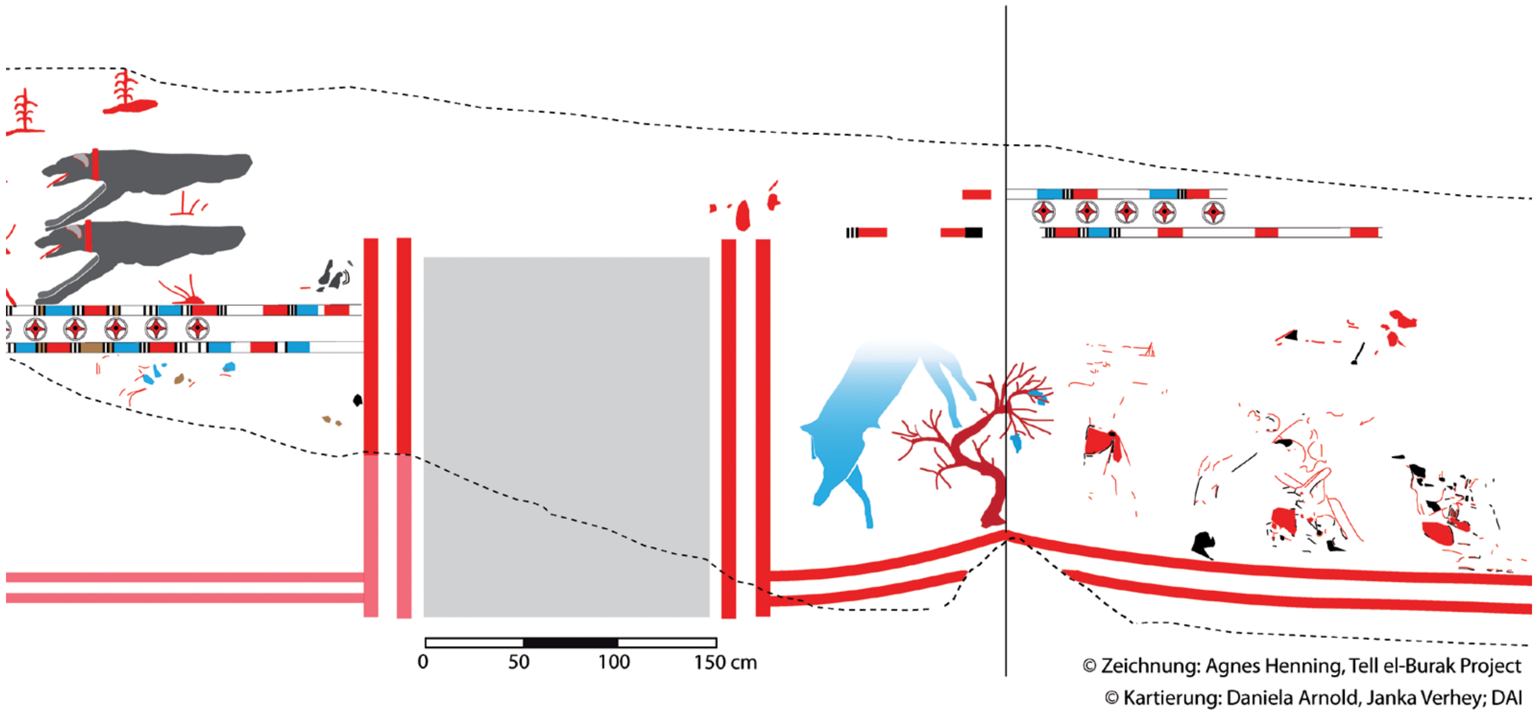
Verhey forthcoming
J. Verhey, Preliminary remarks on the painting technique and the conservation of the Tell el-Burak wall paintings, in: Kamlah – Sader forthcoming.

Woolley 1955
L. Woolley, Alalakh. An Account of the Excavations at Tell Atchana in the Hatay, 1937 – 1949, Reports of the Research Committee of the Society of Antiquaries of London 18 (Oxford 1955).

Plates



Pl. 1: Tracing and partial reconstruction of the paintings on the southeastern wall of room 10, northern part (tracing: D. Arnold, J. Verhey, DAI Orientabteilung; drawing: A. Henning).



Pl. 2: Tracing and partial reconstruction of the paintings on the southeastern wall, southern part, and on the southwestern wall of room 10 (tracing: D. Arnold, J. Verhey, DAI Orientabteilung; drawing: A. Henning).

The Advantages of Visible Induced Luminescence Technique for the Investigation of Aegean-style Wall Painting

A Case Study from Tel Kabri, Israel

Ravit Linn,[1] Eric H. Cline,[2] and Assaf Yasur-Landau[3]

Abstract

Tel Kabri is one of four Eastern Mediterranean sites in which Aegean-style paintings have been discovered. A significant portion of the fragments found during the 2008–2011 excavation seasons were blue in colour; previous examination had identified the pigment as Egyptian Blue, which was commonly used in the ancient world from the 3rd millennium BCE until the end of the Roman period. This study further investigated the blue pigment with the Visible Induced Luminescence technique, allowing us to exclude the use of other blue pigments by the ancient artists of Tel Kabri. It also provided new information on the distribution of the pigment on the surfaces of the fragments, including those in which the blue colour was hardly visible to the naked eye. The technique supported other observations on the layering of the pigments as well as the mixtures of colours and provided data on conservation issues related to the painted fragments. The findings of the study clearly demonstrate the advantages of the technique to investigate areas in Aegean-style Bronze Age wall paintings that were painted using the Egyptian Blue pigment.

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in: J. Becker, J. Jungfleisch and C. von Rüden (eds.) Tracing Technoscapes. The Production of Bronze Age Wall Paintings in the Eastern Mediterranean (Leiden 2017) 101-116.

Keywords: Egyptian Blue; Visible Induced Luminescence Imaging; Aegean-style paintings; Middle Bronze Age II; Tel Kabri; Eastern Mediterranean; pigment distribution; colour layering; colour mixture; conservation issues.

1. Introduction

Egyptian Blue is one of the oldest synthetic pigments which consists of Calcium Copper Silicate ($CaCuSi_4O_{10}$ or $CaOCuO(SiO_2)_4$). It was commonly used throughout most of antiquity as a pigment in paintings, wall paintings, tombs, wrappings of mummies, coffins, and ceramic glazing.[4]

This pigment became widespread in Egypt around 2600 BCE, although its first known use was earlier, possibly in the 1st Dynasty circa 2900 BCE.[5] It was very commonly used during the Roman period. Later it was used more sporadically, including in the Middle Ages and beyond.[6]

During the 2nd millennium BCE, Egyptian Blue was widely used in the Mediterranean area, including Egypt and Mesopotamia,[7] the Aegean,[8] and the Eastern Mediterranean.[9]

During the Bronze Age, Egyptian Blue was the most common blue pigment used in Aegean-style wall paintings, but other blue pigments such as riebeckite (amphibole blue) and rarely azurite and lapis lazuli were used as well, sometimes mixed together.[10] It was used especially to decorate images of the sea, rivers, plants, animals, and other topics.[11]

During the Middle Bronze Age II and Late Bronze Age I, the pigment was in use in the Eastern Mediterranean region for wall paintings and was found at four sites in that region which produced Aegean-style wall paintings: Tell el-Dabᶜa, Qaṭna, Tel Kabri, and Alalakh. It may have been the only blue pigment that was in use at that time.[12]

The painted plaster fragments from Tel Kabri belong to the latter part of the Middle Bronze Age II period.[13] The site contained both painted walls and floors.[14] The discovery of Egyptian Blue in these painted fragments represents the oldest evidence of the pigment's presence in wall paintings found in Israel.[15] The raw materials required

4 Pagès-Camagna – Colinart 2003; Accorsi *et al.* 2009.
5 Hatton *et al.* 2008.
6 Vitruvius 1962; Lazzarini 1982; Riederer 1997; Damiani *et al.* 2003; Gaetani *et al.* 2004; Kakoulli 2009; Piovesan *et al.* 2011.
7 Hatton *et al.* 2008.
8 Profi *et al.* 1976; Brysbaert – Vandenabeele 2004; Brecoulaki *et al.* 2008; Brecoulaki *et al.* 2015.
9 Brysbaert 2008.
10 Cameron *et al.* 1977; Perdikatsis 1998; Perdikatsis *et al.* 2000; Jones – Photos-Jones 2005; Brysbaert 2006; Brysbaert 2008.
11 Vlachopoulos – Sotiropoulou 2013.
12 Brysbaert 2002; Brysbaert 2008; Brysbaert 2011; von Rüden 2011.
13 Cline *et al.* 2011; Cline – Yasur-Landau 2013; Yasur-Landau *et al.* 2014.
14 Kempinski – Niemeier 1994; Niemeier – Niemeier 2000; Niemeier – Niemeier 2002; Kempinski *et al.* 2002; Cline *et al.* 2011; Cline – Yasur-Landau 2013; Yasur-Landau *et al.* 2014; Yasur-Landau *et al.* 2015; Höflmayer *et al.* 2016.
15 Linn *et al.* 2017.

to produce Egyptian Blue occur naturally in Israel, thus it may have been locally produced, although it could have also been imported.[16]

A previous study by the authors on the technology of the painted plaster fragments from Tel Kabri during the 2008–2011 excavation seasons identified five different pigments by using analytical techniques.[17] These pigments included Lime white, Yellow ochre, Red ochre, Manganese black (MnO_2) and Egyptian Blue – the only blue pigment found in these fragments. The Egyptian Blue was analysed by several analytical methods: XRF, PLM, and Raman Spectroscopy, with a few fragments analysed by Visible Induced Luminescence Imaging.[18] This method was formerly proposed by Verri to detect and map Egyptian Blue on wall paintings and other archaeological findings.[19] The method is based on the property of Egyptian Blue to emit luminescence in the near IR spectrum when excited by visible light. This unique property of Egyptian Blue allows it to be distinguished from all other natural or synthetic blue pigments and is still clearly exhibited even in samples that have survived for four millennia.[20]

The potential of using Visible Induced Luminescence Imaging to investigate Aegean-style Bronze Age painting has been shown by Vlachopoulos and Sotiropoulou, who used this technique to detect and map the presence of Egyptian Blue on wall paintings from Akrotiri.[21] In addition, in a study on painted marble pyxides from the classical period in Greece, this technology was used to exclude the presence of Egyptian Blue.[22]

Based on the results of the former study on the painted fragments uncovered during the 2008–2011 excavation seasons in Tel Kabri,[23] and the fact that 26 out of the 60 fragments analysed showed blue colour or suspected blue colour, it was decided to enlarge the scope of the research on the blue painted fragments of Tel Kabri using Visible Induced Luminescence Imaging, as a major tool to investigate the following topics:

a. Survey the presence of Egyptian Blue on the painted fragments from Tel Kabri.
b. Investigate the distribution of Egyptian Blue on the fragments.
c. Provide a definite identification of the blue colour used on the fragments on top of other methods and exclude the use of other blue pigments.
d. Identify patterns and areas painted in blue that were not previously identified.
e. Provide additional information on the painting technology (mixtures, layers, and patterns).
f. Provide data on the conservation status of the fragments, including missing areas, missing layers of colour, dirt, and incrustation.

16 Porat – Ilani 1998.
17 Linn *et al.* 2017.
18 Linn *et al.* 2017.
19 Verri 2009.
20 Accorsi *et al.* 2009.
21 Vlachopoulos – Sotiropoulou 2013.
22 Brecoulaki *et al.* 2014.
23 Linn *et al.* 2017.

Catalogue Fragment No.	Archaeological Data of Fragment	Size of Fragment (mm)	Description of Coloured Surface
1	DS-1; 3055-10	22 × 21	White with 2 blue strips bordered by a black line
2	DS-1; 3055-10	25 × 35	All painted blue
3	DS-1; 3055-10	12 × 8	All painted blue
4	DS-1; 3055-16	20 × 11	All painted blue
5	DS-1; 3055-16	20 × 10	All painted blue
6	DS-1; 3055-10b	3 × 4	All painted blue
7	DS-1; 3055-12	14 × 5	All painted blue
8	DS-1; 3055-12	7 × 6	All painted blue
9	DS-1; 3055-13	11 × 8	White with blue bordered by a black line
10	DS-1; 3055-15	48 × 30	White with 2 black line that bordered a blue colored area
11	DS-1; 3055-16c	26 × 18	Red, white, blue, black
12	DS-1; 3055-16c	20 × 10	Red, white, blue, black
13	DS-1; 3055-16c	16 × 4	Red, white, blue, black
14	DS-1; 3055-16e	3 × 3	All painted blue
15	DS-1; 3055-16f	41 × 45	White with black lines and blue areas
16	DS-1; 3055-16f	38 × 42	White with black lines and blue areas
17	DS-1; 3055-16f	28 × 23	White with black lines and blue areas
18	DS-1; 3055-16f	14 × 11	White with black lines and blue areas
19	DS-1; 3055-16f	20 × 15	White with black lines and blue areas
20	DS-1; 3055-16f	15 × 10	White with black lines and blue areas
21	DS-1; 3055-23	33 × 23	All painted blue with damaged areas of no paint
22	DS-1; 3055-20	7 × 9	Red and blue
23	DS-1; 3021-2	70 × 35	White surface no paint
24	DS-1; 3055-13a	70 × 75	White with thick brown/ black band
25	DS-1; 3055-14	65 × 70	White with thick brown/ black band
26	DS-1; 3055-8	35 × 40	White with traces of blue

Tab. 1: General description of the selected blue painted fragments uncovered in Tel Kabri during the 2008–2011 excavation seasons.

2. Material and Methods

All of the painted plaster fragments (60) that were uncovered at Tel Kabri during the 2008–2011 excavation seasons were checked for blue colour. Of these, 26 fragments had blue colour (or suspected blue colour). These fragments were examined using Visible Induced Luminescence Imaging.

The research was conducted at the Conservation Laboratory of the Conservation of Material Culture Heritage Program, University of Haifa.

Photography of the fragments with regular light was made using a Nikon 7000D DSLR camera, equipped with a 60mm f-2.8 Micro Nikkor lens. These photographs were used for documentation of the fragments' size, colours, and surface condition. Two LED light sources were used in parallel to light the photographed object from the desired angles. These photographic lamps have a power output of 10W, lumen of 1280LM and luminance angle of 55°.

Fig. 1: Fragments no. 15–20, a) photographed in regular photography (left); b) photographed in Visible Induced Luminescence Imaging (right).

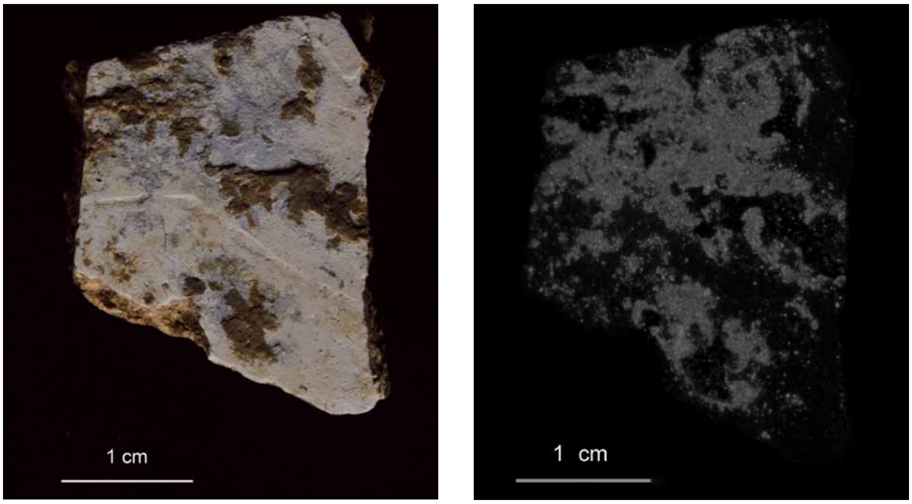

Fig. 2: Fragment no. 26, a) with regular photography (left); b) with Visible Induced Luminescence Imaging (right) – the bright areas are those with Egyptian Blue.

Detailed macro photographs were also made with a Dino-lite 1.3MP AM4113T-FV2W portable digital microscope (AnMo Electronics). The microscope was connected to a computer using DinoCapture 2.0 software (Version 1.5.0). Two magnification bands were used for the microscope: 10–50X and 150–250X. The resolution was up to 1.3 megapixels (1024x1280 pixels) and a colour depth used of 8-bit.

The Visible Induced Luminescence Imaging technique[24] was used to detect and map Egyptian Blue on the painted fragments. This photography was carried out with a Nikon D5100 DSLR camera, with an 18–55mm f-3.5–5.6 Nikkor lens, equipped with an IR filter.

24 Verri 2009.

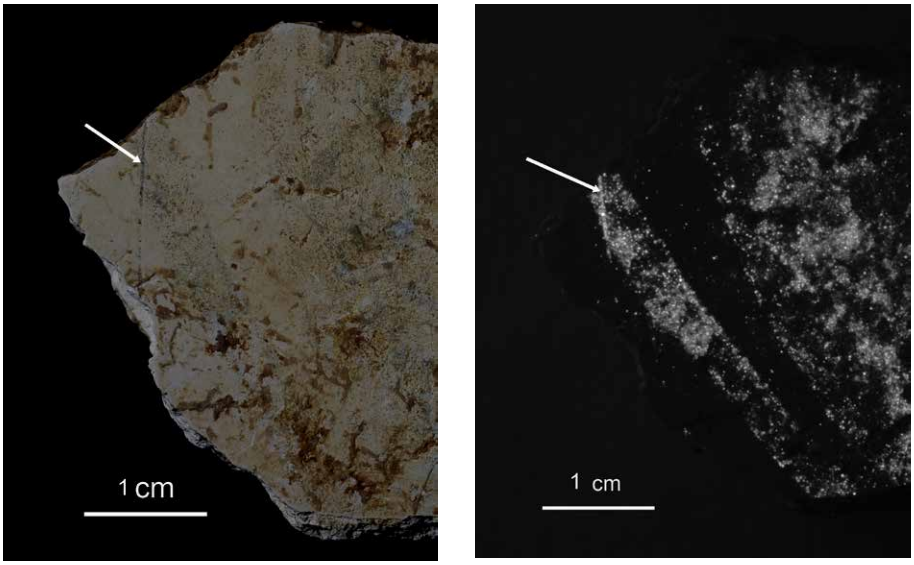

Fig. 3: Fragment no. 23, a) with regular photography (left); b) using Visible Induced Luminescence Imaging (right). Note the thick vertical line on the left of Egyptian Blue and brighter thin line on the upper left corner with more intensive luminescence due to an incised line that gathered higher concentration of the pigment particles (marked with an arrow).

3. Results and Discussion

As noted, 26 out of the 60 painted fragments that were found at Tel Kabri during the 2008–2011 excavation seasons had blue pigment, which represents 43% of all coloured fragments. Moreover, the blue colour is the most dominant and covers substantial areas of the fragments' surface. This fact illustrates the extensive use of blue colour and blue pigment in Tel Kabri paintings, which is by far more widespread than all the other colours that were found. The general description of the 26 blue fragments is presented in Table 1.

The resolution of the results permitted the identification of Egyptian Blue pigment, including documenting very minute quantities of the pigment in some areas and its absolute absence in other areas.

3.1 Identification of Egyptian Blue

The photography of the 26 blue coloured fragments using Visible Induced Luminescence Imaging showed very intense bright colour in the areas of the Egyptian Blue due to its high emission in the near IR spectrum (expected at 910nm).[25]

This phenomenon enabled the definite identification of the Egyptian Blue pigment (Fig. 1). This identification was formerly crosschecked by other analytical techniques such as Raman Spectroscopy and XRF analyses.[26] The results also excluded the use of any other blue pigment in the painted fragments of Tel Kabri.

25 Accorsi *et al.* 2009.
26 Linn *et al.* 2017.

3.2 Distribution of Egyptian Blue on the Painted Fragments

The photography with the Visible Induced Luminescence Imaging was also used to map the distribution of Egyptian Blue on the surface of the painted fragments and particularly to identify areas and patterns that were not observed otherwise.

By using this technique on fragments that had only traces of blue colour, it was evident that the whole surface has been originally painted with Egyptian Blue (Fig. 2).

Figure 3 shows fragment no. 23 that has a white-beige appearance with hardly any colour painted on it. The use of Visible Induced Luminescence Imaging shows that most of the surface of this fragment was originally painted with Egyptian Blue. Moreover, on the left side of the fragment a distinct pattern (perhaps a foliate design) painted with Egyptian Blue is clearly seen, which was not discovered otherwise.

3.3 Examination of the Painting Technology

Visible Induced Luminescence Imaging was also implemented to study the mixtures of pigments, the colour layers, and the layers' order. One fragment shows a unique painted pattern of a 'blue area encompassed by black lines' (Fig. 4a). A photograph of the same fragment with Visible Induced Luminescence shows that the blue area of this pattern is comprised of Egyptian Blue and that the blue area was painted before the black border lines (Fig. 4b). The black line was painted above the Egyptian Blue layer as a border line between the blue area and the white area.

Although the original distribution of the blue colour exceeds the restricted area in which it should have been painted, by using a black border line on top of the blue colour, the artists were able to clearly define the exact pattern. The Egyptian Blue particles that were painted out of the pattern area could be noticed only by the Visible Induced Luminescence technique. The phenomenon of black border lines painted above the blue layer was consistently observed in the entire collection of the fragments.

Figure 5 shows a painted fragment that has a strip of white colour between two blue painted areas, separated by a black line on both sides, as can be clearly seen by regular photography (Fig. 5a). The Visible Induced Luminescence Imaging (Fig. 5b) shows Egyptian Blue that was detected within the central white area, again exceeding the border lines of the design.

3.3.1 Colour Mixtures

Figures 6a–c show examples of colour mixings, in which Egyptian Blue is mixed with black. Two fragments with a design of a wide black strip were examined by that technique in order to decide if they contain Egyptian Blue, in part because of the fact that, immediately after excavation, while still wet, they had a bluish appearance. Figures 6a–b show two fragments with the black band design that appears dull due to incrustation on their surfaces. Figure 6c shows the black coloured area magnified and photographed with Visible Induced Luminescence, showing a low concentration of Egyptian Blue particles that spread within the black colour. This confirms that the Egyptian Blue was originally mixed with the black colour in order to reach a special tone. Due to the low concentration of the pigment in the colour mixture, the IR luminescence of this area is relatively low compared to areas painted solely with Egyptian Blue.

3.3.2 Incised Lines

The Visible Induced Luminescence Imaging enabled us to detect a small incised line on the surface of the fragment on its left side corner (Fig. 3b, Tab. 1 – fragment 23). This was clearly noticed due to the high concentration of Egyptian Blue particles in a small vertical line (pointed out by an arrow in Fig. 3b). This high concentration of Egyptian Blue particles aligns with the incised line that appears within the plaster surface, suggesting that the blue paint layer was painted afterwards (Figs. 3a–b).

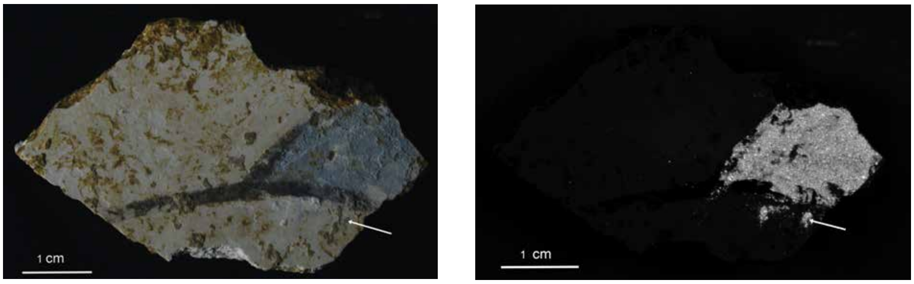

Fig. 4: Fragment no. 10, a) with regular photography (left); b) with Visible Induced Luminescence Imaging (right), showing the distribution of Egyptian Blue layer exceeding the black painted border line of the design (see area marked with an arrow).

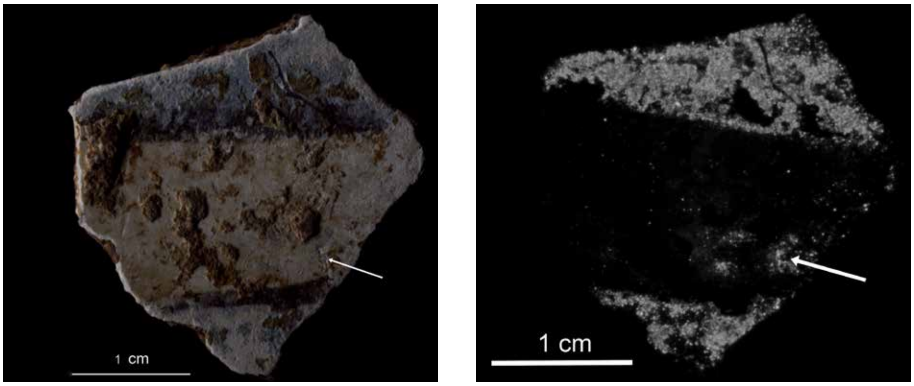

Fig. 5: Fragment no. 1, a) with regular macro photography (left); b) with Visible Induced Luminescence Imaging (right), showing the distribution of Egyptian Blue layer exceeding the black painted border line of the design (see area marked with an arrow).

Fig. 6: Fragments no. 24 and 25 a) and b) with regular photography (a = left; b = centre); c) with Visible Induced Luminescence Imaging (right), detail of 6a, focusing on the right side area of the black strip showing the Egyptian Blue particles in the black paint area.

3.4 Conservation Aspects of the Painted Fragments

Visible Induced Luminescence Imaging also provided important information on areas where colour is missing, or where the paint layer is hidden by encrustation or by superimposed layers. The use of the Visible Induced Luminescence Imaging for conservation purposes was conducted by mapping of the encrustation on the surface of the fragments that hides the painted blue layer underneath. A good example can be seen in Figure 7. Visible Induced Luminescence Imaging showed clearly that the area of the pigment on the surface of the fragment was divided into two major areas (Fig. 7b) by a layer of encrustation that covered the painted area and hid it. After cleaning, the entire area painted with Egyptian Blue was fully and clearly visible (Fig. 7c).

Another conservation issue that was commonly found on the painted fragments from Tel Kabri is damaged paint layers, due to the preservation condition of the fragment. Such an example is well illustrated in Figure 8a. The Visible Induced Luminescence Imaging clearly defines and outlines the damaged areas of missing paint layer that look very dark because of the absence of the Egyptian Blue luminescence (Fig. 8b), and are hardly distinguishable in regular photography (Fig. 8a) (areas marked with arrows).

Such a phenomenon is also reflected in cases when a paint layer that was brushed on top of the Egyptian Blue is damaged. In such cases, the Egyptian Blue underneath will be highly visible through the upper damaged paint layer due to its strong luminescence, showing clearly the areas with the missing colour (Fig. 9).

4. Conclusion

This study examined the presence and properties of Egyptian Blue pigment on the painted plaster fragments from Tel Kabri by using Visible Induced Luminescence Imaging. This non-invasive technique is simple to implement and gives immediate results using basic equipment with no need for previous expertise. The technique was proved as a very efficient tool for definite identification of Egyptian Blue and precise mapping of its distribution on the painted fragments.

The results of the study clearly show that Egyptian Blue is the only blue pigment found on the examined painted fragments from Tel Kabri. It is also the most common colour used, considerably more widespread than all the other pigments. In addition, the use of Visible Induced Luminescence Imaging proved to be a highly valuable technique to examine the blue paint layers and to study the painting technique in those layers, including the mixtures of pigments, the layering of colour, and the colour order. It also provided important data on conservation issues related to the preservation condition of the paint layers, such as areas with missing colour, as well as precise mapping of dirt and encrustation coverage of the surface before treatment and after cleaning of these areas.

Overall, our experience shows that this technique is highly recommended for detailed studies of Bronze Age wall paintings in general and specifically Aegean-style wall paintings, because of the common and extensive use of Egyptian Blue in these paintings and the significant advantages and capabilities of the technique as described in this study.

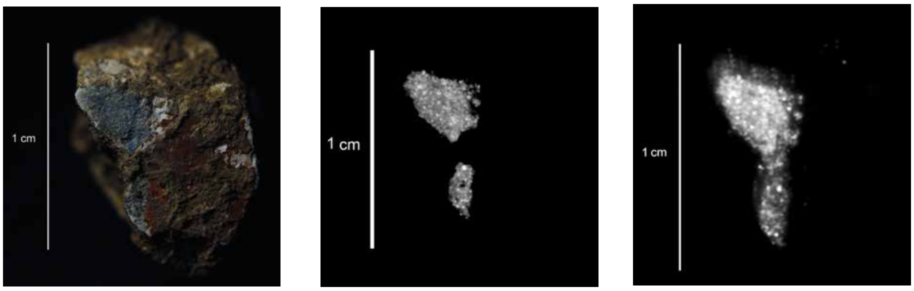

Fig. 7: Fragment no. 22, a) with regular photography (left); b and c) with Visible Induced Luminescence Imaging (b = centre; c = right), showing two cleaning phases removing dirt from the surface of the fragment, revealed by the luminescence of Egyptian Blue.

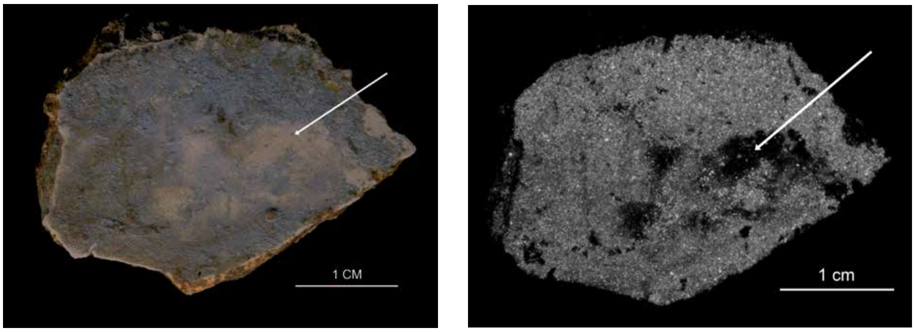

Fig. 8: Fragment no. 21, a) with regular photography (left); b) with Visible Induced Luminescence Imaging (right), showing the dark areas of damaged surface that are clearly notable as dark areas of 8b.

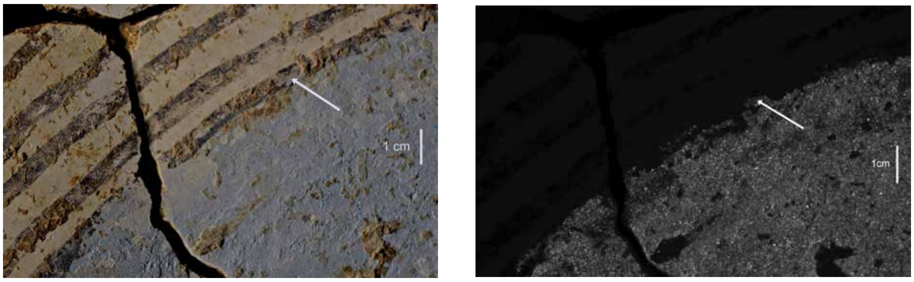

Fig 9: Fragments no. 16–17, showing areas where only minute traces of the black line over the blue paint layer still exist. a) regular photography (left) showing clearly the black line that mistakenly looks intact to the observer, but with Visible Induced Luminescence Imaging; b) (right), here it is possible to see that there are only few remains of that line (see arrows).

Acknowledgements

Many thanks to the Conservation of Wall Painting Department, Courtauld Institute of Art, for introducing the Visible Induced Luminescence imaging technique and its benefits, and with special thanks to Professor Sharon Cather and Dr. Giovanni Verri for the detailed explanations on the technique as well as to Dr. Austin Nevin at the Istituto di Fotonica e Nanotecnologie – Consiglio Nazionale delle Ricerche, Milan, for providing valuable material on Egyptian Blue and his support in analytical identification of the pigment.

The Tel Kabri excavations, and related research, have been supported by grants from the National Geographic Society, the Israel Science Foundation, the Institute for Aegean Prehistory, and donations from private individuals, as well as by the University of Haifa, George Washington University, and Brandeis University, to all of whom we are grateful.

The study was conducted at the Conservation Laboratory of the Conservation of Material Culture Heritage Program, University of Haifa.

References

Accorsi *et al.* 2009

G. Accorsi – G. Verri – M. Bolognesi – N. Armaroli – C. Clementi – C. Miliani – A. Romani, The exceptional near-infrared luminescence properties of cuprorivaite (Egyptian blue), Chemical Communications 23, 2009, 3392–3394.

Brecoulaki *et al.* 2008

H. Brecoulaki – C. Zaitoun – S. R. Stocker – J. L. Davis – A. G. Karydas – M. P. Colombini – U. Bartolucci, An archer from the Palace of Nestor. A new wall-painting fragment in the Chora Museum, Hesperia 77, 2008, 363–397.

Brecoulaki *et al.* 2014

H. Brecoulaki – G. Kavvadias – G. Verri, Colour and luxury. Three classical painted marble pyxides from the collection of the National Archaeological Museum, Athens, in: J. S. Østergaard – A. M. Nielsen (eds.), Transformation. Classical Sculpture in Colour, Meddelelser fra Ny Carlsberg Glyptotek ny ser. 16 (Copenhagen 2014) 152–165.

Brecoulaki *et al.* 2015

H. Brecoulaki – J. L. Davis – S. R. Stocker (eds.), Mycenaean Wall Painting in Context. New Discoveries, Old Finds Reconsidered. Proceedings of an International Workshop Held February 10–11, 2011 at the National Hellenic Research Foundation, Μελετήματα 72 (Athens 2015).

Brysbaert 2002

A. Brysbaert, Common craftsmanship in the Aegean and east Mediterranean Bronze Age. Preliminary technological evidence with emphasis on the painted plaster from Tell el-Dab^{c}a, Egypt, Egypt and the Levant 12, 2002, 95–107.

Brysbaert 2006

A. Brysbaert, Lapis Lazuli in an enigmatic 'purple' pigment from a thirteenth-century BC Greek wall painting, Studies in Conservation 51,4, 2006, 252–266.

Brysbaert 2008
A. Brysbaert, The Power of Technology in the Bronze Age Eastern Mediterranean. The Case of the Painted Plaster, Monographs in Mediterranean archaeology 12 (London 2008).

Brysbaert 2011
A. Brysbaert, The painted plaster from Qaṭna. A technological study, in: von Rüden 2011, 249–269, 329–335.

Brysbaert – Vandenbeele 2004
A. Brysbaert – P. Vandenabeele, Bronze Age painted plaster in Mycenaean Greece. The testing and application of micro-Raman spectroscopy in a technological study, Journal of Raman Spectroscopy 35, 2004, 686–693.

Cameron *et al.* 1977
M. A. S. Cameron – R. E. Jones – S. E. Philippakis, Scientific analyses of Minoan fresco samples from Knossos, Annual of the British School at Athens 72, 1977, 122–184.

Cline – Yasur-Landau 2013
E. H. Cline – A. Yasur-Landau, Aegeans in Israel. Minoan frescoes at Tel Kabri, Biblical Archaeology Review 39,4, 2013, 37–44, 64.

Cline *et al.* 2011
E. H. Cline – A. Yasur-Landau – N. Goshen, New fragments of Aegean painted plaster from Tel Kabri, Israel, American Journal of Archaeology 115, 2011, 245–261.

Damian *et al.* 2003
D. Damiani – E. Gliozzo – I. Memmi Turbanti – J. E. Spangenberg, Pigments and plasters discovered in the house of Diana (Cosa, Grosseto, Italy). An integrated study between art history, archaeology and scientific analyses, Archaeometry 45,2, 2003, 341–354.

Gaetani *et al.* 2004
M. C. Gaetani – U. Santamaria – O. Seccaroni, The use of Egyptian blue and Lapis Lazuli in the Middle Ages. The wall paintings of the San Saba Church in Rome, Studies in Conservation 49,1, 2004, 13–22.

Hatton *et al.* 2008
G. D. Hatton – A. J. Shortland – M. S. Tite, The production technology of Egyptian Blue and green frits from second millennium BC Egypt and Mesopotamia, Journal of Archaeological Science 35, 2008, 1591–1604.

Höflmayer *et al.* 2016
F. Höflmayer – A. Yasur-Landau – E.H. Cline – M.W. Dee – B. Lorentzen – S. Riehl, New radiocarbon dates from Tel Kabri support a high Middle Bronze Age chronology, Radiocarbon 58,3, 2016, 599–613.

Jones – Photos-Jones 2005
R. E. Jones – E. Photos-Jones, Technical studies of Aegean Bronze Age wall painting. Methods, results and future prospects, in: L. Morgan (ed.), Aegean Wall Painting. A Tribute to Mark Cameron, British School at Athens Studies 13 (London 2005) 199–228.

Kakoulli 2009
I. Kakoulli, Greek Painting Techniques and Materials from the Fourth to the First Century BC (London 2009).

Kempinski – Niemeier 1994
A. Kempinski – W.-D. Niemeier, Excavations at Kabri Vol. 7–8. Preliminary Report of the 1992–1993 Seasons (Tel Aviv 1994).

Kempinski *et al.* 2002
A. Kempinski – N. Scheftelowitz – R. Oren (eds.), Tel Kabri. The 1986–1993 Excavation Seasons, Monograph Series of the Institute of Archaeology, Tel Aviv University 20 (Tel Aviv 2002).

Lazzarini 1982
L. Lazzarini, The discovery of Egyptian Blue in a Roman fresco of the mediaeval period (ninth century A.D.), Studies in Conservation 27,2, 1982, 84–86.

Linn *et al.* 2017
R. Linn – E. H. Cline – A. Yasur-Landau, Technological study of Middle Bronze Age painted plaster fragments from the Canaanite Palace of Tel Kabri, Israel. Materials and painting techniques, Journal of Archaeological Science. Reports 13, 2017, 466–475.

Niemeier – Niemeier 2000
B. Niemeier – W.-D. Niemeier, Aegean frescoes in Syria-Palestine. Alalakh and Tel Kabri, in: Sherratt 2000, 763–802.

Niemeier – Niemeier 2002
B. Niemeier – W.-D. Niemeier, The frescoes in the Middle Bronze Age palace, in: Kempinski *et al.* 2002, 254–298.

Pagès-Camagna – Colinart 2003
S. Pagès-Camagna – S. Colinart, The Egyptian green pigment. Its manufacturing process and links to Egyptian Blue, Archaeometry 45,4, 2003, 637–658.

Perdikatsis 1998

V. Perdikatsis, Analysis of Greek Bronze Age wall painting pigments, in: S. Colinart – M. Menu (eds.), La couleur dans la peinture et l'émaillage de l'Égypte ancienne. Actes de la table ronde, Ravello, 20–22 Mars 1997 (Bari 1998) 103–108.

Perdikatsis *et al.* 2000

V. Perdikatsis – V. Kilikoglou – S. Sotiropoulou – E. Chryssikopoulou, Physicochemical characterisation of pigments from Theran wall paintings, in: Sherratt 2000, 103–118.

Piovesan *et al.* 2011

R. Piovesan – R. Siddall – C. Mazzoli – L. Nodari, The Temple of Venus (Pompeii). A study of the pigments and painting techniques, Journal of Archaeological Science 38,10, 2001, 2633–2643.

Porat – Ilani 1998

N. Porat – S. Ilani, A Roman period palette. Composition of pigments from king Herod's palaces in Jericho and Masada, Israel, Israel Journal of Earth Sciences 47, 1998, 75–85.

Profi *et al.* 1976

S. L. Profi – L. Weier – S. E. Philippakis, X-ray analysis of Greek Bronze Age pigments from Knossos, Studies in Conservation 21, 1976, 34–39.

Riederer 1997

J. Riederer, Egyptian Blue, in: E. W. FitzHugh (ed.), Artists' pigments. A Handbook of Their History and Characteristics Vol. 3 (Oxford 1997) 23–45.

von Rüden 2011

C. von Rüden, Die Wandmalereien aus Tall Mišrife/Qaṭna im Kontext überregionaler Kommunikation, Qaṭna Studien 2 (Wiesbaden 2011).

Sherratt 2000

S. Sherratt (ed.), Proceedings of the First International Symposium 'The Wall Paintings of Thera', Petros M. Nomikos Conference Centre Thera, Hellas, 30 August – 4 September 1997 (Athens 2000).

Verri 2009

G. Verri, The spatially resolved characterisation of Egyptian blue, Han blue and Han purple by photo-induced luminescence digital imaging, Analytical and Bioanalytical Chemistry 394,4, 2009, 1011–1021.

Vitruvius 1962

Vitruvius, On Architecture, Vol. II. Books 6–10, F. Granger (ed.), Loeb Classical Library 280 (Cambridge 1962).

Vlachopoulos – Sotiropoulou 2013

A. Vlachopoulos – S. Sotiropoulou, The blue colour on the Akrotiri wall-paintings. From the palette of the Theran painter to the laboratory analysis, Talanta. Proceedings of the Dutch Archaeological and Historical Society 44/2012, 2013, 245–272.

Yasur-Landau *et al.* 2014

A. Yasur-Landau – E. H. Cline – N. Goshen, Initial results of the stratigraphy and chronology of the Tel Kabri Middle Bronze Age palace, Egypt and the Levant 24, 2014, 355–364.

Yasur-Landau *et al.* 2015

A. Yasur-Landau – E. H. Cline – A. J. Koh – D. Ben-Shlomo – N. Marom – A. Ratzlaff – I. Samet, Rethinking Canaanite palaces? The palatial economy of Tel Kabri during the Middle Bronze Age, Journal of Field Archaeology 40,6, 2015, 607–625.

Egypt

Original Painting Techniques

Methods and Materials in 18th Dynasty Tombs, in the Valley of the Nobles, Egypt

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Abstract

This paper discusses the original painting construction, methods, techniques and materials used in Theban elite private tombs of the 18th Dynasty. The findings are based on research, archaeometry, conservation work, as well as experimental archaeology – through the use of reconstructions. Using this multiple research method and the associated findings we will attempt to answer some of the questions most frequently asked about the construction and decoration of painted tomb chapels.

Keywords: wall painting; 18th Dynasty Egypt; technique; chaîne opératoire.

1. Introduction: Some Preliminary Remarks

The tombs discussed are predominately those from the reigns of Thutmose I to Amenhotep III, 1482–1350 BC. After the seventeen year break in the use of the Theban necropolis, due to Amenhotep IV/Akhenaten's schism, Theban painting underwent deep transformation and developed in a direction that is beyond the focus of this paper.

Both authors are involved in conservation projects on Theban tomb paintings, in TT 29, TT 43, TT 59, and TT 96. The origin of our interest in original painting techniques and materials came from this experience, and conservation remains the starting point for these observations. It is a priority due to the heavily deteriorated condition of many of the painted Theban tombs, and is key to safeguarding them for future generations. In order to set in place successful conservation work it is necessary first to

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in: J. Becker, J. Jungfleisch and C. von Rüden (eds.) Tracing Technoscapes. The Production of Bronze Age Wall Paintings in the Eastern Mediterranean (Leiden 2018) 119-148.

understand the techniques of execution, to identify the methods and materials used, and the past, present and future causes of alteration and deterioration. The condition of the Theban tomb paintings is primarily connected to their construction, and how this is affected by external factors including, time the natural geological conditions of the necropolis, as well as manmade damage.

Our belief was that the observations gained for the purposes of conservation work could be united with Egyptology with the addition of scientific research (archaeometry), and experimental archaeology, to significantly increase our understanding of the methods and materials of the original tomb construction and decoration. The research aims to experiment systematically with the process of decoration of painted tombs from plastering to painting[3], using these united methods. The experimental archaeology has to be carried out intensively, ideally in Egypt, to be reliable. Archaeometric data used as part of this research is important in precisely identifying the components of wall plasters and paint layers. Identifying the geological provenance of the pigments analysed can reveal trade routes and commodity exchange patterns. But archaeometry does not fully answer questions on the processes of execution of the decoration of the tombs. Experimental archaeology aims to fill this gap to find out how the components parts identified by scientific methods were treated and applied to produce the resulting artistic creations.

The aim of this paper is to attempt to answer some of the questions asked about the construction and decoration of painted tomb chapels based on the findings of this research method. Of course we cannot solve every question but can try to give directions for answers. Due to the limits on article length we will attempt only to address the plaster, pigments, binding media and methods and materials of their application – without discussing ceiling decoration (which is an independent study beyond that of the wall paintings), the lighting (both natural and artificial) used to undertake the decoration of wall paintings, or detail the division of labour, estimates of the numbers of painters, or discuss details of the provenance of the materials – all of which have been part of this research but require a longer article.

2. Theban Painting: An Attempted Definition

We use the term 'Theban painting' here to include funerary Pharaonic painting located in the area of the necropolis of Thebes, modern Luxor. We will limit it to wall painting, excluding polychrome reliefs, statues, objects, coffins or furniture, despite the evident material and close cultural relationships between them all. Theban painting is used to include paintings from all Dynasties, but the focus is mainly the New Kingdom when the necropolis was most widely used for the creation of painted tomb chapels.

On first examination, the technical principles of Theban wall paintings are simple.[4] The technique is tempera on dry plaster. No evidence of work on wet plaster has yet been found by the authors over a body of circa 100 surveyed documented

3 Abdel Ghaffar Shedid gave some limited proposals for reconstitution of technical painting process. See: Shedid 1988, Tabs. 4, 9, 10a. Unfortunately there has been no further development.

4 For artistic principles, see: Baud 1935, 4–20; Schäfer 1980 [1974]; Davis 1989.

Fig. 1: TT 75 showing the smoothed intonaco surface.

tombs.[5] The preliminary sketches for the scenes are often drawn on a square grid system; this ensures that human figures have the approved proportions, and that scenes are correctly laid out in the available space. The sketch is always drawn in red with a relatively fine brush.[6] Flat colouring of the figures followed the sketches. Finally, details were added, and final outlines, to accentuate edges of all the forms.[7] Occasionally, varnish was applied to specific elements.[8]

3. Plastering the Walls

The Theban tomb-chapels discussed here are rock cut monuments.[9] The majority are located on slopes of the hills facing the royal temples on the alluvial plain of the Nile. The geology of the hills is variable.[10] Cutting regular walls was generally only possible in the fine geological lime layers located at the bottom of the hills.[11] The tombs located here are generally decorated in relief. Nevertheless it is clear that most owners preferred to build their tombs on the more visible places on the hill and chose to locate them on the artificial terraces above, despite the lower quality of the rock.

5 These evidences consist of traces of brushes that were more rigid than modern hair brushes, left on the plaster.
6 Few exceptions of corrections with darker red are mentioned with no precision by Baud. See: Baud 1935, 25.
7 Baud 1935, 21–33.
8 Mackay 1920, 35–38.
9 For technical details, see: Clarke 1896; Mackay 1921, 154–168; Arnold 1991; Stocks 2003.
10 On the geological setting of the Theban tombs, see: Dupuis *et al.* 2011; Karlshausen – Dupuis 2014.
11 Most of sculpted tombs are located in this area (TT 25, TT 53, TT 55, TT 57, TT 192). It is likely that the possibility of sculpting the rock has influenced the location of the chapels.

Locating a tomb on the hill often meant abandoning the idea of using sculptured relief as decoration.[12]

The rock was plastered with different layers of coating in order to create smooth flat walls. Different types of plaster can be found depending on the number of deep holes and cracks that had to be filled to produce a flat surface, but the principle two plaster layers used for the painting substrate are, to use the terminology from fresco painting,[13] 'arriccio' and 'intonaco'. Arriccio was used to obtain a flat, regular rough surface, which would support the final fine layer on which the paintings were executed – the intonaco. This was a thinner layer, usually a pale brown hue. The supporting layers have a great influence on the behaviour and appearance of the paintings, including the drafting, the colours, paint layers, and the drying times. Different kinds of plasters coexist in chapels, depending on the condition of the rock, the period, and the particular mixes. Below is a brief description of the main types found:

• Mud plasters

Mouna is a mix of straw and other vegetable fibres combined with alluvial earth; this kind of plaster is still used in rural areas. The term *mouna* comes from vernacular modern Egyptian Arabic. It is easily recognizable by its dark colour and visible fibres on the surface. It was mainly used by tomb builders to fill large cracks and holes within the rock and is rarely found as a final painted layer in the 18th Dynasty, up to the reign of Amenhotep III.[14]

The *mouna* plastering technique is simple and would not have required highly skilled workmen. It is prepared by mixing earth brought from the fields with the vegetal remains of plants and grass.[15] It shrinks on drying and sets as a durable layer in the cracks and voids in the rock. The vegetable fibres act as moisture retainers and slow down the drying time of the layer; they may also have helped to reduce the weight of the plaster. *Mouna* can also be found as a base layer, in the case of very crumbled, cleaved and split rock (*e.g.* TT 63, TT 96). In this case, it is spread by hand – the imprints of application are still visible in many unfinished tombs; the grooves left by the fingers acted as a key for the subsequent plaster layers.[16] We found mud plaster as arriccio in about 40% of plastered tombs painted from reigns of Ahmose to Amenhotep III.

• White plaster

The walls of chapels cut in finer rock were coated with a pale coloured plaster usually white, eggshell, pink or occasionally grey.[17] A common custom was first

12 The average of sculpted tombs is 1/20. Cf. Baud 1935, VI.

13 The definitions of both terms, if commonly referenced as typical fresco, can be applied without any ambiguity for tempera Theban painting. Cf. Mora *et al.* 1977, 12.

14 For the former reigns, few instances include the passage of TT 80, and the north wall of TT 24, the plaster of the south wall is different, and does not contain straw.

15 Cartwright 2008, 25–29.

16 When plaster was too flat to insure good adhesion of later layers, it was regularly keyed after drying (e.g. TT 42, TT 77, TT 80, TT 82, TT 90). This was less successful with the final layer largely detached, which may have helped modern period theft.

17 Passage of the TT 96A.

to fill the deepest holes, produced by cutting the walls, with this white plaster[18] rich in anhydrite (a dehydrated calcium sulphate). Deposits of white anhydrite[19] are regularly found between the sedimentary layers of Theban rock formation. It could be used as raw filler material as well as for finer coatings.[20]

Cracks could also be filled with chips of limestone in the plaster.[21] After this first layer/filling, a second very different plaster layer was applied, coating all of the surfaces. It was frequently pinkish or beige. Both colours often coexist in a tomb, they can be found adjacent to each other and overlapping, the different colours relating to different batches of plaster, which varied from day to day depending on the daily supply of materials. This helps to reveal the sequences of plastering.[22] The thickness of the coating varied according to the quality of the underlying rock, but the consistency of particle size within the mix is distinctive. Examination indicated that particles size distributions varied from ± 0.3–2.0mm. This appears to indicate that material was obtained by sieving the raw components rather than by grinding.[23] Laboratory analyses showed this plaster to be mainly composed of anhydrite, kaolinite, calcium carbonate, magnesium calcium carbonate, and quartz from sand.[24] The pink colour is due to natural iron oxides within the clay. What is striking is the resemblance between the colour of the fillers and the geological residues at various places of the necropolis. This led us to investigate the possibility of the use of the latter as raw material, as suggested by Marcelle Baud.[25] Samples of various sieved rocks were prepared and compared with the original plasters, and showed a remarkable similarity, including setting comparable to the original wall plasters. The setting time is very slow, with durability increasing with aging.[26] The presence of salts, clay and sulphate in this partially dehydrated limestone powder acts as natural cement; the quartz particles naturally present prevent cracking, while the clay present in the raw powder gives the plaster plasticity and adhesion.

The final and finest plaster layer (the intonaco) is usually beige, light brown, or eggshell in colour. It is rich in lime and clay and poor in sand.[27] It varies in thickness from ± 0.1–3.0mm.[28] Its appearance is smooth, sometimes a little shiny. This is typical of the 18th Dynasty Theban tombs until the reign of Amenhotep III. It was used in more than 90% of the tombs of that period – the others are painted on smooth *mouna*. The intonaco layer was probably adhered to the coarser layer by dampening the surface with water before application. The plastering of this layer

18 E.g. TT 29, TT 94, TT 95, TT 99, TT 108, TT 121.
19 Kent – Dupuis 2004, 140, 144.
20 Garcia-Guinea *et al.* 2008, 849–853.
21 E.g. TT 29, TT 61, TT 63, TT 71, TT 81, TT 82, TT 85, TT 87, TT 88, TT 91, TT 96, TT 99, TT 165, TT 201, TT 256.
22 E.g. TT 29, TT 43, TT 61, TT 66, TT 81, TT 83, TT 84, TT 93, TT 94, TT 95, TT 131, TT 155, TT 228.
23 Baskets and sieves in vegetal fibres and palm leaves found by archaeologists in TT 353. See: Dorman 1991, pl. 44b.
24 Garcia-Guinea 2008, 849–853.
25 Baud 1935, 36.
26 Tests made in Egypt found the plaster was much tougher a year after application than immediately after drying.
27 It corresponds to natural marl composition.
28 The volume of raw powder needed to coat 1m^2 is around 3 litres.

was specialised work, probably done in close collaboration with the painters.[29]

We believe that plasters were obtained by recycling of the rocks produced by the cutting of the tombs, mixed with selected deposits from the area. This sieved 'powder' of debris and/or local soils had the natural inclusions of lime and calcium sulphate with varying percentages of clay, sands etc. This mix did not require transformation by heat (as do gypsum or lime plaster) to become hard on drying and cohere to the rock. This hypothesis is a conclusion of our own experiments in the Theban Necropolis. The quantity of dry powder needed to coat the walls of a tomb argues in favour of this theory. It is estimated that the average quantity of plaster required for a tomb located in coarse limestone or shale layers is around 30–50kg/m^2. That would mean a weight of approximately 10–20 tons for an average tomb. Providing this quantity of plaster from a distance would have been a major task. It also seems unlikely that such a volume of raw material was transformed by heating, as for gypsum plaster.

Fig. 2: Experimental arriccio using Theban materials.

4. Tools and Implements of Plastering

Through study of the large number of unfinished tomb chapel paintings it was possible to understand the original stratigraphy of the coatings and the process of plastering. After visual diagnosis of the plastering technique this was compared with the study of the plastering tools surviving in museum Egyptian collections, to try to understand the techniques of plastering. The vast majority of the so-called plastering tools in collections are wooden.[30] There are two types of these wooden smoothers or floats – it seems there was no use of trowels due to the use of hands for plaster application. The first type consists of a narrow wooden board with a handle[31] – efficient for levelling the plaster, while the angular end would be useful for the corners. The second type consists of small hand smoothers made from a single piece of wood.[32] Both categories of smoothers have the advantage of being lightweight and manoeuvrable, with an enclosed grip handle to avoid dropping the tool, useful in uncomfortable working conditions. Copies of plastering floats and smoothers were experimented with to recreate the plastering method.

The different plaster zones can be tracked by observation of plasters, which vary slightly from batch to batch, with overlapping edges also indicating different daily

29 Laboury – Tavier 2010, 96.

30 The one in *calcite alabaster* from Middle Kingdom, displayed in Cleveland Museum of Art (Inv. 1914.825) is probably votive, see: Berman – Bohač 1999, 134. Petrie found a metal trowel of an unknown period (could be late or Roman period), see: Clarke – Engelbach 1930, fig. 263f.

31 London, British Museum EA5986, see: De Garis Davies 1913, pl. XVIII. New York, MMA 11.150.34. New York, MMA 30.8.6, a model mason's float from the Foundation Deposit for Hatshepsut's Tomb (KV20). New York, MMA 26.2.36.

32 Manchester Museum cat. no. 52a and 52b, see: Petrie 1917, pl. XLVII.53, 54. London, UC 16700, see: Petrie 1890, 26, pl. IX.9. New York, MMA 31.3.65.

work areas. Interestingly, the zones are not very large, approximately 1m^2; they are likely to relate to the quantity of plaster that could be held in trough or basket. Plasterers worked from top to bottom, even if the floor level was not yet cut. The walls were smoothed in arcs of a circle corresponding to the reach of the arm of a standing man. We have not observed the smoothing techniques with fabric described by John Romer in KV35[33] in private tombs.

Experimentation found that despite the hot desert climate, the time taken for thick layers of plaster to dry and harden within the tombs is longer than might be assumed – mud plasters and thick lime coatings taking several days. It was found that, if the plaster layer was too thick and dried too fast, it detached from the arriccio layer to create a wavy cracked surface – this effect can also be observed in some of the tombs where the same problem has occurred (*e.g.* TT 96A, TT 96B). In other cases it caused the detachment of the upper layers (*e.g.* TT 77, TT 101).

5. Design and Layout

The surfaces of the plastered walls were divided into registers. A horizontal line separated the space devoted to the frieze from the registers intended for the various scenes. Paintings appear to have been executed panel by panel to form whole scenes, but in different areas of the chapel and not continuously across the walls. In order to achieve visual consistency and a well-functioning composition, a preliminary plan is most likely to have existed. Figured sketched ostraca, found by archaeologists during excavation of tombs,[34] could be seen as a first step of organisation of the wall decoration with a preliminary layout, or as 'memoranda' for painters themselves of scenes to be painted.[35] The registers and frames were simply delineated with lines traced by a rope dipped in red ochre water and snapped on the walls. Each dipping allows the marking of 5–6 perfectly straight lines. Plumb bobs ensured verticality[36] and a triangular level the horizontality – the use of a plumb triangle level can be confirmed by the correct horizontal almost always found in the tombs, regardless of the verticality of the walls.

6. Painting Materials

6.1 Pigments

The colour categories in Ancient Egypt are limited to a restricted list of basic colours chosen both for their aesthetic properties and for their symbolic functions[37] – white, black, red, yellow, green, blue. From the Old Kingdom to late New Kingdom Dynasties, basic colours were enriched by intermediate hues including pink, orange, mauve, and grey which were obtained by mixing 'pure' colours. Although the colour range of 18th Dynasty

33 Romer 1975, 331–332.
34 E.g. Guksch 1995, pls. 19, 47.
35 De Garis Davies 1917, 235; Hayes 1942.
36 Surprisingly the verticality was not still obtained e.g. in TT 229. See: Mackay 1921, 74, pl. XV. This must be interpreted as evidence of the great haste of the work, often in relation to incomplete chapels.
37 Schenkel 1963, 131–147; Schenkel 2007, 211–228; Matthieu 2009, 25–52. For classification of colours by Egyptian, see: Iversen 1955; Harris 1961; Baines 1985; Aufrère 1991; Matthieu 2009.

painting evolved from a restricted to a much more extensive palette (from reign of Amenhotep IV), this was more due to aesthetical evolution and colour mixing, than to an enlargement of the coloured materials available. Mixing of pigments or layering transparent glazes produced different hues from a basic colour. Pigments can be classified in two categories: natural and artificial.[38] In the first, we group natural minerals with pigments obtained by simple grinding: white, red (brown and orange), yellow, green, and blue. In the second, those acquired by a chemical process, for example heating, cooking or carbonisation: Egyptian blue, Egyptian green and green frit as well as black. According to Claude Traunecker, Egyptians listed pigments in two categories, natural powders (*stj*) measured by volume, and those obtained by grinding (*dr.wy*) measured by weight.[39]

The conservation project at the tomb of Menna was one of the most comprehensive recent studies of a Theban tomb.[40] The tomb, TT 69, is one of the best known and most visited of the Nobles' Tombs due to the high quality of its paintings. The project was primarily one of conservation and scientific analysis. It was unusual at the time in combining visual examination with non-invasive scientific archaeometric analysis as part of the process to understand the painting method and to attempt to identify precisely grounds, pigments, binders and glazes. The results from the tomb of Menna project are valuable as it is one of the most complete analytical in situ surveys of a tomb to date, allowing its precise findings to be extrapolated for use against findings from other tombs, where the identification of the materials was obtained at different times using less precise analytical methods.

The project was conceived from the start as one that would rely on non-invasive methods of analysis as opposed to sampling methods to pinpoint the materials used in construction. Earlier archaeometric information on Egyptian wall paintings tended to rely on results from samples in order to identify organic and inorganic materials,[41] and these were often taken from detached fragments in museum collections. The analysis of Menna's tomb used non-invasive methods for several reasons. Firstly, due to Egyptian government restrictions on the taking of samples for examination; secondly, to ethical considerations of sampling, which if used extensively can counter conservation principles. The limiting factor of samples was also a consideration – they are, by their nature, very specific to the area from which they are taken, and not necessarily representative of whole areas. Using combined non-invasive analysis with imaging allowed a precise selection of representative areas to analyse, with a much higher number of analysed spots than would be ethically possible through sampling. The Menna project followed on from some slightly earlier projects which also attempted in-situ, non-invasive techniques in Egyptian sites. One of these projects was conducted at the royal tomb of Amenhotep (Amenophis III) KV22 by the Waseda University.[42]

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38 Traunecker 1977, 115–117.
39 Traunecker 1977, 115–117.
40 2007–2009, under the direction of Dr Melinda Hartwig, sponsored by Georgia State University and administered by the American Research Centre in Egypt (ARCE) as part of its Egyptian Antiquities Conservation Project.
41 Corzo – Afshar 1993, 55–65; Lee – Quirke 2000, 104–120; Davies 2001, 1–52; Middleton – Uprichard 2008, 19–24.
42 Yoshimura – Kondo 2004, 205–207.

The aims of the archaeometric research at the tomb were to obtain scientific and objective data on materials and techniques. This included documenting the wall painting materials (mortars, pigments, binders and coatings) and their techniques of application, through the use of complimentary mobile techniques. The research investigated painting techniques and the artistic work process by analysing the stratigraphy of the paintings, while the analysis also helped to understand the degradation of the pictorial layer, which is important in identifying appropriate conservation methods. The techniques used were X-ray Fluorescence (XRF), Ultraviolet, visible and near infrared diffuse reflectance spectography (UV-vis spectroscopy and NIR spectroscopy), and Raman spectroscopy. This combination of techniques was chosen as they were complimentary, and enabled the exploration of the properties of organic and inorganic materials, while allowing an entire survey of the tomb with a high number of analysed spots. This is believed to be the first time this combination of on-site non-destructive techniques was performed in Egypt,[43] although these techniques had been used to examine Egyptian objects in museum contexts.[44] The equipment was originally conceived as laboratory based and non-portable. At the time of the Menna project, these technologies were only just becoming portable and viable outside the laboratory. In fact, some difficulties were faced during the project due to using this highly sensitive equipment in the hot, dusty conditions on site.[45] A high definition photographic survey was also undertaken in flat, raking and UV light. This was used to aid visual interpretation, to show brushstrokes, and impasto effects. UV light, as well as allowing the study of the condition of the surface layer, could also confirm the presence of certain organic coatings, surface sediment and help to discriminate between some of the pictorial materials – including some whites, and organic coatings including wax. It could also be used to detect certain organic varnishes.

6.1.1 Results

The palette identified at the tomb of Menna revealed a relatively standard palette for the period.[46] This included the use of calcium carbonate as a ground, carbon black, a calcium carbonate for the standard white, and huntite for white highlights. The blues and greens were Egyptian blue and green. The reds and yellows were largely iron oxides, although realgar was found as well as pigment mixes of yellow oxide with arsenic, suggesting the use of orpiment for golden objects – see below. Greys were a mix of whites and blacks; some colours, which were perceived as black, were in fact degraded Egyptian blue with organic coatings.

Although the colour palette was quite limited the colours in the tomb appear much more varied in tone, depth, transparency and effect, due to different treatments – grinding and mixing, the method of application, the opacity of the pigment, and the effects created by using glazes, or the application of organic coatings.

43 Hartwig 2013, 93–111.

44 Pagès-Camagna *et al.* 1998, 141–145; Middleton – Humphrey 2001, 10–16; Pagès-Camagna – Colinart 2003, 637–658; Ambers 2004, 768–773; Ambers 2008, 31–40.

45 During the first two weeks of the data gathering, problems occurred with the XRF readings, which it is believed may have been due to the high temperatures and fine dust particles present in the tomb.

46 These agreed with many of the findings from the Nebamun wall paintings at the British Museum. Cf. Parkinson 2008, 44–63.

Detailed below are the pigments which have been found and identified in Theban tombs and which largely tie in with the Menna results:

6.1.1.1 Natural pigments[47]

- Whites

  The whites identified have been: calcium carbonate (calcite, $CaCO_3$), with the raw material is usually obtained from deposits of calcium carbonate or white stone; sulphate carbonate (gypsum, $CaSO_4$-$2H_2O$, anhydrite, $CaSO_4$); dolomite (calcium magnesium carbonate, $CaMg(CO_3)_2$).

  Huntite[48] (magnesium calcium carbonate mineral ($CaMg_3(CO_3)_4$) has been identified on some Middle Kingdom painted objects, with its use is mainly attested in wall painting from new New Kingdom, and mainly in the reign of Hatshepsut.[49] The source of the huntite used in Egypt is not known.[50] It is thought to have been imported from areas in modern day Turkey (predominately Anatolia) and Greece where its presence is abundant.[51] But huntite occurs both in inland saltlakes and on the margin of magnesium- rich strata conditions which can also be found in Egypt.[52]

  Analyses of white paint layers mainly reveal a natural mix of minerals: gypsum, anhydrite and calcite. The painters would not have had a precise idea of the mineral composition of the colours, but would have been interested in the appearance of the colour and its optical properties. The random composition of white zones, for example in TT 56,[53] makes us believe painters mixed their own whites with compositions made up to deliberately vary the white painted zones. In many cases, the white background of funeral scenes is a little bluish, obtained by the addition of black pigments,[54] to contrast with other white zones. Huntite white was believed to have been used for its reflecting properties.[55] While magnesium calcite found in analysis of Theban tombs from the 12th, 18th and 20th Dynasties[56] is also believed to have been used as a priming layer applied to give intensity and magnifying qualities to the subsequent colour (usually reds and yellows). The use of huntite for such purpose may have been underlined too hastily. In 18th Dynasty private tombs, according to archaeometric data, this is not statistically the case. The brighter white paint we found experimentally is quite simply Egyptian finely ground alabaster.[57]

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47 Identified pigments based on the principal mineral content. Mineral pigments are rarely pure, geological deposits are often mixed. For example, calcium carbonate is often associated with sulphate carbonate or magnesium. In most cases, this was not the painter's intention.

48 Riederer 1974, 102–109; Heywood 2001, 5–9.

49 El Goresy *et al.* 1986.

50 Heywood 2001, 5.

51 Kadir 2003, 1–9; Calvo *et al.* 1995, 627–632.

52 Lee – Quirke 2000, 115; Hünerfuß *et al.* 2006, 1224–1228.

53 Beinlich-Seeber – Shedid 1987, 151.

54 Pagès-Camagna *et al.* 2010, 676.

55 Bryan 2001, 67.

56 Lee – Quirke 2000.

57 Egyptian alabaster is mainly composed of calcite ($CaCO_3$). It must not be confused with gypsum alabaster.

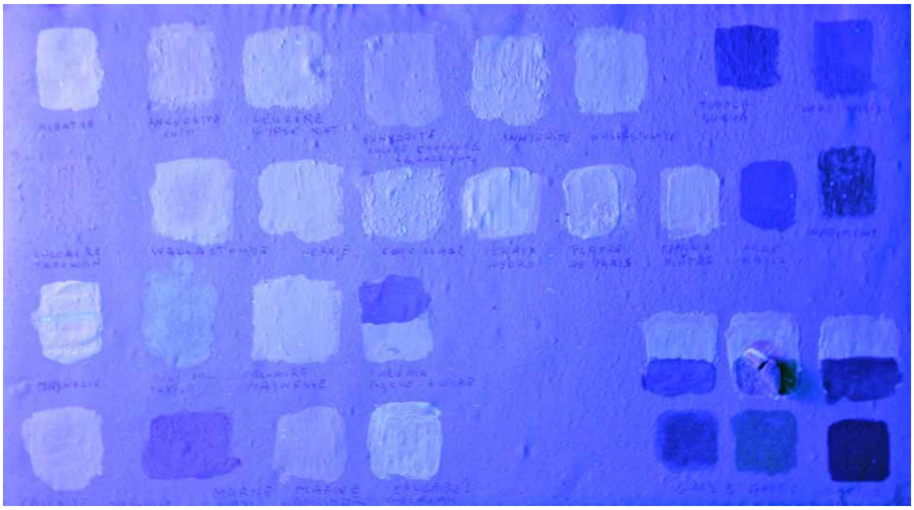

Fig. 3: Recreated Egyptian whites under UV.

- Red-brown-orange
  Red ochre (oxide, Fe_2O_3) is the main red pigment used in Egyptian painting until Roman times. Realgar, a natural arsenic sulphide mineral (AS_4S_4), can be found mixed with red ochre (oxide) (cf. TT 69). As with orpiment (see below) realgar is associated with red or yellow ochres and it is difficult to interpret whether the arsenic sulphide is naturally occurring within the ochre, or an intentional addition.[58]

  Red oxide can also be obtained by heating yellow ochre (oxide). In our experiments, we obtained it by heating yellow ochre at 900°C to create a deep red similar to the red paint frequently found in Theban tombs. Further research is required to compare this created red ochre with red ochre from Aswan.

- Yellow
  Yellow ochre is commonly found, it is clay based with variable amounts of hydrated iron oxide (goethite, $FeO.OH$; limonite, $FeO.nH_2O$).[59] Jarosite (hydrous sulphate of potassium and iron)[60] is also found, and can easily be confused with yellow ochre in colour and appearance. Orpiment, a natural arsenic sulphide (AS_2S_3), is attested in polychromy from Middle Kingdom.[61] Up to the present the geological occurrence of orpiment layers is not firmly attested in Egypt. It is highly probable that it was 'imported' from Asia Minor.

58 It is actually difficult to interpret occurrences of other minerals (e.g. clay, calcite, anhydrite) other than the main pigments as intentional or natural. Cf. Rouchon *et al.* 1990, 90.

59 Colinart 2001, 1–4.

60 Colinart 1998.

61 Middleton 1999, 37– 44; Middleton – Humphrey 2001, 10–16.

- Green
  Malachite[62] is attested as pigment during the Old Kingdom and its use seems to have been later abandoned in polychromy, and in wall painting – in particularly during the New Kingdom. Its occurrence in samples could be due to degradation of rich glass and alkali in Egyptian blue.[63] Tests we carried out on Egyptian blue, submitting it to heavy acid and alkaline agents in the course of a year, showed green crystalline particles – which reacts only with alkali. Our experiments showed that malachite powder mixed with Egyptian blue could be used to obtain a green turquoise colour similar to Egyptian green.

- Blue
  One instance of azurite pigments has been attested on a painted leather piece from early 18th Dynasty.[64] It has yet to be found in wall paintings, but there is a possibly that it could be found. The characteristic blue colour of the stone is largely lost in the grinding process, which explains why artificial blue was used.

6.1.1.2 Artificial pigments

- Egyptian blue
  Cuprorivaite ($CaCuSi_4O_{10}$) was obtained by heating a mixture of copper, quartz, sodium (natron or ashes) and limestone in oxidizing conditions at high temperature (870°C–1150°C).[65] Varying specific factors made it possible to control the manufacture of the colours, including rate of flux and duration of cooling.[66] Very precise parameters in fabric procedures indicate it must have been made by specialised workshops. Once cooked, the result is a hard material that has to be ground into a powder. Larger particles give an intense deep blue,[67] while smaller ones produce pale blue.[68] In addition to varying the particle size to alter the tone, white pigments could be added, or the blue could be applied over a black under layer to obtain intense deep blue.[69]

- Egyptian green
  This artificial green was obtained by heating the same raw material as for Egyptian blue, but in different proportions, specifically the copper and the flux proportions. A slow cooling followed heating. It is chemically distinct from Egyptian blue by presence of parawallastonite crystals ($CaSiO_3$).[70] As with Egyptian blue, particle sizes influence the tone of the resulting colour. It is interesting to note that a green

62 Lucas 1962, 344–345.
63 Schiegl *et al.* 1989.
64 It was found in debris of the MMA tomb 815 in Western Thebes necropolis of Asasif. See: Roehrig *et al.* 2005, 46, cat. no. 24.
65 Jaksch *et al.* 1983, 525–535.
66 Pagès-Camagna 2003; Pagès-Camagna *et al.* 2006.
67 Le Fur 1994, 67–70.
68 Pagès-Camagna *et al.* 2010, 677.
69 Such technique seems to be specific to royal tombs in particular for star-based deep blue ceilings.
70 Pagès-Camagna – Colinart 2003, 637– 658; Pagès-Camagna *et al.* 2006, 141–145.

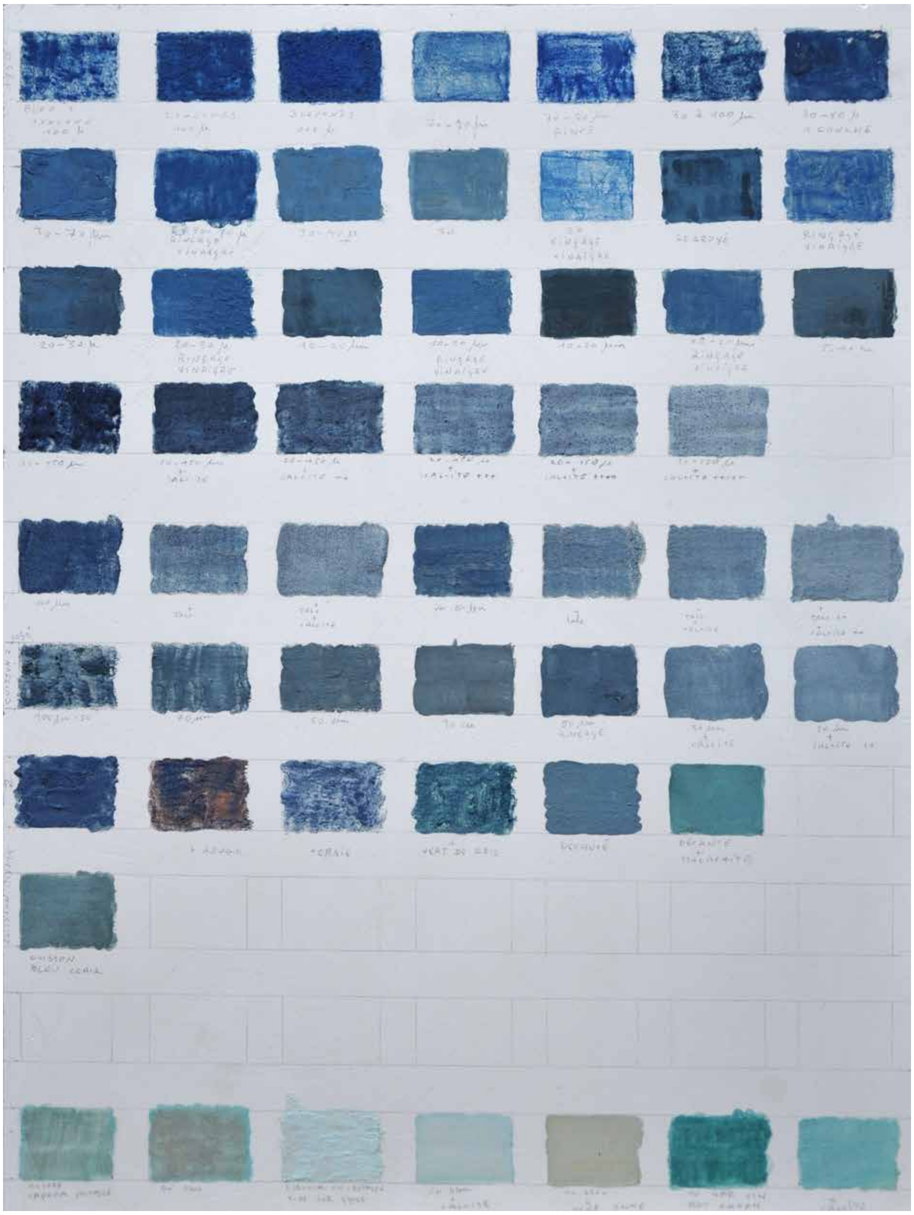

Fig. 4: Experimental recreations of Egyptian Blue.

paint was also often obtained by mixing Egyptian blue with yellow pigment.[71] This suggests it was easiest for painters to control the colour using this method rather than by manufacturing Egyptian green.

71 A mix of this type (Egyptian blue and goethite) is also attested in the Tomb of Amenhotep III. See: Uda *et al.* 2004.

- Black

  There are two types of carbon black – soot black obtained by collecting the soot from burned organic materials, and coal black obtained from the calcination of wood. The blacks can be easily identified by the size and shape of the particles. Soot particles are extremely fine (Microns) and our own experiments found they can be used without any grinding. They can be diluted in solution with a binder and used as an ink, while charcoal particles are pigments. The soot black ink penetrates the plaster or surface layer, while our experiments found coal black paint sits on the surface and has a tendency to detach (see binder).

6.2 Binding Media and Coatings

- Binder

  Most analyses of wall painting reveal the polysaccharides from gum Arabic (Acacia gum) as the main binder.[72] Raman analysis at the Tomb of Menna project agreed with these earlier analyses,[73] and pointed to the presence of plant gum as a binder, although it could not specify the gum. Specific identification of organic materials and binding media at the Menna project was less straightforward than pigment identifications, partly due to the nature of the material to be analysed, but also to difficulties with the Raman analysis and achieving reliable readings outside laboratory conditions (as well as due to the remains of modern coating on the paintings of Paraloid B72™, which covered the majority of the painted surfaces and caused interferences to spectra).[74] Gum Arabic binds pigments efficiently, while the permanence of paintings is ensured by the dry conditions of the tombs. The solution cannot exceed a 50% concentration – concentrations stronger than this result in shrinkage during drying, which cause the pulling up and loss of the layer. This phenomenon is often visible in Theban painting, mainly with blues, greens and blacks. It is common in Egyptian blue and green, where, due to the size and weight of the frit particles, a more concentrated (strong) binder[75] is used. In coal black, a slight excess of binder results in the same phenomenon. It could be avoided by the addition of a little honey or fruit syrup in the binder liquid. This ancient 'painter's trick' needs to be kept in mind in the interpretation of analysed samples of gum where sugars (glucose and fructose) are identified.

  Although an occurrence of oil has been revealed in analyses of paintings in TT 92[76] which has been interpreted as binder, this oil could have been applied as a kind of varnish layer, which later fused with the paint layers – Theban paintings are clearly not oil-based.[77]

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72 Vieillescazes – Le Fur 1991, 97–98; Newman – Serpico 2000, 477–493; Newman – Halpine 2001.
73 Hartwig 2013. See also particular analysis from the Nebamun wall painting fragments at the British Museum, Parkinson, 2008, 44–63.
74 Hartwig, 2013, 93–111.
75 The binder sometimes gives a dark yellow varnished appearance to the surface. Cf. Daniels *et al.* 2004.
76 Yoshimura – Kondo 2004, 205–207, McCarthy 2001, 17.
77 Bryan 2001, 71.

6.3 Paint Brushes

No hair brushes have been attested in Theban paintings through archaeological data. The few brushes discovered are all vegetal, from ligneous wooden stems or from vegetable fibres held together by twists of cord.[78] The paint layers and outlines observed show the characteristics of fibres from rigid brushes – outlines are often separated into two or three lines. It seems that some brushes were not adapted for circular brush strokes, but for straight ones. Painters often made circular motifs with a series of small strokes. Experiments with brushes based on those attested in Pharaonic times[79] confirmed the use of vegetal brushes.[80] It is difficult to precisely identify species by single traces left in paint, but a comparative study of different brushes informed our investigation. Results show the following list of plants, which maybe have been used as brushes due to their fibrous qualities:

Siwak or arak in Arabic (*Salvadora persica*)[81]
Willow (*Salix aegyptiaca*)[82]
Palm tree (*Phoenix dactylifera*)
Flax (*Linum*)
Rush (*Juncus rigidus*)[83]
Halfa grass (*Desmostachya bipinnata*)[84]

7. Painting process

- Grids
  The sizes of the grid squares are usually between 1 to 8cm[85] depending on the size of the figures or motifs. The precision of the grids varies and does not appear to have had a heavy influence on the final result. Grids should probably be considered as a general guide rather than as a guarantee of perfection. Our investigations and experiments in situ suggest that most of the squares correspond in size to multiples of finger(s) and hands (statistically the most common measurements correspond to 1-2-3-4 fingers). The use of the fingers or palm as a measuring tool is fast, efficient and would have been easy to use in the often-uncomfortable painting conditions. We were able to create grids with a precision of 1mm only using fingers and palms. If digits and palms were the 'official' unites of cubits,[86] in

78 De Garis Davies 1913, 5, pl. XVIII. Brussels MRAH E.444. Turin Museo Egizio s.7661–3, s.7655, s.7659, London, British Museum EA36893. London. British Museum EA5555.1–3. In TT 29 a simple wood brush with two fibrous heads was used for blue and yellow. This would indicate that the same man painted both colours, not one man per colour as sometimes describe by the past.
79 Baum 1988.
80 Experiment by Le Fur with palm tree. See: Le Fur 1994, 74–78.
81 Vartavan 1996, 11; Newton 2005, 358–365.
82 Baum 1988, 90, 243.
83 Vartavan 1996, 12.
84 Abd El-Ghani – El-Sawaf 2004, 322–323; Boulos – Fahmy 2007, 509.
85 Mackay 1921, 76.
86 E.g. Carlotti 1995.

Fig. 5: A selection of brushes.

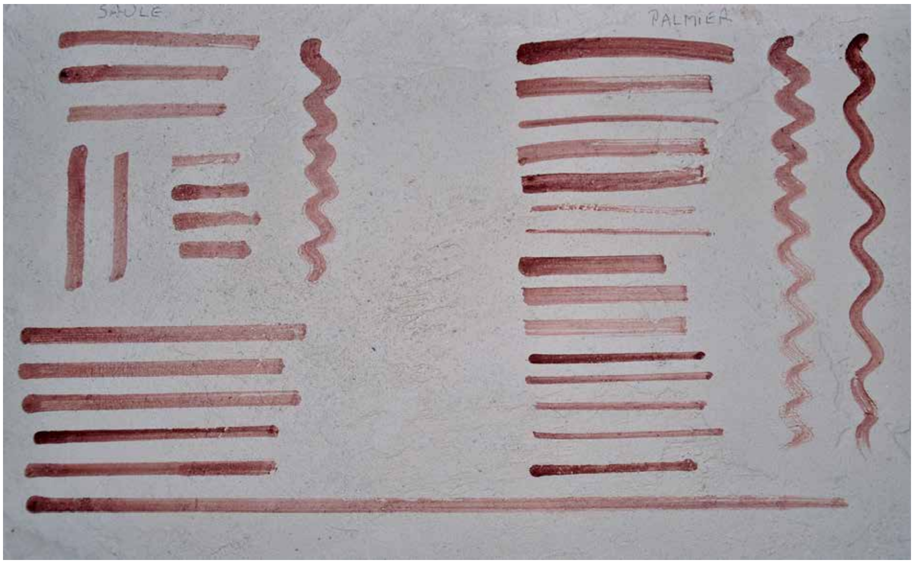

Fig. 6: Experimental lines with willow and palm brushes.

most cases painters appear to have used fingers and hands pragmatically, not rules or graduated rods.

In many cases, mainly for smaller figures, the painters only used guidelines to divide the main parts of the body.[87] Experimentally we were able to obtain reliably proportioned guidelines using fingers.

- Sketching
  Draftsmen, or the painters themselves, drew more or less precise sketches of the scenes in red. One can appreciate the quality of drawings in the unfinished tombs or as revealed by the phenomena of detached paint layers. The characteristics of the sketches vary from very accurate and precise during the reigns of Hatshepsut and Thutmosis III (*e.g.* TT 251) to more sketchy from the reign of Amenhotep II to Amenhotep III (*e.g.* TT 181) – the sketches found reveal that the composition was more or less improvised in situ. It is relevant that throughout the entire 18th Dynasty draughtsmen respected the technical rules for drawing the most common motifs such as human figures and face profiles. The success of the drawing depends on respect for the sequences of the lines, used for example for faces (forehead, nose, lips etc.), legs (knee, thigh etc.) and other elements. The same sequence can be observed in final outlines.

- Colouring
  Typically a white background is found, or less commonly in private tombs during the 18th Dynasty a yellow background (*e.g.* TT 21, TT 80 long hall, TT 93, TT 181 long hall, TT 340). A small brush was used to outline the motifs followed in a second step, with broad brushes to fill in the backgrounds around them. Some painters followed the line scrupulously (*e.g.* TT 42, TT 81, TT 88, TT 93, TT 96, TT 251), while others 'overflowed' (*e.g.* TT 29, TT 80, TT 85, TT 90, TT 92, TT 101, TT 201). Due to the ability to hide or modify mistakes with later opaque layers, a lack of accuracy and precision in the preliminary stages did not have significant consequences on the final result, although the more precision taken in the preliminary stages of painting the better the final result. Painting the backgrounds is a quick process and could easily have been carried out by pupils or less qualified painters. It is likely to have been used as a training stage for apprentices. The application of the backgrounds immediately renders the shapes of the decoration more visible. This process of working, starting by blocking out the negative spaces, is the exact equivalent of the process used in relief carving, removing matter from the outlines of the object to be rendered, and may well derive from this heritage. The white background paint is usually opaque. In some cases, it can be a little transparent – this thinner ground could have been an unfinished intermediate layer that was intended to be over-coated with a thicker white paint (*e.g.* TT 29 long hall, TT 75, TT 92). We obtained a similar effect to the transparent wash using anhydrite, collected in the area of the Theban necropolis. Powdered and diluted in water, without any binder, it produces a whitewash. This penetrates into the wall plaster instead of sitting on

87 E.g. Mackay 1921, pl. XVIII.

Fig. 7: Experiments using 2-2-3 fingers.

Fig. 8: Experiments using 3-3-4 fingers.

the surface as with other kinds of white (calcite, huntite) with a gum binder. All white areas of the motifs were painted at the same time as the white grounds, and more rarely the white areas of hieroglyphs in text columns (TT 29, TT 95). In some instances, the white primer for the reds and yellows (mainly the skin tones) was painted at the same time as the white grounds (TT 75).

The forms were then filled in with other colours, one by one; red or yellow skin tones for the figures, blues, greens etc. It is clear that the painters systematically filled the motifs one colour at a time on a specific zone, the size dependant on the area already sketched. Typically red was applied after the white but there appears to have been no particular order for the following colours, except for the black, which was the last colour to be used – without exception. The use of black as a final colour can be explained by the difficulties of covering or removing it in the event of a mistake or stains. In addition, carbon black paint is more sensitive than other colours to contact with moisture from other painted areas, risking contamination or the bleeding of colours. Its final position in the sequence of the painting process explains why the black zones are so often missing in unfinished decorated chapels.

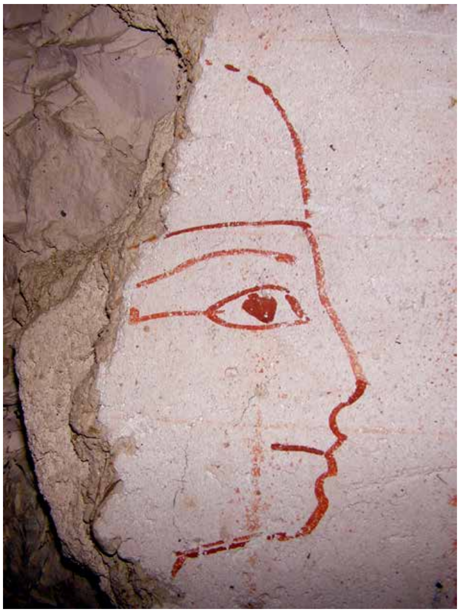

Fig. 9: TT 87, showing the line sequence in a sketch.

The continuity of the painting process during the largest part of the 18th Dynasty reveals a closed artistic tradition developed by few artists and workshops probably fewer in number than supposed.[88] It must be remembered that the total number of painted chapels produced was statistically approximately one per year.[89] The majority were unfinished, biographical data can explain the lack of completion of some: disgrace from the king, or decease before the end of the works, but the lack of artists could also explain this phenomenon.

- Final outlines
  On completion of the colouring of the motifs, red or occasionally black (TT 93), final outlines were applied – as in all painted-polychrome images in Egyptian art they would not be complete without outlines, these are found in papyri, sculpted reliefs, paintings on wood etc. The success of the outlines depends on the respect of sequences in tracing the lines, as well as the use of very efficient brushes. These could be made with rigid wooden stems/sticks, with the tip cut into an X-shape, or with soft fibrous sticks from dates or willow. The question is to know if the outlines were traced by masters, or specialised draughtsmen – the so-called 'outline masters' (*zS-qdw*) or by painters, but this remains a difficult issue to answer. It appears that, from the reign of Amenhotep II generally, lines, sketches, colour and outlines were carried out by the same hand, since in most unfinished chapels, works were abandoned with the stages of decoration halted at different stages of completion (*e.g.* TT 29, TT 38, TT 43, TT 52, TT 75, TT 76, TT 88, TT 92, TT 95, TT 101, TT 108, TT 367).

88 Laboury – Tavier 2010.

89 According John Romer "the mean rate of tomb production during the New Kingdom was around eight decorated tombs per decade". Cf. Romer 1994, 212.

8. Conclusions (provisory)

The archaeometric results from Menna (TT 69) confirm that painting materials during the18th Dynasty were faithful to the polychrome tradition in use from the Old and Middle Kingdoms. Huntite is believed to have been largely introduced in wall painting during the New Kingdom[90] but was known and in casual use on polychromy of objects from Old Kingdom.[91] Orpiment, found in coffin polychromy during the Middle Kingdom, seems to belong to the New Kingdom wall painter's palette. Experimentation can supplement the scarce epigraphic data concerning construction and decoration of 18th Dynasty Theban private tombs. Painting experiments confirm the great technical expertise of painters and their ability and knowledge of the painting tradition. Evidence that work was done very gradually in small sections confirms some epigraphic sources of variable team sizes, from a few to 15–20 workmen, masons and plasterers. Visual analyses – consisting of measuring the information given by the material aspect of the painting process against stylistic characteristics reveal a number of painters working in a tomb, but not more than three or four.[92]

Most of the materials used in the paintings are of Egyptian origin. As regards pigments and binding media, with the probable exception of orpiment which as far as geological bibliographical data is correct is from 'trade' import, it would have been perfectly possible to make a tomb with only Egyptian materials. The quantity of pigments needed for the decoration of tombs is large. We assume that it was not possible to obtain this volume of pigments without the approval of the officials suppliers, particularly as the pigments' quality is consistently high and probably sourced from the best geological areas in Egypt and its borders. Production of Egyptian blue and green required very specialised makers – blue is found in all the decorated tombs. This would indicate that there was no difficulty in supplying the painters. The quality is equal to that of temples and royal monuments. In addition to this, the quantities of pigments used demonstrate that private tombs cannot have been made without the approval of the hierarchy and the suppliers of the King's administration. The network and type of connections between the members of the elite who were allowed them to build funerary monuments, and the painters or workshops are still not known.

The number of painters at work is not easy to estimate. Given that the materials are nearly always the same, archaeometric data does not help to answer this question, while the identification of individual hands is also problematic due to the rigorously obeyed standards and norms of the painting process. Through experiments, we found it was easier to work alone on a determined area of around $1m^2$, completing all the painting operations. Painting one meter square per day is a sustainable ratio. The common tomb making process consisted of the preparation of limited wall areas, meaning it would not have been possible to involve many painters at the same time. In addition, without epigraphic information, it is impossible to know if works were carried out seasonally or continuously. Visual analysis has to be done on a case-by-case basis. This paper aims to act as a frame, presenting wide observations, which can cast light on individual cases.

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90 El Goresy *et al.* 1986, 34.
91 Heywood 2001, 5.
92 Beinlich-Seeber – Shedid 1987, 139–142; Shedid 1988, 88–91; Laboury –Tavier 2010.

The lack of completion of the paintings for most of the tombs is not the painters' fault; in the majority of cases, the painted decoration is unfinished because the works of construction and plastering was unfinished. It is rare to find walls ready to be painted, and yet unfinished (*e.g.* TT 143). The reasons for this must be numerous and varied: the technical impossibility of continuing the hill cutting[93] the unexpected decease of the 'owner'; royal disgrace; or the attribution of a burial in a more prestigious place close to the King (*e.g.* Amenemope (TT 29) who was probably buried in KV41).[94] The Theban painting experiments made us aware that tomb decoration took much more time than expected. It is noticeable that the tombs painted during the reigns of Hatshepsut, Thutmosis III and the beginning of the reign of Amenhotep II are the most complete.[95] From the end of the reign of Amenhotep II, through the reign of Thutmosis IV, until the reign of Amenhotep III, we can see a tendency to speed up tomb construction with smaller tomb sizes, with less care taken in cutting, coarser plaster (a high percentage of unfinished long halls) associated with a faster painting process, a more spontaneous and fluid style, and the choice of more simple ceiling pattern. The tomb of Hepu TT 66 (vizier under Thutmosis IV) demonstrates this; it is small with quickly executed paintings, and unfinished walls and ceiling decoration.

The tomb of Menna, famous for the quality of its painting, conforms to a normal Theban tomb in nearly all points. Painters magnified the colours of a limited palette by their artistic and technical expertise, as well as their acute sense of harmony.

Acknowledgements

We would like to express gratitude to Dr Dimitri Laboury and Dr Laurent Bavay for their invaluable assistance in our investigations, to Dr Melinda K. Hartwig for help, support and the generous use of her material, and to Dr Gabriele Pieke for her extremely valuable insights and guidance.

References

Abd El-Ghani – El-Sawaf 2004

M. Abd El-Ghani – N. El-Sawaf, Diversity of plant species in agro-ecosystems of Egypt, Systematics and Geography of Plants 74,2, 2004, 319–336.

Ambers 2004

J. C. Ambers, Raman analysis of pigments from the Egyptian New Kingdom, Journal of Raman Spectroscopy 35, 2004, 768–773.

Ambers 2008

J. C. Ambers, Pigments, in: Middleton – Uprichard 2008, 31–40.

93 TT 92, TT 93, TT 95.

94 Davis 1908; Reeves 1984, 227–235; Bavay 2007, 14.

95 E.g. TT C3, TT 21, TT 39, TT 61, TT 67, TT 81, TT 82, TT 83, TT 84, TT 96, TT 99, TT 100, TT 228, TT 251.

Arnold 1991
D. Arnold, Building in Egypt. Pharaonic Stone Masonry (New York, Oxford 1991).

Aufrère 1991
S. Aufrère, L'univers minéral dans la pensée égyptienne, Bibliothèque d'étude. Institut Français d'Archéologie Orientale du Caire 105 (Cairo 1991).

Baines 1985
J. Baines, Color terminology and color classification. Ancient Egyptian color terminology and polychromy, American Anthropologist 87, 1985, 282–297.

Baud 1935
M. Baud, Les dessins ébauchés de la nécropole thébaine au temps du Nouvel Empire, Mémoires publiés par les membres de l'Institut Français d'Archéologie Orientale 63 (Cairo 1935).

Baum 1988
N. Baum, Arbres et arbustes de l'Égypte ancienne. La liste de la tombe thébaine d'Ineni (N° 81), Orientalia Lovaniensia Analecta 31 (Leuven 1988).

Bavay 2007
L. Bavay, La tombe thébaine d'Aménémopé, vizir d'Amenhotep II, Égypte, Afrique & Orient 45, 2007, 7–20.

Beinlich-Seeber – Shedid 1987
C. Beinlich-Seeber – A. G. Shedid, Das Grab des Userhat (TT 56). Archäologische Veröffentlichungen 50 (Mainz 1987).

Berman – Bohač 1999
L. M. Berman – K. J. Bohač, Catalogue of Egyptian Art. The Cleveland Museum of Art (New York 1999).

Bryan 2001
B. M. Bryan, Painting techniques and artisan organization in the tomb of Suemniwet, Theban Tomb 92, in: Davies 2001, 63–72.

Boulos – Fahmy 2007
L. Boulos – A. G. Fahmy, Grasses in Ancient Egypt, Kew Bulletin 62, 2007, 501–511.

Calvo *et al.* 1995
J.-P. Calvo – M. G. Stamakis – A. C. Magganas, Clastic huntite in Upper Neogene Formation of the Kozani Basin, Macedonia, Northern Greece, Journal of Sedimentary Research 64,4a, 1995, 627–632.

Carlotti 1995
J.-F. Carlotti, Quelques réflexions sur les unités de mesure utilisées en architecture à l'époque pharaonique, Cahiers de Karnak 10, 1995, 127–140.

Cartwright 2008
C. Cartwright, Plant remains from the mud plaster, in: Middleton – Uprichard 2008, 25–29.

Clarke 1896
S. Clarke, Of the methods used in making and ornamenting an Egyptian rock tomb, Archaeologia. Or Miscellaneous Tracts Relating to Antiquity 55, 1896, 21–32.

Clarke – Engelbach 1930
S. Clarke – R. Engelbach, Ancient Egyptian Masonry. The Building Craft (London 1930).

Colinart 1998
S. Colinart, Jarosite et natrojarosite. Pigment ou altération de la peinture de l'Ancienne Égypte?, in: Colinart – Menu 1998, 95–102.

Colinart 2001
S. Colinart, Analysis of inorganic yellow colour in ancient Egyptian painting, in: Davies 2001, 1–4.

Colinart – Menu 1998
S. Colinart – M. Menu (eds.), La couleur dans la peinture et l'émaillage de l'Égypte ancienne. Actes de la Table ronde, Ravello 20 – 22 mars 1997, Scienze e materiali del patrimonio culturale 4 (Bari 1998).

Corzo – Afshar 1993
M. A. Corzo – M. Afshar (eds.), Art and Eternity. The Nefetari Wall Paintings Conservation Project 1986–1992 (Santa Monica, California 1993).

Daniels *et al.* 2004
V. Daniels – R. Stacey – A. Middleton, The blackening of paint containing Egyptian blue, Studies in Conservation 49,4, 2004, 217–230.

Davies 2001
W. V. Davies (ed.), Colour and painting in ancient Egypt (London 2001).

Davis 1908
Th. M. Davis, The tomb of Siphtah. The Monkey Tomb and the Gold Tomb (London 1908).

Davis 1989
W. Davis, The Canonical Tradition in Ancient Egyptian Art (Cambridge 1989).

Dorman 1991
P. F. Dorman, The Tombs of Senenmut. The Architecture and Decoration of Tombs 71 and 353, Publications of the Metropolitan Museum of Art Egyptian Expedition 24 (New York 1991).

Dupuis *et al.* 2011
C. Dupuis – M.-P. Aubry – C. King, –R. W.O'B. Knox – W. A. Berggren – M. Youssef – W. Fathi Galal – M. Roche, Genesis and geometry of tilted blocks in the Theban Hills, near Luxor (Upper Egypt), Journal of African Earth Sciences 61,3, 2011, 245–267.

El Goresy 2000
A. El Goresy, Polychromatic wall painting decorations in monuments of Pharaonic Egypt. Compositions, chronology and painting techniques, in: S. Sherratt (ed.), Proceedings of the First International Symposium 'The Wall Paintings of Thera', Petros M. Nomikos Conference Centre Thera, Hellas, 30 August – 4 September 1997 (Athens 2000) 49–70.

El Goresy *et al.* 1986
A. El Goresy – H. Jaksch – M. Abdel Razek – K. L. Weiner, Ancient Pigments in Wall Paintings of Egyptian Tombs and Temples. An Archaeometric Project, Heidelberg, Max-Planck-Institut für Kernphysik (1986 unpublished).

Garcia-Guinea *et al.* 2008
J. Garcia-Guinea – S. Sanchez-Moral – V. Correcher – Sánchez-Muñoz – S. Cuezva – A. Cremades – D. Benavente – J. M. Galán, Phosphor plasters of $CaSO_4$. Dy on the courtyard wall of Djehuty's tomb (Luxor, Egypt), Radiation Measurements 43, 2008, 849–853.

De Garis Davies 1913
N. de Garis Davies, Five Theban Tombs. Being those of Mentuherkhepeshef, User, Daga, Nehemawäy and Tati, Archaeological Survey of Egypt 21 (London 1913).

De Garis Davies 1917
N. de Garis Davies, Egyptian drawings on limestone flakes, Journal of Egyptian Archaeology 4,4, 1917, 234–240.

Guksch 1995
H. Guksch, Die Gräber des Nacht-Min und des Men-cheper-Ra-seneb. Theben Nr. 87 und 79. Archäologische Veröffentlichungen 34 (Mainz 1995).

Harris 1961

J. R. Harris, Lexicographical Studies in Ancient Egyptian Minerals, Deutsche Akademie der Wissenschaften zu Berlin Institut für Orientforschung, Veröffentlichung 54 (Berlin 1961).

Hartwig 2013

M. K. Hartwig (ed.), The Tomb Chapel of Menna (TT 69). The Art, Culture and Science of Painting in an Egyptian Tomb, American Research Centre in Egypt Conservation Series 5 (Cairo, New York 2013).

Hayes 1942

W. C. Hayes, Ostraka and Name Stones from the Tomb of Sen-Mut (No. 71) at Thebes, Publications of the Metropolitan Museum of Art Egyptian Expedition 15 (New York 1942).

Heywood 2001

A. Heywood, The use of huntite as white pigment in ancient Egypt, in: Davies 2001, 5–9.

Hünerfuß *et al.* 2006

K. Hünerfuß – A. von Bohlen – D. Kurth, Characterization of pigments and colors used in ancient Egyptian boat models, Spectrochimica Acta Part B: Atomic Spectroscopy 61, Issues 10–11, 2006, 1224–1228.

Iversen 1955

E. Iversen, Some Egyptian paints and pigments. A lexicographical study, Det Kongelige Danske Videnskabernes Selskab. Historisk-fililogiske Meddelelser 34,4, 1955, 34–42.

Jaksch *et al.* 1983

H. Jaksch – W. Seipel – K. L. Weiner – A. El Goresy, Egyptian Blue – Cuprorivaite. A window to ancient Egyptian technology, Die Naturwissenschaften 70, 1983, 525–535.

Kadir 2003

S. Kadir, Huntite deposits in the Neogene lacustrine sediments of the Çameli Basin, Denizli, SW Turkey, Carbonates and Evaporites 2003, 1–9.

Karlshausen – Dupuis 2014

C. Karlshausen – C. Dupuis, Architectes et tailleurs de pierre à l'épreuve du terrain. Réflexions géo-archéologiques sur la colline de Cheikh Abd el-Gourna, Bulletin de l'Institut Français d'Archéologie Orientale 114, 2014, 261–290.

Kent – Dupuis 2003
D. V. Kent – C. Dupuis, Paleomagnetic study of the Paleocene–Eocene Tarawan Chalk and Esna Shale: Dual polarity remagnetizations of Cenozoic sediments in the Nile Valley (Egypt), Micropaleontology 49 Suppl. 1, 2003, 139–146.

Laboury – Tavier 2010
D. Laboury – H. Tavier, À la recherche des peintres de la nécropole thébaine sous la 18e dynastie. Prolégomènes à une analyse des pratiques picturales dans la tombe d'Amenemopé (TT 29), in: E. Warmenbol – V. Angenot (eds.), Thèbes aux 101 portes. Mélanges à la mémoire de Roland Tefnin, Monumenta Aegyptiaca 12 (Turnhout 2010) 91–106.

Lee – Quirke 2000
L. Lee – S. Quirke, Painting materials, in: Nicholson – Shaw 2000, 104–120.

Le Fur 1994
D. Le Fur, La conservation des peintures murales des temples de Karnak (Paris 1994).

Lucas 1962
A. Lucas [ed. J. R. Harris], Ancient Egyptian Materials and Industries, 4th edition (London 1962).

Mackay 1920
E. Mackay, On the use of beeswax and resin as varnishes in Theban tombs, Ancient Egypt 1920, 35–38.

Mackay 1921
E. Mackay, The cutting and preparation of tomb-chapels in the Theban necropolis, Journal of Egyptian Archaeology 7, 1921, 154–168.

McCarthy 2001
B. McCarthy, Technical analyses of reds and yellows in the Tomb of Suemniwet, Theban Tomb 92, in: Davies 2001, 17–21.

Mathieu 2009
B. Mathieu, Les couleurs dans les Textes de Pyramides. Approche des systèmes chromatiques, Égypte Nilotique et Méditerranéenne 2, 2009, 25–52.

Middleton 1999
A. Middleton, Polychromy of some fragments of painted relief from El-Bersheh, in: W. V. Davies (ed.), Studies in Egyptian Antiquities. A Tribute to T. G. H. James, British Museum Occasional Paper 123 (London 1999) 37–44.

Middleton 2008
A. Middleton, Arriccio to intonaco, in: Middleton – Uprichard 2008, 19–24.

Middleton – Humphrey 2001
A. Middleton – S. Humphrey, Pigments on some Middle Kingdom coffins, in: Davies 2001, 10–16.

Middleton – Uprichard 2008
A. Middleton – K. Uprichard (eds.), The Nebamun Wall Paintings. Conservation, Scientific Analysis and Display at the British Museum (London 2008).

Mora *et al.* 1977
P. Mora – L. Mora – P. Philippot, La conservation des peintures murales (Bologne 1977).

Newman – Serpico 2000
R. Newman – M. Serpico, Adhesives and binders, in: Nicholson – Shaw 2000, 475–494.

Newman – Halpine 2001
R. Newman – S. M. Halpine, The binding media of ancient Egyptian painting, in: Davies 2001, 22–32.

Newton 2005
C. Newton, Upper Egypt. Vegetation at the beginning of the third millennium BC inferred from charcoal analysis at Adaïma and Elkab, Journal of Archaeological Science 32,3, 2005, 355–367.

Nicholson – Shaw 2000
P. T. Nicholson – I. Shaw (eds.), Ancient Egyptian Materials and Technology (Cambridge 2000).

Pagès-Camagna 1998
S. Pagès-Camagna, Pigments bleu et vert égyptiens en question. Vocabulaire et analyses, in: Colinart – Menu 1998, 163–176.

Pagès-Camagna – Colinart 2003
S. Pagès-Camagna – S. Colinart, The Egyptian green pigment. Its manufacturing process and links to Egyptian blue, Archaeometry 45,4, 2003, 637–658.

Pagès-Camagna *et al.* 2006
S. Pagès-Camagna – I. Reiche – C. Brouder – D. Cabaret – S. Rossano – B. Kanngiesser – A. Erko, New insights into the colour origin of archaeological Egyptian blue and green by XAFS at the Cu K-edge, X-Ray Spectrometry 35,2, 2006, 141–145.

Pagès-Camagna *et al.* 2010
S. Pagès-Camagna – E. Laval – D. Vigears – A. Duran, Non-destructive and in situ analysis of Egyptian wall paintings by X-ray diffraction and X-ray fluorescence portable systems, Applied Physics A. Materials Science & Processing 100, 2010, 671–681.

Parkinson 2008
R. Parkinson, The Painted Tomb-chapel of Nebamun. Masterpieces of Ancient Egyptian Art in the British Museum (London 2008).

Petrie 1890
W. M. F. Petrie, Kahun, Gurob and Hawara (London 1890).

Petrie 1917
W. M. F. Petrie, Tools and Weapons. Illustrated by the Egyptian Collection in University College, London, and 2000 Outlines from other Sources, Publications of the Egyptian Research Account and the British School of Archaeology in Egypt 30 (London 1917).

Reeves 1984
N. Reeves, Excavations in the Valley of the Kings, 1905/6. A Photographic Record, Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo 40, 1984, 227–235.

Riederer 1974
J. Riederer, Recently identified Egyptian pigments, Archaeometry 16,1, 1974, 102–109.

Roehrig *et al.* 2005
C. H. Roehrig – R. Dreyfus – C. A. Keller (eds.), Hatshepsut. From Queen to Pharaoh (New York 2005).

Romer 1975
J. Romer, The Tomb of Tuthmosis III., Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo 31, 1975, 315–351.

Romer 1994
J. Romer, Who made the private tombs of Thebes?, in: B. M. Bryan – D. Lorton (eds.), Essays in Egyptology in Honor of Hans Goedicke (San Antonio 1994) 211–232.

Rouchon *et al.* 1990
O. Rouchon – J. Fabre – M.-P. Etcheverry – M. Schvoerer, Pigments d'Égypte. Étude physique de matières colorantes bleue, rouge, blanche, verte et jaune provenant de Karnak, Revue d'Archéométrie 14, 1990, 87–97.

Schäfer 1980 [1974]
H. Schäfer [ed. E. Brunner-Traut – J. Baines], Principles of Egyptian art (Oxford 1980 [1974]).

Schenkel 1963
W. Schenkel, Die Farben in ägyptischer Kunst und Sprache, Zeitschrift für ägyptische Sprache und Altertumskunde, 88,2, 1963, 131–147.

Schenkel 2007
W. Schenkel, Color terms in ancient Egyptian and Coptic, in: R. E. MacLaury – G. V. Paramei – D. Dedrick (eds.), Anthropology of Color. Interdisciplinary Multilevel Modeling (Amsterdam, Philadelphia 2007) 211–228.

Schiegl *et al.* 1989
S. Schiegl – K. L. Weiner – A. El Goresy, Discovery of copper chloride cancer in ancient Egyptian polychromic wall paintings and faience: a developing archaeological disaster, Naturwissenschaften 76, 1989, 393–400.

Shedid 1988
A. G. Shedid, Stil der Grabmalereien in der Zeit Amenophis II. untersucht an den Thebanischen Gräbern Nr. 104 und Nr. 80, Archäologische Veröffentlichungen 66 (Mainz am Rhein 1988).

Stacey 2008
R. Stacey, Paint media and varnishes, in: Middleton – Uprichard 2008, 51–60.

Stocks 2003
D. A. Stocks, Experiment in Egyptian Archaeology. Stoneworking Technology in Ancient Egypt (London, New York 2003).

Traunecker 1977
C. Traunecker, Farbe (technisch), in: W. Helck – W. Westendorf (eds.), Lexikon der Ägyptologie Vol. 2 (Wiesbaden 1977) 115–117.

Uda *et al.* 2000
M. Uda – S. Sassa – S. Yoshimura – J. Kondo – M. Nakamura – Y. Ban – H. Adachi, Yellow, red and blue pigments from ancient Egyptian palace painted walls, Nuclear Instruments and Methods in Physics Research B 161-163, 2000, 758–761.

Uda *et al.* 2004
M. Uda – M. Tamada – Y. Nakajima – A. Ishizaki – R. Satoh – K. Okada – S. Yoshimura – J. Kondo – N. Kawai, Analyses of the pigments and plaster. In situ characterization of pigments and plaster in the royal tomb of Amenophis III using X-ray diffractometer, fluorescence spectrometer, and optical microscope, in: Yoshimura – Kondo 2004, 39–82.

Vartavan 1996
C. de Vartavan, Flore de l'Égypte prédynastique (20.000-5000 BP). Étude préliminaire, Archéo-Nil 6, 1996, 9–16.

Vieillescazes – Le Fur 1991
C. Vieillescazes – D. Le Fur, Identification du liant dans la peinture murale égyptienne (Temple de Karnak), Bulletin de la Société d'Égyptologie de Genève 15, 1991, 95–100.

Dumas *et al.* 2009
P. Dumas – Ph. Walter – A- Zivie, Identification moléculaire des peintures de la tombe Bubasteion I.19 (dite "des artistes") par spectroscopie infrarouge. Online <http://hypogees.org/pages/francais/conservation.htm> (last access 21 July 2017).

Yoshimura – Kondo 2004
S. Yoshimura – J. Kondo (eds.), Conservation of the Wall Paintings in the Royal Tomb of Amenophis III. First and Second Phases Report. Joint Project of Supreme Council of Antiquities, Ministry of Culture, Arab Republic of Egypt and Institute of Egyptology, Waseda University (Tokyo 2004).

Malqata – The Painted Palace

Peter Lacovara[1] and Alexandra Winkels[2]

Abstract

It is daunting to understand the nature and meaning of the various architectural components in the limited number of palaces we have from ancient Egypt. Aspects of their decoration can aid us in interpretation. The Eighteenth and Nineteenth Dynasties provide us with the greatest number of palaces to analyse and discern what are overall patterns in decoration and layout and what they might mean. The Palace complex at Malqata, and specifically Amenhotep III's Main Palace or the Palace of the King, as it is also known, gives us the most extensively preserved sections of wall painting in their approximate original position. As in Assyrian palaces, where the relief scenes were fitted to the function of each room, the decoration of Egyptian palaces may mirror the use of the rooms they decorate. This paper will try to suggest some possibilities for the Palace of the King at Malqata based on the Metropolitan and Tytus Expeditions and attempt to extrapolate that to other royal residences.

In addition, selected results of scientific plaster analysis implemented in a portable field lab present complementary information about ancient Egyptian plaster technology and wall painting techniques applied at the King's Palace and nearby Site K.

Keywords: Amenhotep III; palace; mud brick architecture; ancient Egyptian wall painting; wall decoration; plaster technology; mortar analysis; mobile field laboratory; conservation science.

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in: J. Becker, J. Jungfleisch and C. von Rüden (eds.) Tracing Technoscapes. The Production of Bronze Age Wall Paintings in the Eastern Mediterranean (Leiden 2018) 149-172.

1. Wall Decoration and Purpose in Eighteenth Dynasty Royal Residences

> "*I made a palace decked with gold, whose ceilings were of lazuli* […] *The doors were of copper and the bolts were of bronze. It was made for everlastingness, at which eternity fears."* The teaching of Amenemhet (ca. 1991–1962 BCE).[3]

While it is difficult to discern much about the function of royal residences in ancient Egypt from the few surviving palaces we have, aspects of their decoration can aid us in their interpretation. The New Kingdom gives us the best-preserved and largest sample of palace structures, and comparisons between them can give us a better understanding of what were conventionalised as opposed to unique features. In particular, the painted wall decoration can provide us with some idea as to the purpose and function of some of the rooms within these royal residences.

The excavations of the palace complex at Malqata,[4] and specifically Amenhotep III's Main Palace or the Palace of the King, as it is also known, gives us the most extensively preserved sections of wall painting in their approximate original position, though their excavation was laborious and difficult as Winlock noted in his field diary for January 20–23, 1911:

> "*The work on the fragments of painted ceiling is the most difficult and thankless job I have ever seen. These four days have been spent entirely at it. We – White and I – have been attempting to take up the certain bits which have been found face down lying scattered in the thick redim.*[5] […] *It is taken up on a board and carried to a glass table.* […] *I lie on my back under the glass and White moves around the hunks to make the best fits possible, but as the friable edges are continually crumbling and the mud falling between the pieces it is a long and tedious job to get them together once their positions are known. It is almost impossible for a man to make himself understood to one looking down who is, moreover, entirely in the dark as far as fits go because he sees only the backs of the pieces.* […] *God have mercy on our souls!*"[6]

As in Assyrian palaces, where the relief scenes were fitted to the function of each room, the decoration of Egyptian palaces may mirror the use of the rooms they decorate. This paper will try to suggest some possibilities for the Palace of the King at Malqata based on the Metropolitan and Tytus Expeditions and attempt to extrapolate that to other royal residences.

The palace complex at Malqata appears to have gone through several stages of rebuilding, not only with additions, but even a complete re-orientation (Fig. 1).[7] In addition, an earlier royal palace may have been located to the south at a place known

3 Breasted 1906, 232.
4 Cf. Daressy 1903, 165–170; Tytus 1903; Winlock 1912, 185–187; Evelyn-White 1915, 253–256; Hayes 1951, 82–112; Kemp – O'Connor 1974, 101–136.
5 Can be translated as "debris".
6 Manuscript on file in the Department of Egyptian Art, Metropolitan Museum of Art.
7 On the chronology of the settlement, see esp.: Hayes 1951, 35–37.

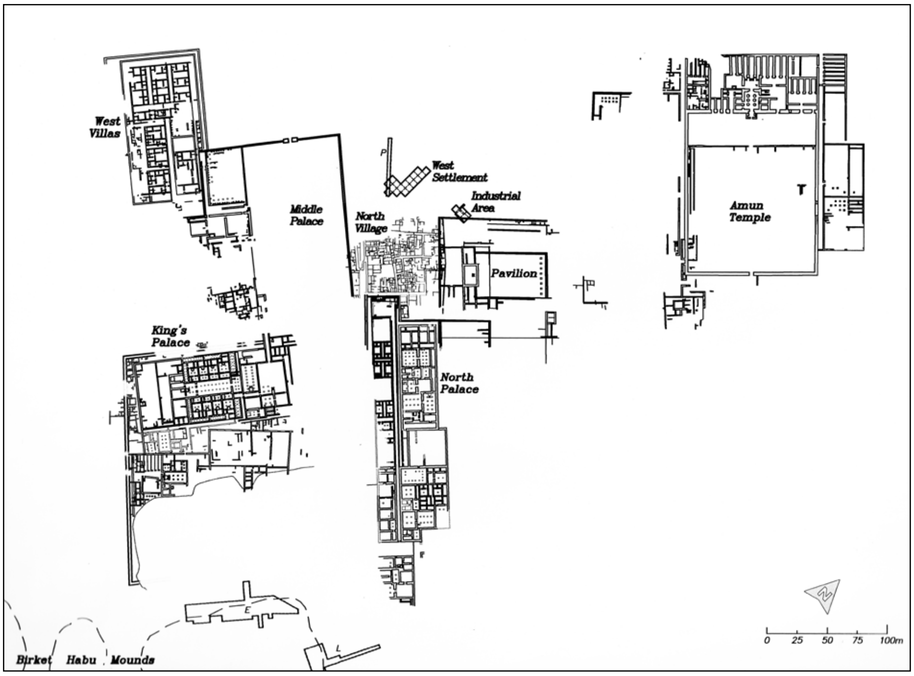

Fig. 1: Map of central quadrant of the Malqata Palace complex (by Joel Paulson; courtesy of the Metropolitan Museum of Art).

Fig. 2: Google Earth image of Malqata showing the location of Site K (by Joel Paulson; courtesy of the Metropolitan Museum of Art).

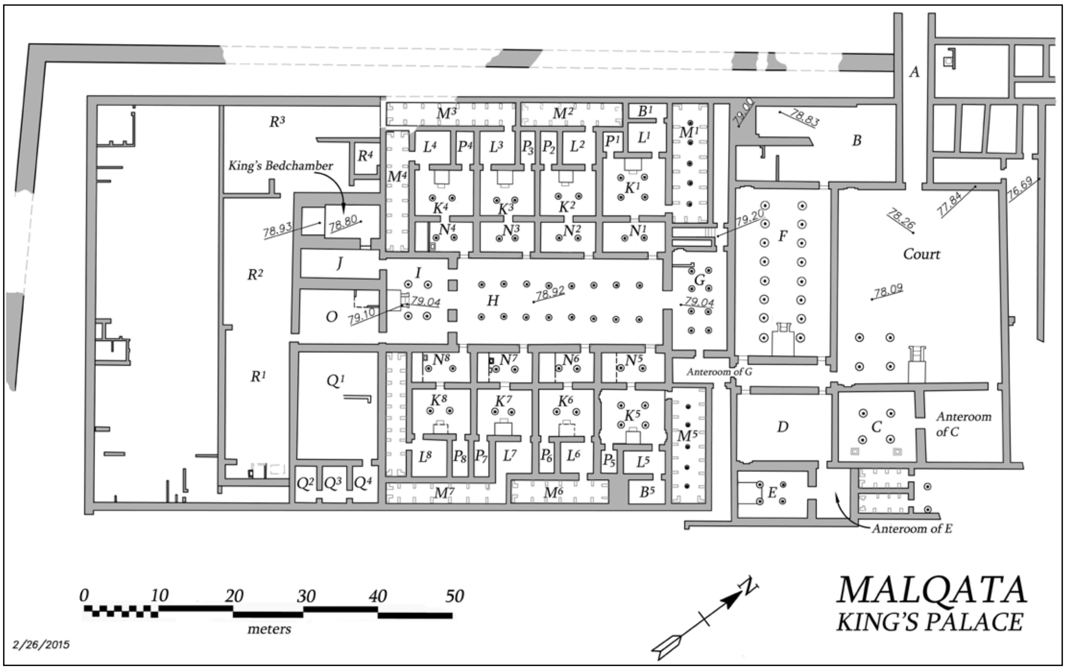

Fig. 3: Plan of the Palace of the King at Malqata (drawn by Andrew Boyce).

as Site K excavated by Kemp and O'Connor (Fig. 2).[8] And a number of painted plaster fragments with Aegeanising scenes were discovered there.[9]

The compound enclosing the Palace of the King covers an area of more than 150 by 100 meters, with the central palace being more or less symmetrical in plan with a long, narrow hall running along the central axis of the structure (Fig. 3). At the southern end of this hall was located a throne room and behind it, what has been identified as the private apartments of the King, which included a bedroom, antechamber and bath. At the northern end of the palace was another series of courts, many with a raised dais opposite the entrance.

The excavators of the Tytus Expedition attempted to assign functions to the rooms they uncovered,[10] beginning with the entrance corridor (A). Opposite this was a large 'hall' with a raised dais and flanked by tree pits. Behind the dais was another suite of rooms (D and E) taken to be an 'audience chamber' and its 'ante-room'. To the south of this was a small chamber with a raised floor (B) not unlike the 'bedrooms' at Tell el-Amarna.[11] This room is associated with the remains of a large court or hall (F), badly destroyed, but preserving a decorated throne base at its far end. A room to the south

8 Kemp – O'Connor 1974, 101–136; Patch *et al.* 2012/2013, 76–84.
9 Kemp 2000, 45–46.
10 While many of these attributions seem whimsical at first, they are perhaps worth note, Tytus 1903, 14–25.
11 Tytus (1903, 15) refers to a parallel at Tell el-Amarna, which was clearly not one of the residential parts of the palace, one might suggest that this could have been a 'porter's lodge' as in the private houses at Amarna. Alternatively, Tytus suggests that it may have been a statue base for a shrine. This also would have parallels in domestic architecture such as the courtyard shrines at Deir el-Medina.

Fig. 4a: 'Wave Pattern' painted at the base of the interior west wall in the 'King's bedchamber' of the Palace of the King at Malqata (photograph by the author).

of this (G) had a painted 'false-door' niche and fronted a stairway giving access to the roof. Beyond this was the long, central hall (H) that the excavators compared with a 'feudal banqueting hall'. To the east of the central hall was a series of reduplicated suites of rooms (N, K, L and P). The rooms numbered N were taken to be 'bathrooms' and a stone tub still remained in situ in one of them. The central room of the suite (K) had a pair of columns flanking a raised dais. Behind this, it was suggested, was a 'bedroom' (L) and a lavishly decorated 'ante-room' (P). A room opposite the stairwell (M) had a series of columns running down the centre and a wood shelf supported on brick piers running along both long walls of the room at a height of 80cm above the floor.

The later excavations of the Metropolitan Museum exposed much more of the palace area and called into question some of the interpretations of the Tytus Expedition. At least nine other rooms similar to M were found placed at the periphery of the structure. Their position and design suggests they may have been storage magazines for palace goods. An additional set of rooms mirroring the suites N, K, L and P were found opposite the central hall, making a total of eight groups. William Stevenson Smith suggested that these were chambers set aside for the royal harem.[12] They do resemble, on a smaller scale, the 'Kings's bedchamber' and its associated rooms in the southwest corner of the palace. The first court (C) was double the width suggested in the Tytus plan. A corridor, running at a lower level and parallel to the western wall of the palace, gives access to the kitchens and magazines to the south.

12 Smith 1998, 285.

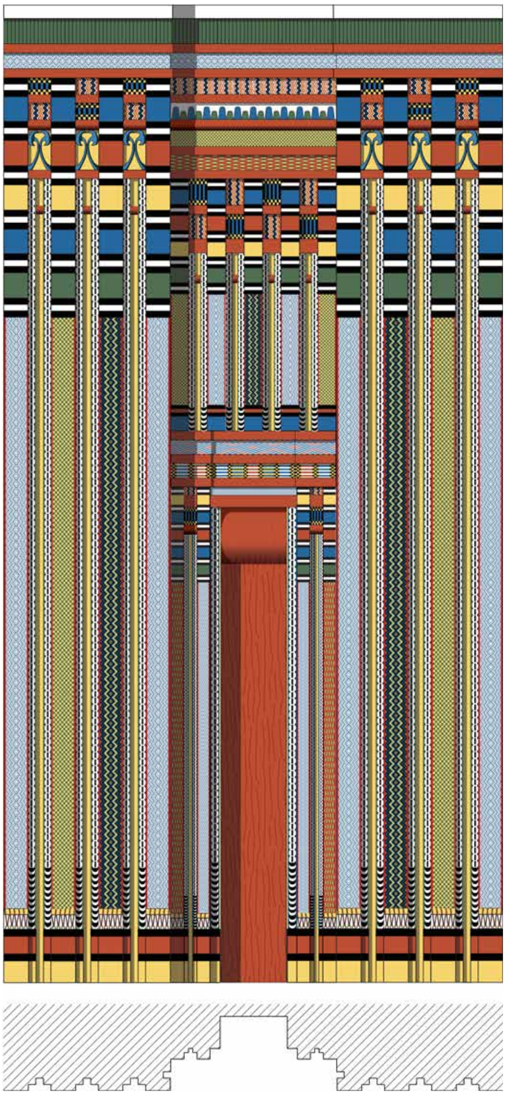

Fig. 4b: False door pattern (drawn by Franck Monnier; courtesy of Franck Monnier).

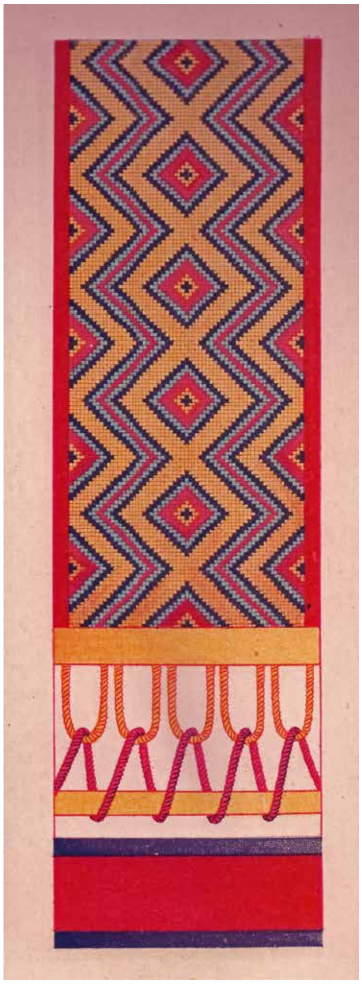

Fig. 4c: Origin of 'Wave Pattern' in a representation of rope tier for coloured mat panels at the base of a painted false door pattern from the Tomb of Hesy (Quibell 1913, pl. IX).

While little artifactual material was recovered or recorded that can shed light on the function of these rooms, many fragments of the decorative elements of the structure were noted.[13] The palace had been embellished with an elaborate series of wall murals, painted pavements, ceilings and inlays. No trace of the decoration of the entrance corridor is mentioned. The first room with decoration recorded was the hall C that had a ceiling of vultures with outstretched wings. A small fragment of painted pavement was also found in this area, but the details of it were not reported.

13 Nishimoto 1990a, 58–79; Nishimoto 1990b, 111–121; Nishimoto 1991a, 9–13; Nishimoto 1991b, 101–112.

Room D appears to have had a wall painting of 'dancing girls' above a dado consisting of panels of 'false door' blocks set between alternating *sa* and *ankh* signs with an undulating line at its base. This motif is repeated throughout the palace. The pattern is a simplification of a very ancient type of decoration known in Egypt as 'palace façade'. This design in a much more elaborate form, is found decorating the mud brick tombs of the First and Second Dynasties.[14] It is an imitation of coloured woven matting that would have been used to embellish early structures of reed and wood. The undulating line represents the rope that would have secured the matting to 'curtain rods' running above and below the matting (Fig. 4).

In the small 'audience hall' beyond this room, fragments of the decoration were recovered by Daressy's earlier expedition, including pieces of a pavement consisting of a pool with swimming ducks and fish surrounded by a border of papyrus with flying birds.[15] The throne base had steps decorated with bound prisoners and representations of the 'nine bows' and was faced with sandstone blocks painted yellow with inscriptions in red and blue. The ceiling in this room was decorated with running spirals in yellow alternating with blue and red rosettes.[16] No trace of any wall decoration was found in this room.

The floor in the next large court (F) was poorly preserved, but much of the rest of the decoration of the court was discovered.[17] The throne base was again decorated with the captive and bow motif and above it was a 'canopy' or 'half-roof' with the flying vulture pattern. The rear wall behind the dais was decorated with what appeared to be a scene of hunting in the desert, and fragments of a large female figure were found in the court.

The great central hall (H) had another painted pavement with a pond and marsh scene. There were eighteen limestone column bases supporting two rows of wooden columns with lotus-bud capitals. A dado of painted panels ran around the walls of the central hall and a figure of the king seated on his throne was painted on the southern wall.[18] No decoration was reported from the throne room beyond this.

The 'antechamber' and the 'King's bedchamber,' however, were lavishly decorated. The ceiling of the 'antechamber' was decorated with an elaborate panel of running spirals, buchrania and rosettes (Fig. 5). The walls were covered with the panel decoration with undulating line base, that we have already seen in some of the other rooms of the palace. The 'King's bedchamber' had a ceiling decorated with flying vultures and the panel dado as in the antechamber. In this room it was surmounted by paired figures of the god *Bes*.[19]

The 'Harem suites' were also lavishly decorated with ceilings painted with flying pigeons, ducks or song birds.[20] Even the magazines had elaborate mural decorations depicting tables heaped with food, papyrus plants and leaping calves. These magazines

14 E.g. Tomb 3070 at Saqqâra. Cf. Emery 1968.
15 Egyptian Museum, Cairo, Special Register number 3+5+27+4.
16 Tytus 1903, 17.
17 Tytus 1903, 17–18.
18 Tytus 1903, 20–21.
19 Smith 1998, 166–167.
20 Tytus 1903, 22.

Fig. 5: Portion of ceiling painting from the Palace of the King at Malqata with repeating pattern of rosette-filled running spirals alternating with bucrania from the antechamber to the 'King's bedroom'; h. 140cm (55 1/8in), w. 140cm (55 1/8in) (Metropolitan Museum of Art Rogers Fund, (1911) MMA 11.215.451; photograph courtesy of the Metropolitan Museum of Art).

had shelves with cavetto cornices modelled in mud plaster.[21] Fragments of other sculptural elements in mud plaster, wood and faience used as architectural decoration were found throughout the palace (Fig. 6).

Although many earlier expeditions had worked here – Tytus in 1901–1902, the Metropolitan Museum in 1910–1911, and Waseda University in 1985–1988 – still an enormous number of fragments of painted mud plaster remain at the site and one of the goals of the current Joint Expedition to Malqata[22] is to document and preserve not only the remaining in situ paintings but also the fragments scattered in the fill throughout the palace. Although many have been disturbed by the earlier archaeological work, much can still be gleaned about their original context and their place in the overall decorative scheme.

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21 Tytus 1903, 22.
22 Lacovara 2014, 28–33.

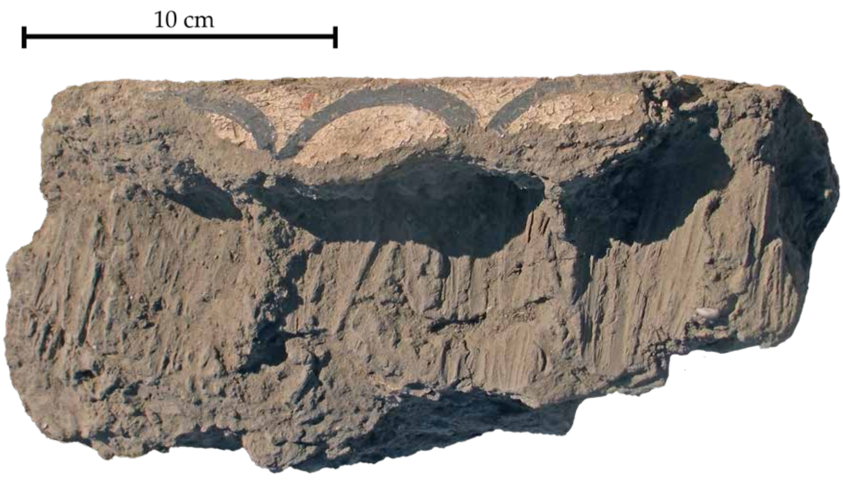

Fig. 6a: Fragment of a cavetto cornice modelled in mud and painted from the Palace of the King at Malqata (photograph by the author).

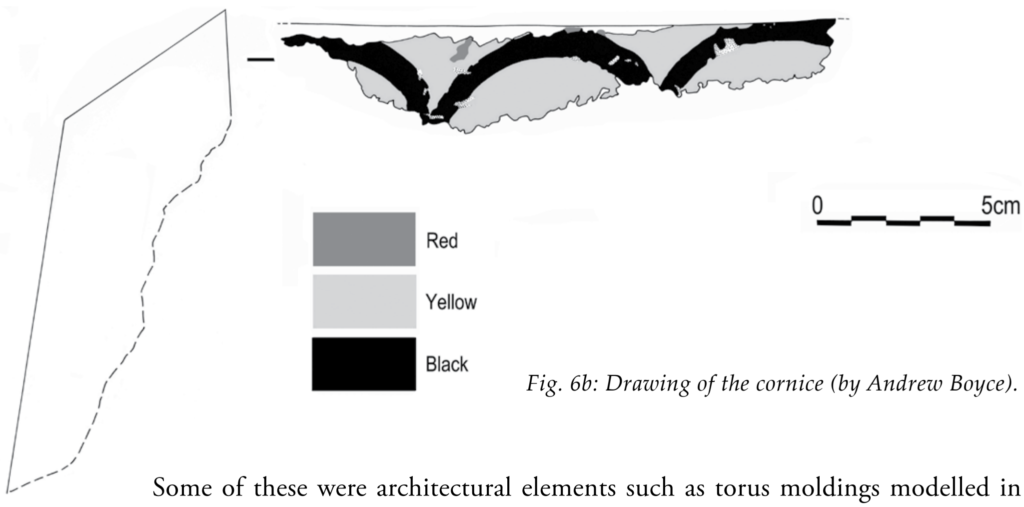

Fig. 6b: Drawing of the cornice (by Andrew Boyce).

Some of these were architectural elements such as torus moldings modelled in mud and then painted or even a cavetto cornice set into the wall on wooden sticks driven in at an oblique angle and then the cornice modelled in mud and painted (Fig. 6). Other, purely decorative painting included elements of ceiling patterns, floral swags and even figural decoration. While much of the ceiling and floor paintings survived intact, preserved when the roof of the palace 'pancaked in', far less of the wall decoration remained so it is still unclear what the extent and composition of these decorations were like. Both the surviving architectural embellishments and the mural decoration in the Palace of Amenhotep III are, by far, the most completely preserved of any Egyptian royal palace and suggest aspects of both the symbolic and actual function of the royal residence.

Peter Lacovara

2. Analysis of Painted Floor- and Wall Plasters from Malqata and Site K in Western Thebes

To obtain detailed knowledge about the original materials used for the construction and decoration of architectural surfaces in the King's Palace, conservation- and natural scientific mortar analysis was implemented on selected plaster fragments[23] during the 2015 and 2016 field season of the Joint Expedition to Malqata.[24] This paper presents preliminary results from the recent analysis of the palace's mortars and plasters and the applied plaster technology and wall painting technique.

Based on prior visual-phenomenological investigations of the site's archaeological mud brick architecture and its fragmentary preserved plasters and wall paintings, various mortar- and plaster materials could be differentiated. Representative small mortar and plaster fragments with different technological functions were then sampled from floors, walls, daises and collapsed ceilings of different rooms within the Malqata palace. For comparison further small samples could be collected from the stratigraphy of the remaining excavation sections of Kemp and O'Connor at nearby Site K,[25] especially in trench Ka and Kb.[26]

Besides the determination of the chemical-mineralogical composition and a categorisation of the different mortar and plaster types according to their main binders another focus lay on the documentation of technological features that reveal the applied plaster and wall painting technology at the royal residence and the probable earlier palace at Site K.

Considering the restrictions of sample export and transport from and within Egypt all material analysis had to be conducted on site. Therefore a 'mobile field laboratory' assembled for the plaster research was set up in the old mud brick guardhouse next to the King's Palace. With portable photographic and analytical equipment it was possible to perform essential natural and conservation scientific investigations under challenging circumstances. The implemented methods included stereo and digital microscopy on Cyclododecane[27] cross sections, histochemical-staining techniques, wet chemical analysis, digital multispectral imaging and image analysis (including 'visible-induced

23 The analysis is carried out as part of an ongoing research and PhD project of A. Winkels on: "Mortars and plasters in ancient Egyptian wall painting and architecture. A comparative study of the materials and technology using conservation and natural scientific methods" based at the Conservation Department of the Academy of Fine Arts Dresden, Germany. The project investigates the spectrum of ancient Egyptian mortars and plasters with different technological functions that were processed for architectural construction and surfaces on mud brick, stone and rock-cut architecture from the Predynastic, Pharaonic towards the Greco-Roman period, at significant archaeological sites in Egypt.

24 Directed by Dr. Diana Craig Patch (Metropolitan Museum of Art, New York) and co-author Dr. Peter Lacovara (Ancient Egyptian Heritage and Archaeology Fund).

25 The work at Site K was possible through a generous grant of the Institute for Aegean Prehistory, Philadelphia, USA.

26 Kemp – O'Connor 1974, 101–136, 122, fig. 19. The painted plaster fragments, found at the earlier excavation have been described by Kemp 2000 and Nicolakaki-Kentrou 2003.

27 Cyclododecane is a volatile binder used for temporary conservation purposes. Melted or dissolved in non-polar solvents it can be applied on or soaked in different materials or objects and thus be used for temporary structural consolidation, as well as for the recovery of archaeological finds. When exposed to the air it changes slowly from a solid into a gaseous state and sublimates again from the structure of the treated objects without residue, see Stein – Kimmel no date; Hangleiter *et al.* no date.

 

Figs. 7 and 8: Fragments of ceiling- and wall plaster, uncovered in room K[1] of the King's Palace.

Fig. 9: Ceiling fragment with three layers of dark brown Nile clay plaster (red lines mark the borders). The composition of the plasters varies slightly in the content of mineral aggregates and organic fillers made from finely chopped and coarser plant fibres. The upper plaster carries a polychrome ceiling painting. Scale 1mm.

luminescence imaging' to detect faded Egyptian blue in the wall paintings) or the determination of the calcium carbonate content in the mortars.[28]

The analytic results revealed that four main mortar and plaster types were used for the construction and design of the architectural surfaces within the King's Palace. These were processed for individual technological functions within the architecture. The comparison of the representative Site K samples from the various plaster types give important evidence that nearly the same plaster materials were used for the construction of architectural surfaces as at the nearby ancient royal city Malqata.[29]

28 Concerning the methods, see e.g. Winkels 2007, 275–280; Winkels – Riedl 2015, 264–269.

29 Unfortunately, without further excavation the Site K plaster fragments cannot be related to a defined room, complex, or stratigraphic layer being from a demolished building and due to their burying situation.

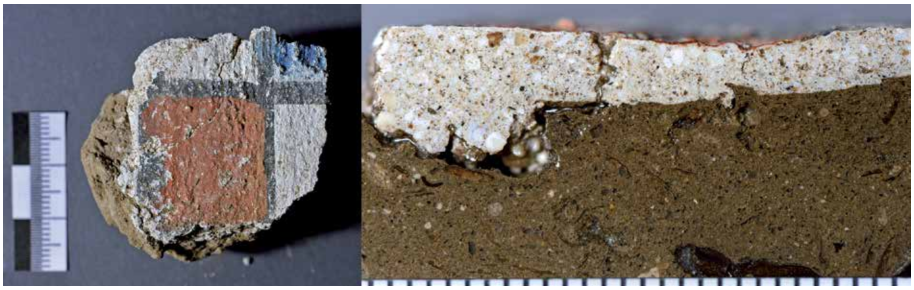

Fig. 10: Fragment of chequerboard frieze with two different plaster types; the cross section shows the first clay plaster layer and a thinner second gypsum-lime plaster that functions as wall painting support carrying the white ground colour with black outlined red and Egyptian blue cubes. Scale 1mm.

Most frequently dark grayish-brown clay plasters were used to construct and cover the floor, wall, dais and ceiling surfaces of the royal palace's mud brick architecture (Figs. 7, 8). The dark brown clay that functions as mortar binder is Nile clay from the alluvial flood plain. Main mineral aggregates of these Nile clay plasters are fine silt and quartz sand with few fossil and shell inclusions which are mostly a primary content of the natural clay. Yet certain amounts of sand appear to have been secondarily added to the raw mortar as additional mineral aggregate. Very characteristic for the Nile clay plasters is a higher content of plant fibres as organic fillers, primarily straw and leaf fragments or fibres, *e.g.* from shredded wheat or palm trees, functioning as material immanent reinforcement.

Often multi-layered plaster stratigraphies can be observed, as especially ceilings but also selected wall levels have been built with up to three plaster layers in one building phase (Fig. 9). The plant fibre content is mostly higher and coarser in the lower plaster layers. These contain also bigger plant fragments as rounded stem pieces, partly from the matting used as reinforcement of the ceilings into which the lowest plaster layer was pressed.

On painted surfaces the top plaster layer respectively carries the paint layer of the wall and ceiling paintings.

On single painting fragments of room K^1, uncovered in 2016, a yellowish white to reddish white mortar was applied on top of the clay plaster and carries the wall painting (Fig. 10). It occurred under parts of a blue, green and red chequerboard pattern frieze on white background, possibly from the room's ceiling.[30] The mortar material obviously functioned as a plaster repair and was apparently limited to certain areas of the ceiling. No widespread plaster application could be noted on other fragments of the frieze. But the same mortar was also used as stucco to form a small round bar that possibly ran around the upper wall or maybe a doorframe of the room.

A very similar yellowish-grayish white material functioned as setting mortar and partial plaster for the stones of a bathroom basin in room N^4.

30 Lacovara 1994, 18. A similar pattern was here reconstructed on a drawing of a "cross section of the ceiling in the 'king's bedchamber' at Malqata".

The analysis verified that these materials could be defined as gypsum-lime mortars and plasters. Though they contain higher calcium carbonate contents between 16% up to 74%,[31] gypsum (calcium sulphate) takes the main binder function within the mortars. It can occur in different variants called calcium sulphate dihydrate (gypsum), calcium sulphate hemihydrate (bassanite) or the anhydrous calcium sulphate form (anhydrite) that result in different solubilities and setting times.[32]

The binder of this mortar type appears to have been produced from a dry powder of decomposed limestone containing varying amounts of gypsum and the other calcium sulphate modifications bassanite and anhydrite as secondary efflorescent deposits.[33] Other impurities are reddish-brownish clay minerals and iron oxides. The raw material occurs below the surface of the Egyptian limestone plateaus and is also called 'gypsite'.[34]

The interacting binder types in the gypsum-lime mortars are therefore different gypsum modifications[35] and calcium carbonate – recrystallised from the fine stone powder.[36] So the calcium carbonate here did not develop in a chemical process like in a classical lime plaster (see below).

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31 Measurement result in mass percent.

32 The gypsum modifications with different contents of chemically combined water occur naturally or can be produced by firing quarried gypsum stone or gypsite material. During the firing process the gypsum raw material passes through a series of phase changes according to the existing firing temperature:

- Firing below 40°C: Calcium sulphate dihydrate ($CaSO_4 \cdot 2\ H_2O$ – gypsum, low fired gypsum)
- Firing above 40°C–110°C–200°C: Calcium sulphate hemihydrate ($CaSO_4 \cdot 0.5\ H_2O$ – bassanite; often called 'plaster of paris' or 'stucco gypsum').
- Firing above 200–1.180/1.200°C: Anhydrous calcium sulphate (different phases – anhydrite III-I). Between 200–300°C anhydrite III ($CaSO_4$III) is converted in anhydrite II ($CaSO_4$II).

With increasing firing temperature the water solubility of anhydrite II decreases, until it becomes hardly soluble. Above 700°C the so-called 'Estrich' gypsum is produced (still anhydrite II). Anhydrite I is built above 1.180°C. For listed reactions and chemical formulas see e.g. Bundesverband der Gipsindustrie e.V. 2013, 16–19; Lenz – Sobott 2008, 25–26.

The anhydrite-phases are also termed 'high fired gypsum'. They differ from gypsum/bassanite burned below 200°C by material properties, such as a much slower setting behaviour and an enhanced hardness.

33 Further detailed investigations on this mortar type and the related raw materials including firing processes are ongoing in the mentioned ancient Egyptiant plaster research project of the author. Especially in connection with the Great Aten Temple excavation by Barry Kemp (Amarna Project) where it was used in large scale and ongoing analysis of the painted floor plasters of the Amarna palaces, see e.g. Winkels 2014, 22–23. Detailed results will be published in the near future.

34 Concerning the raw material, see: Lucas 1924, 129–130; Harrell 2014, 25–26, 28.

35 In the setting process of gypsum mortars, the different gypsum varieties reform in contact with water. During this rehydration, the hemihydrate bassanite and the anhydrous anhydrite recrystallise to gypsum (calcium sulphate dihydrate) again and an intergrowth of new gypsum crystals is formed. The curing and hardening of gypsum-based plasters therefore occurs proportionally to the conversion of the bassanite or anhydrite into the calcium sulphate dihydrate. While the bassanite hardens very fast, the rehydration and hardening of anhydrite is slower and takes longer, extending several days, see Lenz – Sobott 2008, 25–28. Therefore, once this process is finished anhydrite-rich mortars build more stable mortars than those with higher gypsum or bassanite contents. This allows a longer processing time of the fresh mortar and affects a higher stability of the hardened material.

36 The raw material for the mortar binder production was apparently only heated enough, at estimated firing temperatures between 300 and 600°C, to burn and reduce the included gypsum minerals during the firing process, while the limestone powder remained unfired. The unburnt calcium carbonate has partly recrystallised, possibly in contact with carbonate water added during the mortar mixture or secondary moisture penetration by the capillary rise of ground water. The recrystallised calcium carbonate binds the aggregates together in mixture with the included rehydrated gypsum phases and partly only by mechanical adhesion. Accordingly the mortar appears softer as a carbonated lime mortar.

Fig. 11: Thin gypsum-lime plaster with underlying first clay plaster layer on the dais in room K[1]. The thin plaster wash shows brush stroke impressions from the application. Scale 1cm.

Fig. 12: Unpainted white lime plaster floor fragment from palace room E with characteristic fine plant fibres as organic fillers. Scale 2mm.

Main mineral aggregates are limestone and gypsum powder and particles, crystalline calcite and fewer amounts of quartz grains or fragments of other stone varieties. These could derive partly from a natural grain size distribution of the fine gypsite soil. But especially the medium and coarser grained aggregates to some extent must have been especially collected, processed and additionally added. No plant fibres as organic fillers are included.

The reasons why this mortar material was chosen for the purposes of setting stones and repairing wall plaster sections might be its higher structural stability, increased hardness and lower shrinking potential. Compared to clay plasters, gypsum-lime mortars or plasters are less sensitive in contact with water.[37] Based on its lower hygroscopicity and dense texture of non-swellable materials it does not swell and disintegrate immediately in contact with water as swellable clay minerals. It further matches the material colour of the used lime stones.

The application of comparable mortar and plaster material not only for floor, wall, and ceiling plasters but also for repairs in clay plaster or rock cut stone surfaces could be observed *e.g.* in many tombs of the nearby Theban necropolis.[38]

The good properties of the described gypsum-lime mortars were also used for another purpose: While in many rooms of the King's Palace the dark brown Nile clay plasters function as first ground layer on floors or daises, millimeter-thin brownish white plasters applied on top build the visible architectural surfaces (Fig. 11). Like on the dais of room K[1] sometimes up to four of such floor phases could be noted on top of each other, all having a first Nile clay plaster layer and a second thin gypsum-lime plaster wash as the upper, visible layer.

The plaster material could be categorised as 'gypsum-lime plaster' with higher calcium carbonate contents as it was also made of a finer gypsum-lime mortar. The binder and main aggregates of these plasters merely consist of fine to middle grained

37 That being an important aspect especially for features like the bathroom basin or floorbound aplications.
38 See e.g. García-Moreno *et al.* 2013, 101–102; Middelton 2008, 23–24; Miller 2008, 61–62.

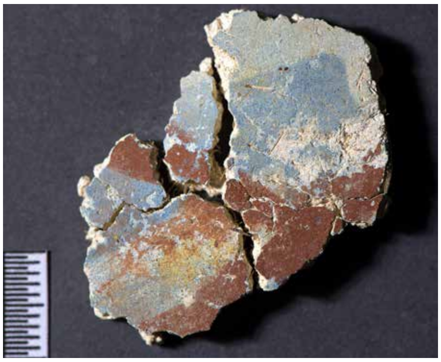

Fig. 13: Painted lime plaster floor fragment from room E. The evenly smoothed upper plaster layer carries polychrome painting and is only 2mm thin.

Fig. 14: Especially well-preserved painted floor or dais plaster fragment from Site K with a first clay plaster layer and a second thin lime plaster surface.

Fig. 15: Cross section of painted dais plaster from palace room F with fine brownish organic plant fibres and shrinking cracks within the mortar matrix. The evenly smoothed plaster surface carries a yellow paint layer with red colour fragments.

Fig. 16: Cross section of lime plaster with fine organic fibres and rounded "lime pats" from Site Ka. On the potential floor plaster green, yellow and black paint is preserved. The green colour was smoothed into the plaster surface after application.

limestone powder and different gypsum modifications with traces of clays and iron oxides. Unlike the alluvial clay plasters or the fine lime floor plasters described in the following (Fig. 12), no organic fillers are included. Further analysis will show if also kaolin or pale brown calcium carbonate rich marl clays, available in the near-by Theban Mountains and also called 'hiba' in Egyptian Arabic, have partly been processed for these thin floor plasters.[39] Fine impressions in the surfaces show that the millimeter-thin plasters have been applied with brushes like 'white washes' or rather fine 'plaster washes' onto the underlying clay plaster on floors and floor-bound daises (Fig. 11). Should the created bright coloured surfaces suggest or imitate the

39 In such 'hiba' or marl clay plasters the clay minerals or possible calcite-clay reactions would take the main binder function.

construction from more stable materials like stone daises or lime plaster floors that required more elaborate production processes?

However the lime plaster technique was indeed applied within the royal palace architecture to produce slightly more pressure-resistant white floor plasters: On floors and daises of selected rooms with apparently significant meaning the underlying Nile clay plaster layer[40] was covered with a millimetre thin bright white lime plaster[41] which received polychrome paintings (Figs. 13, 14).

The analysis showed that these lime plasters of *e.g.* the painted floor in the 'audience hall' of room E or the throne base in room F contain very high calcium carbonate contents up to 85% (Fig. 15). Small binder particles in the form of rounded 'lime pats' within the mortar matrix suggest that the lime binder was likely produced in a 'dry slaking' process.[42] The described 'lime pats' and the potential use of this lime binder production practice could also be observed in and for lime plasters from the earlier palace district of the 18th dynasty at ᶜEzbet Helmi, Tell el-Dabᶜa.[43]

Fine-grained limestone powder is the main mineral aggregate of the lime plasters but thicker plaster applications like the dais plaster can also contain rounded-sub-rounded unburnt to partly burnt limestone particles (Fig. 15). Very fine plant fibres function as organic fillers and reinforcement. Very different from the organic fillers used in the alluvial clay plasters, the often only 0.1–0.4mm thin fibres clearly have been especially prepared for this purpose. Microscopically they could be related to chopped palm leaf midrib fibres and sheath fibres from the netting around local date palm tree trunks and their leaf bases.

The same fibres could be detected in several of the collected Site K fragments that also proved to be painted lime plaster (Figs. 14, 16). These show nearly the same mineralogical composition as the painted dais and floor plasters from the palace rooms at Malqata and consist of a calcium carbonate based binder matrix that contains rounded binder particles and fine-grained limestone powder, sub rounded limestone particles and very fine plant fibres as main mineral aggregate and organic fillers.

All evidence indicates that the small lime plaster samples also appear to be floor or dais plaster fragments on a partly preserved underlying dark brown Nile clay plaster.

At both sites the lime plasters received a very elaborate treatment. Very fine ridges and smoothing structures give evidence of a strong compaction and even flattening

40 These showed a similar composition as the wall or ceiling plasters from the palace (see e.g. Fig. 9), varying in the amount of contained mineral aggregates and usually a high content of plant fibres primarily chopped straw as organic fillers.

41 This plaster type requires a more complex binder production process: The firing of limestone at temperatures above 890–900°C and a subsequent slaking of the burnt limestone (CaO, calcium oxide/quick lime) in water. The hydrated, slaked lime ($Ca(OH)_2$, calcium hydroxide) can then be used as a binder for lime washes or lime mortars, when mixed with mineral aggregates and organic fillers. During the carbonation process, the slaked lime reacts with carbon dioxide (CO_2) from the air while slowly releasing water and hardening as it carbonates back to calcium carbonate binding the added aggregates in the lime mortar matrix. For the lime cycle, see e.g. Weyer *et al.* 2016, 383–384; Hughes – Válek 2003, 1–2.

42 In this burnt lime processing type the calcium oxide, is slaked without water surplus and only so much water that is stoichiometrically necessary for the hydration and formaion into calcium hydroxide, see Elert *et al.* 2002, 63–64. A predominantly dry, paste-like calcium hydroxide is produced that includes rounded pats of calcium hydroxide and non-hydrated remaining calcium oxide.

43 Winkels 2007, 287–288.

Fig. 17: White lime plaster surface (see Fig. 14) with fine smoothing structures. The yellow paint was applied while the plaster was still slightly damp and plastic leaving brush scratches. Pastose black and red applications apparently followed with an additional organic binder.

Fig. 18: Floor fragment from room E of the King's Palace. Fine textile impressions visible in the plaster surface and it's paint layer indicate the covering of the painted lime plaster floor during the plastering and painting process to ensure proper carbonation.

of the plaster (Fig. 17). During this process, a water-binder surplus is pressed to the surface of the fresh lime plaster. The fine smoothing structures then develop when flat trowel-like plaster tools are moved over the surface and through the surficially collected binder.

The colours were painted directly onto the evenly smoothed white plaster surface without noticeable underdrawing, including the bright white lime plaster tone as white background colour in the painting.

Very interesting is the occurrence of fine textile impressions in the surfaces of several lime floor plaster fragments from Malqata[44] (Fig. 18). Obviously, after the smoothing process the floors and possibly also the daises have been covered with fine woven textile that was supposedly moistened to ensure a complete carbonation process and prevent the premature drying of the lime plaster.[45]

The fact that some colour applications within such areas show impressions and tiny losses where the textile must have touched the surface suggests that floor parts were also covered with the textile after or in between the painting process. This suggests that the 'fresco' technique was intended for the floor bound paintings on lime plaster and the proper carbonation of the colours within the plaster surface should be aided. Other features confirm that certain areas and special colour applications were painted in the 'fresco' technique while the plaster was still damp and plastic. – These are *e.g.* brush strokes and streaks of thin brushes lightly impressed into the plaster surface during painting (Fig. 17).

44 Such impressions were also found by the author at the Great Aten Temple foundations at Amarna and on floor paintings of the Amarna palaces, see Weatherhead 2007, 367–368, pl. 67.

45 In this case the carbonation process cannot be completed and the lime based binder dries within the mortar to a fine white powder that has no or only a mechanical cohesive force.

However microscopic investigations proved no overall fresco bonding, especially not for the pastose colours. Most of the painting surfaces are strongly susceptible to moisture and not protected by a sinter layer of calcium carbonate.[46]

These observations indicate that the floor paintings were carried out in a mixed 'fresco-secco' painting technique.[47] It also could be noted that *e.g.* more pastose red and black colour applications or corrections with white colour fill these fine textile structures in the underlying plaster and the impressions cannot be found in the related paint surfaces. So parts of the painting were carried out afterwards in a 'secco' technique likely with an organic binder onto the dried plaster and painting surface.

Three main blue-green colour types could be observed on the painted lime plasters: The use of pure Egyptian blue in coarser and finer grained variations mixed in different pigment-binder ratios (Fig. 13), a mixture of Egyptian green with a low content of Egyptian blue and the use of a green earth pigment containing glauconite and a little content of Egyptian green and blue grains (Fig. 19).

Several of these Egyptian blue and pale green to pale bluish green colour applications appear to be strongly compacted and partially bound within the lime plaster surface during a supplementary smoothing and following carbonation process (Figs. 13, 19).[48]

In this respect it cannot be fully excluded that the calcium carbonate binder existing between the pigment grains is not only mortar binder pressed to the surface during the compacting smoothing. It partially could derive from an additional use of slaked lime as mineral binder for pigments. Resulting selected Egyptian blue and green colour applications could have been painted in a 'lime fresco' or 'lime secco' technique and additionally smoothed after application.

The wall and ceiling paintings preserved within the palace rooms were carried out in a clear 'secco' technique directly onto the dry, smoothed, dark brown clay plaster surface, without an all over interlaying white fine layer as we know it *e.g.* from painted tombs of the Theban necropolis (Fig. 7).[49] Compared to the painted floors, the wall and ceiling plasters were not always very thoroughly compacted and smoothed. While the described fine smoothing structures made by flat trowel-like plaster tools could also be observed on the clay plaster surfaces, many fine brush stroke impressions show that the finishing smoothing of the clay plasters was predominantly done with brushes. Leaving more uneven surface structures in large areas together surficially visible with organic fillers (Fig. 7).

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46 Possibly a lack of moisture partly prevented the carbonation of the pigments within the plaster surface as it is characteristic for fresco painting. The arid desert climate on site with low relative air humidity could have caused a faster drying of the thin lime plaster layers. Additionally the underlying clay plasters prevented an extensive moistening before the lime plaster application because their clay binder dissolves in contact with too much water. Accordingly, a lot of the moisture from the fresh lime mortar might have easily been reduced by environmental conditions. Leaving no sufficient moist calcium hydroxide matrix to bind all colour applications into the plaster surface upon carbonation into calcium carbonate.

47 The relevant wall painting techniques that should shortly be differentiated here are the 'secco' technique or 'lime secco' (if lime is used as pigment binder) in which the paintings are carried out on a dry plaster. The painting on a fresh and still damp lime plaster is called 'fresco' or 'lime fresco' (if lime is used as additional binder for pigments before fresco application) and on half-damp lime plaster 'mezzo fresco'. See Weyer *et al.* 2016, 66.

48 The development of secondary lime crusts on the fragments during their long-term burial could only be observed very rarely due to the comparatively dry soil in the arid climate.

49 See e.g. Hartwig – Leterme 2013, 140–143.

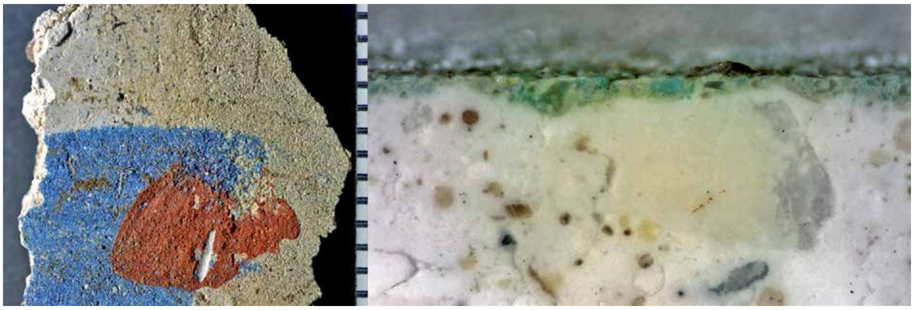

Fig. 19: Floor plaster fragments of Site K with Egyptian blue and light yellowish-green colour application that is strongly compacted and bound by a lime based binder. Width 4mm.

Fig. 20: Painted plaster fragment from the King's Palace showing lines and drips from a cord string that was soaked in red colour and then snapped onto the surface.

Fig. 21: Another painted plaster fragment from the King's Palace with traces of red outline and preliminary drawing that preceded the polychrome paint application.

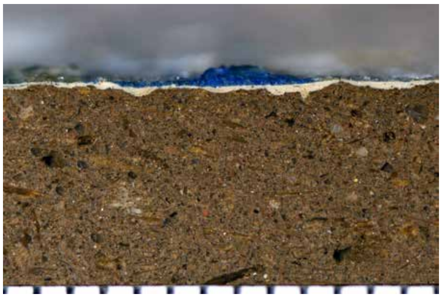

Fig. 22: Cross section of painted ceiling plaster with a calcium carbonate based first white wash on the plaster surface and a bright Egyptian blue paint layer.

Fig. 23: Cross section of painted wall plaster fragment with a compact bright yellow paint layer directly on the clay plaster surface. The pigment appears to be Orpiment.

In selected areas of the decoration schemes, a white wash was applied that functions as background colour and further paint layer support (Fig. 10). On such white painted areas, some fragments show the use of red-coloured cord string marks and partial red preliminary drawings for the composition of the decorations on walls and ceilings (Figs. 20, 21). The polychrome painting of the surfaces was then implemented in different stages by a first application of the main colours, next to and partly overlaying each other. The succession of colours can often nicely be understood. Afterwards black and red contours were drawn as well as elaborate interior patterns. The application of Egyptian blue and green colour shades usually followed last but it could also be observed in places that last contours or corrections were painted over blue and green colour areas. The bluish green colour shades noted on the floor plasters are also included in the colour spectrum of the wall paintings. On selected fragments the differentiated use and mixture of green earth pigment with Egyptian blue and green could be investigated and verified in detail by 'visible-induced luminescence (VIL)-imaging'.[50]

The further colour palette used for the wall and ceiling paintings matches the pigments of the floor and dais paintings within the King's Palace and Site K, including different shades of yellow ochre, red iron oxide, manganese and charcoal black and calcium carbonate as fine grained white pigment applied as a lime wash or mixed with an organic binder (Fig. 22). One special pigment appears to have been used primarily in selected areas of the wall paintings within the palace rooms. The bright yellow pigment appears to be the arsenic sulfide Orpiment (Fig. 23). Further pigment analysis in the future will help to verify the determination of the different pigments.

Continuing the analysis and investigations of the painted plasters in the King's Palace and the Site K fragments alongside with emergency conservation treatment, promises not only to add our knowledge about the sophisticated work know-how and elaborately applied techniques. But as well about the function and program of the decoration, both in the context of the Amenhotep III's building program at Malqata and also providing an important comparison to Tell el-Amarna. Enabling us to address questions such as were the same artists involved and the same materials used? And what can the similarities and difference in the decorative schemes tell us about the nature of the Amarna palaces? Even in its destroyed state Amenhotep's palace can still offer so much information from the remaining architectural fragments and beautiful wall and floor paintings about three thousand years later and hopefully the ongoing conservation efforts will preserve this important relic of Egypt's grandest age for generations to come.

Alexandra Winkels

50 Egyptian blue emits a bright luminescence that lies in the infrared range when it is excited by visible fluorescent light. With a infrared-sensitive digital camera (modified through the professional removal of the integrated Infrared(IR)- and Ultraviolet(UV)-blocking filter) this luminescence can be photographed. As a special filter applied in front of the camera lens captures the IR-radiation but blocks out all visible light. Thereby also the tiniest traces of Egyptian blue that are not noticable anymore in visible light can be shown in the digital IR-image. See e.g. Verri 2008, 41–50.

References

Breasted 1906

J. H. Breasted, Ancient Records of Egypt Vol. 1 (Chicago 1906).

Bundesverband der Gipsindustrie e.V. 2013

Bundesverband der Gipsindustrie e.V. (ed.), Gips-Datenbuch (Berlin 2013). Online <http://www.gips.de/fileadmin/user_upload/download/publikationen/bucher/gipsdatenbuch_2013.pdf> (last access 25 Sept. 2016).

Daressy 1903

M. G. Daressy, Le palais d'Aménophis III et le Birket Habou, Annales du Service des Antiquités de l'Égypte 4, 1903, 165–170.

Elert *et al.* 2002

K. Elert – C. Rodriguez-Navarro – E. Sebastian Pardo – E. Hansen – O. Cazalla, Lime mortars for the conservation of historic buildings, Studies in Conservation 47,1, 2002, 62–75.

Emery 1968

W. B. Emery, Tomb 3070 at Saqqâra, The Journal of Egyptian Archaeology 54, 1968, 11–13.

Evelyn-White 1915

H. G. Evelyn-White, The Egyptian Expedition 1914–15. II. Excavations at Thebes, The Metropolitan Museum of Art Bulletin 10,12, 1915, 253–256.

García-Moreno *et al.* 2013

R. García-Moreno – F.-P. Hocquet – F. Mathis – E. Van Elslande – D. Strivay – P. Vandenabeele, Archaeometry research on the wall paintings in the tomb chapel of Menna, in: Hartwig 2013, 93–111.

Hangleiter *et al.* no date

H. M. Hangleiter – E. Jägers – E. Jägers, Flüchtige Bindemittel. Online <http://www.kremer-pigmente.com/media/pdf/87099-87108Fluechtige-Bindemittel.pdf> (last access 1 Aug. 2017).

Harrell 2014

J. A. Harrell, Report on geological prospection in the vicinity of Amarna, in: Kemp 2014, 25–33.

Hartwig 2013

M. Hartwig (ed.), The Tomb Chapel of Menna (TT 69). The Art, Culture, and Science of Painting in an Egyptian Tomb, American Research Centre in Egypt Conservation Series 5 (Cairo, New York 2013).

Hartwig – Leterme 2013
M. Hartwig – K. Leterme, Visual and archaeometric analysis of the paintings, in: Hartwig 2013, 133–161.

Hayes 1951
W. C. Hayes, Inscriptions from the Palace of Amenhotep III, Journal of Near Eastern Studies 10,2, 1951, 82–112.

Hughes – Válek 2003
J. Hughes – J. Válek, Mortars in Historic Buildings. A Review of the Conservation, Technical and Scientific Literature (Edinburgh 2003).

Kemp 2000
B. J. Kemp, The discovery of the painted plaster fragments at Malkata, in: A. Καρέτσου (ed.), Κρήτη Αίγυπτος. Πολιτισμικοί δεσμοί τριών χιλιετιών. Μέλετες. Αρχαιολογικό Μούσειο Ηρακλείου 21 Νοεμβρίου – 1999 21 Σεπτεμβρίου 2000 (Athens 2000) 45–46.

Kemp 2014
B. J. Kemp, Tell el-Amarna, 2014, Journal of Egyptian Archaeology 100, 2014, 1–33.

Kemp – O'Connor 1974
B. J. Kemp – D. O'Connor, An ancient Nile harbour University Museum excavations at the 'Birket Habu', International Journal of Nautical Archaeology 3,1, 1974, 101–136.

Lacovara 1994
P. Lacovara, In the realm of the Sun King. Malkata. Palace city of Amenhotep III. Amarna Letters 3, 1994, 6–21.

Lacovara 2014
P. Lacovara, Preservation & interpretation of the palace of Amenhotep III at Malqata in western Thebes, Bulletin of the American Research Centre in Egypt 204, 2014, 28–33.

Lenz – Sobott 2008
R. Lenz – R. Sobott, Beobachtungen zu Gefügen historischer Gipsmörtel, in: M. Auras – H.-W. Zier (eds.), Gipsmörtel im historischen Mauerwerk und an den Fassaden, WTA-Schriftenreihe 30 (Munich 2008) 23–34.

Lucas 1924
A. Lucas, Mistakes in chemical matters frequently made in archaeology, Journal of Egyptian Archaeology 10,2, 1924, 128–132.

Middleton 2008
A. Middleton, Arriccio to intonaco, in: Middleton – Uprichard 2008, 19–24.

Middleton – Uprichard 2008
A. Middleton – K. Uprichard (eds.), The Nebamun Wall Paintings. Conservation, Scientific Analysis and Display at the British Museum (London 2008).

Miller 2008
E. Miller, Painterly technique, in: Middleton – Uprichard 2008, 61–67.

Nicolakaki-Kentrou 2003
M. Nicolakaki-Kentrou, Malkata, Site K: The Aegean-related motifs in the painted decoration of a demolished building of Amenhotep III, in: Z. Hawass (ed.), Egyptology at the Dawn of the Twenty-first Century. Proceedings of the Eighth International Congress of Egyptologists, Cairo, 2000 Vol. 1 (Cairo, New York 2003) 352–360.

Nishimoto 1990a
S. Nishimoto, Restoration of the hieroglyphic inscriptions on the ceiling of room H at Malkata Palace, Bulletin of Science and Engineering Research Laboratory. Waseda University 129, 1990, 58–79.

Nishimoto 1990b
S. Nishimoto, Reconstruction of the figure Nekhbet on the ceiling of the Great Columned Hall at the Malkata Palace. Studies on the Malkata Palace I, Journal of Architectural Planning and Environmental Engineering 416, 1990, 111–121.

Nishimoto 1991a
S. Nishimoto, Notes on the wall fragments bearing the inscription "*irp*" (wine) found from Malkata Palace, Bulletin of Science and Engineering Research Laboratory. Waseda University 131, 1991, 9–13.

Nishimoto 1991b
S. Nishimoto, Reconstruction of "the Scroll Pattern" on the ceiling of the Great Columned Hall at the Malkata Palace. Studies on the Malkata Palace II, Journal of Architectural Planning and Environmental Engineering 425, 1991, 101–112.

Patch *et al.* 2012/2013
D. C. Patch – C. H. Roehrig – P. Lacovara, Malqata. A Century of Exploration, KMT. A Modern Journal of Ancient Egypt 23,4, 2012/2013, 76–84.

Quibell 1913
J. E. Quibell, Excavations at Saqqara 5, 1911–12. The Tomb of Hesy (Cairo 1913).

Smith 1998
W. S. Smith, [ed. W. K. Simpson], The Art and Architecture of Ancient Egypt, 3rd edition (New Haven, London 1998).

Stein – Kimmel no date

R. Stein – J. Kimmel, Cyclodecane ($C_{12}H_{24}$), sealing wax. Online <http://www.kremer-pigmente.com/media/pdf/87100e.pdf> (last access 1 Aug. 2017).

Tytus 1903

R. DeP. Tytus, A Preliminary Report on the Re-excavation of the Palace of Amenhetep III (New York 1903).

Verri 2008

G. Verri, The use and distribution of Egyptian blue. A study by visible-induced luminescence imaging, in: Middleton – Uprichard 2008, 41–50.

Weatherhead 2007

F. J. Weatherhead, Amarna Palace Paintings, Egypt Exploration Society Excavation Memoir 78 (London 2007).

Weyer *et al.* 2016

A. Weyer – P. Picazo – D. Pop – J. Cassar – A. Özköse – J.-M. Vallet – I. Srša (eds.), EwaGlos. European Illustrated Glossary of Conservation Terms for Wall Paintings and Architectural Surfaces, Series of Publications by the Hornemann Institute 17, 2nd revised edition (Petersberg 2016). Online <http://193.175.110.9/hornemann/doi/2016ewa2a.pdf> (last access 1 Aug. 2017).

Winkels 2007

A. Winkels, Restauratorisch-naturwissenschaftliche Untersuchung von tuthmosidischen Putzen aus ᶜEzbet Helmi / Tell el-Dabᶜa. Ein Beitrag zur Erforschung altägyptischer Kalkputztechnik, Egypt and the Levant 17, 2007, 273–293.

Winkels 2014

A. Winkels, Further analysis of Amarna's mortars and plasters, in: Kemp 2014, 22–23.

Winkels – Riedl 2015

A. Winkels – N. Riedl, Entwicklung von Putz- und Maltechnik in der Petosiris-Nekropole von Tuna el-Gebel. Erste Untersuchungsergebnisse zu Akkulturationsprozessen in der Region Mittelägypten, in: K. Lembke – S. Prell (eds.), Die Petosiris-Nekropole von Tuna el-Gebel Vol. 1, Tuna el-Gebel 6 (Vaterstetten 2015) 260–303.

Winlock 1912

H. E. Winlock, The work of the Egyptian Expedition, The Metropolitan Museum of Art Bulletin 7,10, 1912, 184–190.

How to Paint a Landscape

Technical Perspectives on the 'Aegean'-style Landscape Paintings from Tell el-Dab^{c}a

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Abstract

Although much has been written about the 'Aegean'-style wall paintings from Tell el-Dab^{c}a, the question of who executed these paintings still puzzles us and will possibly never be answered with absolute certainty. As a consequence, we should consider adjusting our focus of inquiry. Rather than asking who decorated the walls of this 18th Dynasty palatial precinct in the eastern Nile Delta, we could examine how the paintings were executed; in other words, study the technical practice of their production. Although this will not solve the question who executed these paintings, it will at least allow us to trace the habitual schemes of action and the practical knowledge of the craftspersons responsible.

Following one chief concern of the Tell el-Dab^{c}a wall painting project, the aim of this paper is, therefore, to present and interpret technical details of the large-scale landscape paintings from Tell el-Dab^{c}a. Although the material is highly fragmented, the related pieces give sufficient evidence to reconstruct the various steps in the production of these wall paintings. By sketching out this *chaîne opératoire*, it will be possible to trace the painterly techniques of the craftspersons working at Tell el-Dab^{c}a.

Keywords: Egypt; Tell el-Dab^{c}a; 'Aegean'-style; wall paintings; technique; chaîne opératoire.

Introduction

An intuitive method to start the study of a wall painting is the examination of the image displayed on its surface and, with it, all related issues such as style, iconography, composition and content. I myself followed this approach in my study of the large-

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in: J. Becker, J. Jungfleisch and C. von Rüden (eds.) Tracing Technoscapes. The Production of Bronze Age Wall Paintings in the Eastern Mediterranean (Leiden 2018) 173-190.

scale landscape paintings from the 18th Dynasty palatial precinct of ᶜEzbet Helmi/Tell el-Dabᶜa.[2] Among a large variety of highly interesting subjects,[3] a considerable number of wall painting fragments unearthed in Area H/I show large-scale floral motifs and elements of landscape. Most of the related pieces found in deposits at the base of the ramp leading up to 'Palace F' could be assigned to a potentially wall-filling composition. Although the painting is highly fragmented, its main elements and the general layout of the composition are approachable up to a certain point.[4]

A large-scale griffin formed the central element of the painting. The fabulous creature was shown in Aegean style. Especially its wing – with spirals along the upper end, notched plume pattern on its central part and arched sections at its rear end – finds close comparisons in the iconography of the Bronze Age Aegean.[5] Even though several parts of the white body are preserved, the posture of the griffin could not be determined with certainty. Undulating terrain motifs, which divided the background of the painting in red and light ochre areas, characterised the surrounding landscape. In addition, the composition featured various plants, which also show strong links to Minoan and Cycladic wall paintings.[6]

An iconographic analysis is of course a reasonable and appropriate way to investigate a mural. Such studies form a core element of archaeological and art-historical research, as they provide information about ancient societies, their imagery, which reflects ancient peoples' concepts and believes, and – as exemplified by the murals from Tell el-Dabᶜa – interconnections between different cultures. In focussing on the images, however, past research sometimes neglected other aspects of the painting. Notably the production of the paintings was occasionally marginalised by mentioning technical details as incidental remarks or as short appendices to broader iconographic studies.[7] More recently, researchers devote more attention to the complex fabrication processes of ancient wall paintings.[8]

Following this trend, the iconography of the large-scale landscape paintings from Tell el-Dabᶜa will merely be mentioned in passing. Rather, I will focus on the technical aspects of the griffin composition, which I have briefly described above. Although Ann Brysbaert already conducted a more general archaeometric analysis of the technology of

2 For the context and date of the palatial precinct of ᶜEzbet Helmi/Tell el-Dabᶜa see: Bietak 2005a; Bietak *et al.* 2007, 20–43; Bietak 2010.

3 Different iconographical groups have already been published. For a brief overview with further literature see: Bietak *et al.* 2012/2013, 132. For the animal hunt scenes see: Marinatos 2010; Morgan 2010a; Morgan 2010b. For the large-scale male figures see: Aslanidou 2005. For the bull-leaping scenes see: Bietak *et al.* 2007. For the stucco relief paintings see: von Rüden 2015.

4 For a preliminary study of the griffin composition, which will also be integrated in my PhD-Project at the University of Heidelberg see: Becker 2016.

5 E.g. the griffin depicted on a wall painting from building Xeste 3 at Akrotiri/Thera. See: Doumas 1992, 131, figs. 122, 128. For further comparison see: E.g. Morgan 2010, 312–313, figs. 12–18.

6 See: Becker 2016, 27–31, figs. 3–6.

7 E.g. Coleman 1973, 286, 287–288; Majewski – Reich 1973. A notable exception is the comprehensive analysis of Aegean wall paintings by Mark Cameron, who not only focused on the iconography of the murals but also on their technical characteristics. See: Cameron 1976, Vol. I, 274–302. Cf. also Rodenwaldt 1912, 205–210, 217; Heaton 1912; Lang 1969, 10–25, 229–230.

8 E.g. the exemplary study of the wall paintings from the 'Tomb chapel of Menna'. See: García-Moreno *et al.* 2013; Hartwig – Leterme 2013; Madden – Tavier this volume. See also: Brecoulaki *et al.* 2008. Earlier studies which focus on the technique of Bronze Age wall paintings are for instance: Lucas 1962, 338–361; Cameron *et al.* 1977.

the painted plaster from Tell el-Dabᶜa,[9] a case study of one specific painting will broaden the previously published results. Despite the state of preservation, the fragments assigned to this painting, notably larger pieces which show various elements of the composition, give sufficient information to trace the different steps in the *chaîne opératoire*[10] of the ancient craftspersons and thus illustrate how this landscape has been painted.

Although the erection of the building and the acquisition of the required materials are mandatory stages, I will leave these aspects aside and solely focus on the execution of the mural.[11] For the present paper, it is enough to note that we are dealing with a mud brick architecture of Egyptian type[12] and a lime plaster with a high percentage of calcite.[13] The pigments used are ochre-based reds and yellows, manganese black, lime white, as well as Egyptian Blue that was also mixed with ochre to obtain green.[14]

1. First Step: Preparation of the Painting Surface

The first step in the *chaîne opératoire* of the griffin composition was the creation of a suitable surface to paint on. For this purpose, the craftspersons covered the mud brick wall with a thick lime plaster coat. In general, the fragments show multiple layers of plaster (Fig. 1).

A first thick layer filled the joints between the mud bricks and levelled irregularities of the wall. Whether the joints between the bricks were scraped out or rather left open intentionally could not be determined.[15] Nevertheless, the plaster between the bricks probably served as anchorage to enhance the adhesion of the render on the wall. Today, the negative impressions of the mud bricks, which are sometimes still visible on the rear of the fragments (Fig. 2), offer the opportunity to recognise the original orientation of the fragment on the wall and, consequently, give valuable information for the reconstruction of the painting.[16]

Two thinner layers of lime plaster followed on top of the thick backing coat (Fig. 1). These two layers have a strong connection to one another and, therefore, are not always differentiable as separate layers. However, these coats frequently flake off as a whole along the surface of the lowermost plaster layer. Conceivably, the plasterers had waited too long before they applied the second plaster layer and the backing plaster had already set too much. This resulted in a lack of bonding between the first and second coating.[17]

Subsequently, the craftspersons applied a thin lime plaster slip and floated or trowelled the surface to obtain an even surface.[18]

9 See: Brysbaert 2002; Brysbaert 2007. For an earlier technical study of the paintings from Tell el-Dabᶜa see: Seeber 2000.
10 For a brief introduction to the concept of *chaîne opératoire* see: Sellet 1993.
11 The eventual discard of the fragments from Tell el-Dabᶜa will also not be considered. Cf. Bietak *et al.* 2007, 38–39.
12 See: Jánosi 1996; Bietak 2005b, 141–158.
13 See: Seeber 2000, 94; Brysbaert 2007, 153–155.
14 See: Seeber 2000, 98–99; Brysbaert 2007, 155–160.
15 Manfred Bietak suggested that the brick joints were scraped out intentionally. See: Bietak *et al.* 2001, 40. Cf. Jungfleisch this volume.
16 Cf. Becker 2016, 31.
17 Cf. Doerner 2001, 237, 238; von Rüden – Skowronek this volume.
18 Cf. Brysbaert 2002, 99, 101; Brysbaert 2007, 155.

Fig. 1: Profile view of fragment F00505 showing multiple layers of plaster with clear demarcation between levelling coat and upper plaster layers.

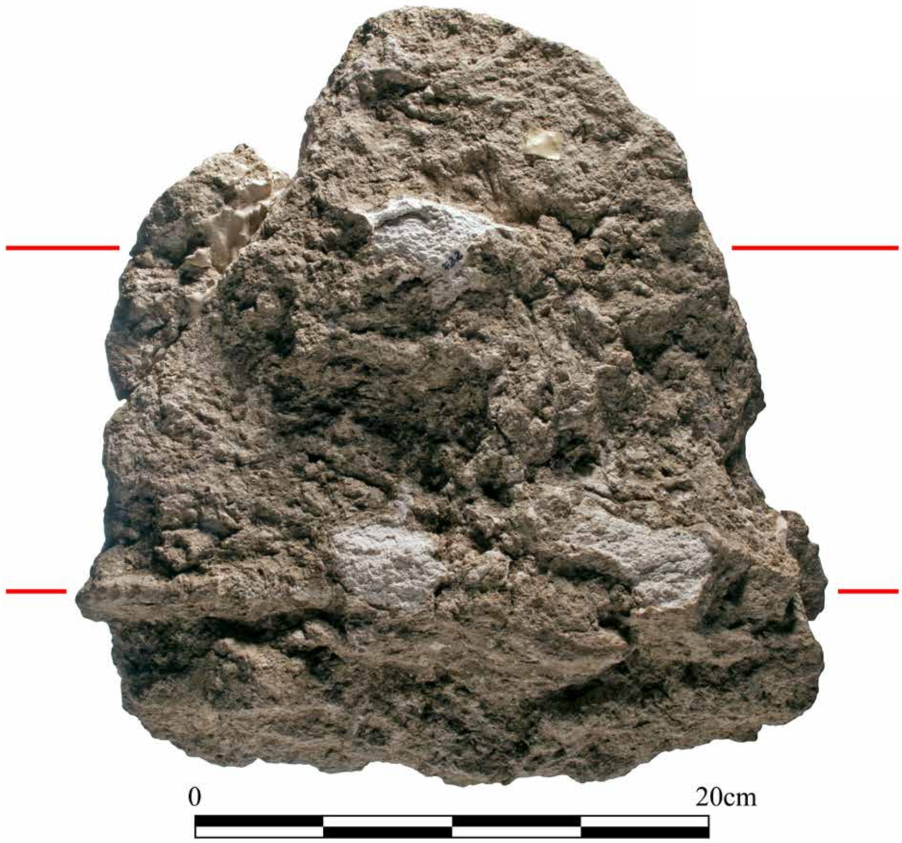

Fig. 2: Rear of fragment F00032; red lines indicating the position of horizontal mud brick impressions.

Fig. 3: Detail of fragment F00510 showing string impressed guideline below the main paint layers.

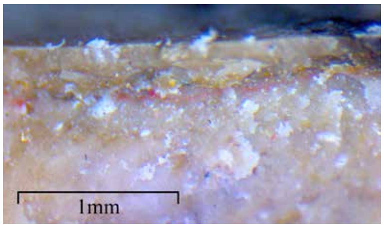

Fig. 4: Detail of fracture of fragment F00173 showing red preliminary drawing concealed by main paint layers.

2. Second Step: Planning of the Composition

On this well-prepared surface, the craftspersons executed the painting. The first stage within this process was the planning of the composition. The artisans had different aids at hand to lay out the borders and components of the painting. String lines impressed in the still wet plaster were used to mark out the edges of the painting prior to its execution. This can, for instance, be seen on fragment F00510, on which the straight upper end of the composition correlates with such a guideline (Fig. 3).[19] In this case, the string impression was concealed by the upper paint applications and is only visible where these layers flaked off.

Although incised lines are occasionally observable on fragments of the griffin composition, their specific purpose within the drafting process of this mural is mostly not recognisable.[20] In contrast, the usage of preliminary drawings is quite clear. The artisans sketched out the figure of the griffin with red lines. Such a sketch line can, for example, be spotted along the upper outline of the griffin's tail on fragment F00173 (Fig. 4). These lines were later concealed by the main paint layers and, therefore, were not visible in the finished painting. The preliminary sketch was not implemented line for line, but rather provided a rough orientation for the figure that was painted later.[21]

3. Third Step: Execution of the Painting

After sketching out the overall design, the artisans started to execute the painting. The craftspersons' approach in executing this probably wall-filling composition can be traced by studying the overlay of colours. It is obvious that a colour coat which fully or partially covers another layer of paint must have been applied later than the one it superimposes. By sequencing these overlaps, the workflow of the artisans becomes clear.

The sequence of paint application is quite distinct on one of the largest preserved pieces (Figs. 5, 6, 7). Since fragment F00505 shows a floral motif, a part of the white

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19 In the case of the Tell el-Dab^ca wall paintings, string-impressed guidelines have been used frequently for the planning of repetitive patterns or straight multicoloured borders. See: E.g. Bietak *et al.* 2000, 84–85, figs. 6–7.

20 In Tell el-Dab^ca, the use of incised lines for the planning of a repetitive pattern is, for instance, observable in the case of a spiral frieze from area H/III. See: Aslanidou 2007, 191. For further evidence cf. Brysbaert 2002, 99, 101–102.

21 The process of planning a large-scale figure with red lines can also be traced in the case of the representation of a lion from area H/I of Tell el-Dab^ca which Constance von Rüden, Johannes Jungfleisch and I currently study.

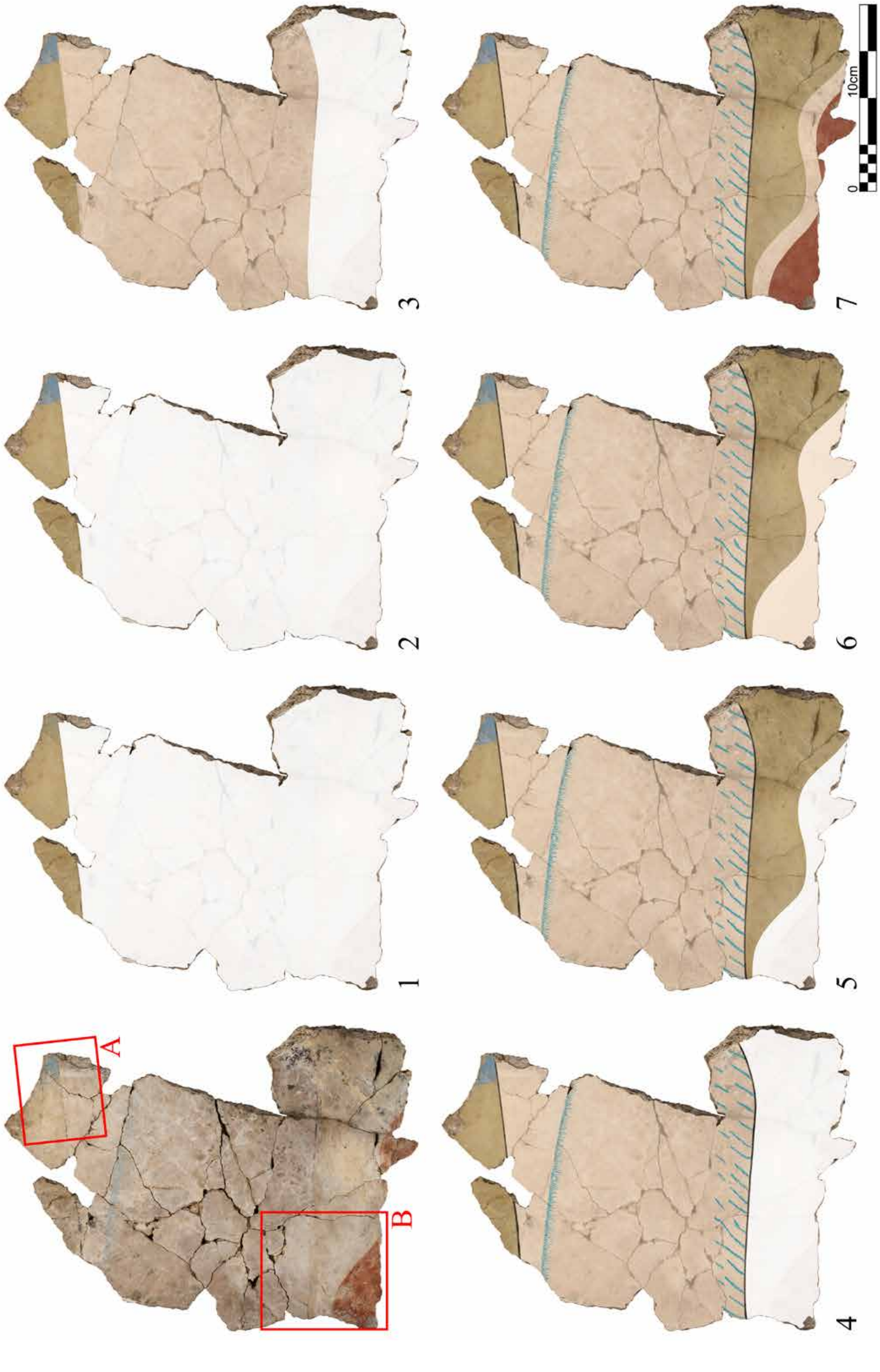

Fig. 5: Fragment F00505. Unaltered image with indications of the positions of Fig. 6 (A) and Fig. 7 (B). 1.–7. Sequence of paint application (cf. description in the main text).

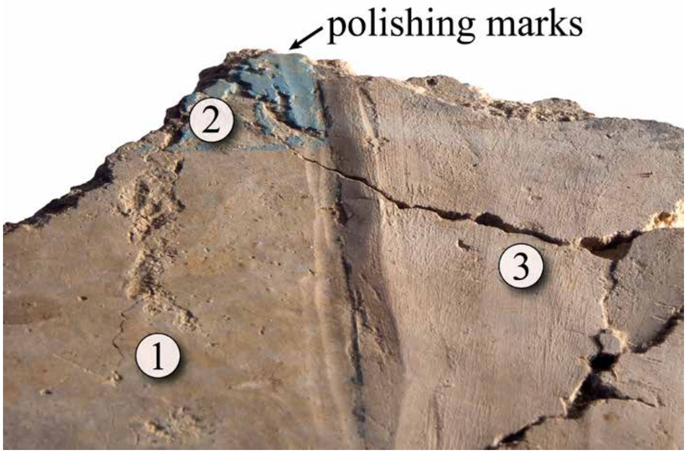

Fig. 6: Detail of fragment F00505 (upper part; cf. section A in Fig. 5) showing overlay of colours with numbers (corresponding to the numerical additions of Fig. 5.1–3) indicating the sequence of paint application and polishing.

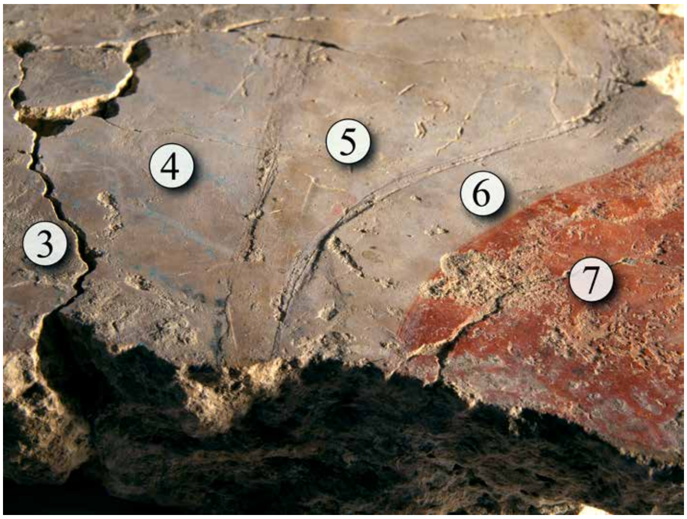

Fig. 7: Detail of fragment F00505 (lower part; cf. section B in Fig. 5) showing overlay of colours with numbers (corresponding to the numerical additions of Fig. 5.3–7) indicating the sequence of paint application.

body of the griffin as well as the background of the composition with an undulating landscape element, all main components of the mural are present.[22]

The overlay of colours reveals the following workflow: Firstly, the light ochre background in the uppermost part of the fragment was painted (Figs. 5.1, 6), followed by the execution of a blue leaf in the upper right corner (Figs. 5.2, 6). In the next step, the craftspersons applied the white colour for the body of the griffin (Figs. 5.3, 6, 7) and elaborated this figure with details (Figs. 5.4, 6, 7). Only after this, the light ochre background below the griffin was coloured (Figs. 5.5, 7). Finally, the undulating terrain motif in the lowermost part was executed, whereby the artisans applied a white layer first (Figs. 5.6, 7) on top of which the red background was painted (Figs. 5.7, 7).

22 For this fragment see: Becker 2016, 33–34, fig. 8. It must be noted, however, that no preliminary drawings could be recognised on fragment F00505. Since preliminary drawings are occasionally only visible where the upper paint layers have flaked off or as thin red layers in the sections of other fragments (Fig. 4), it can be assumed that, in this case, the sketch lines are hidden under the thick paint layers.

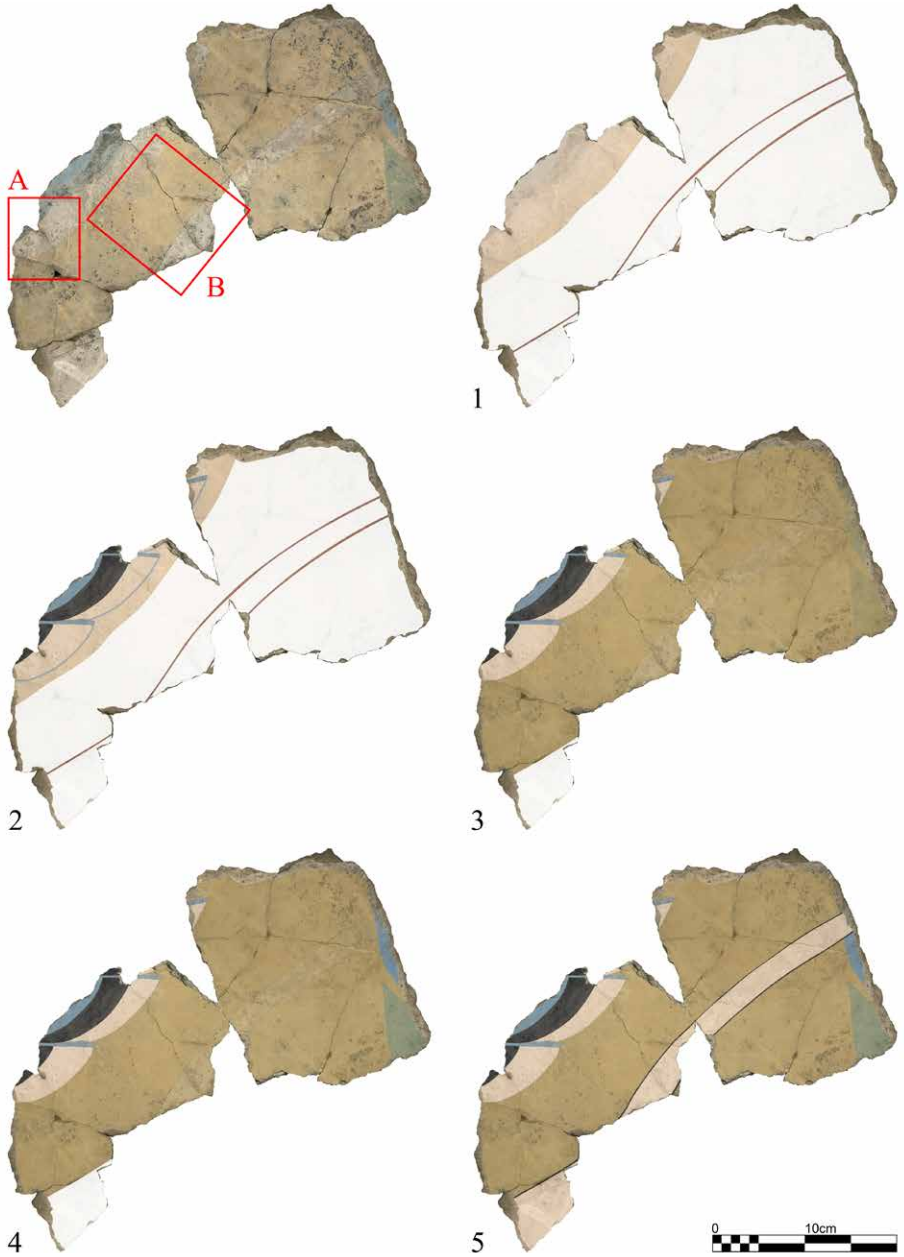

Fig. 8: Fragment F00173. Unaltered image with indications of the positions of Fig. 9 (A) and Fig. 10 (B). 1.–5. Sequence of paint application (cf. description in the main text).

Consequently, the craftspersons did not colour the whole background first and add the figural elements of the composition afterwards. On the contrary, they worked in consecutive sections from the top of the wall down.

The overlay of colours on fragment F00173, which shows parts of the griffin's wing and tail as well as a floral motif, illustrate the same working procedure. In this case, the artisans applied a thick white layer in the upper left area (Figs. 8.1, 9) on top of which

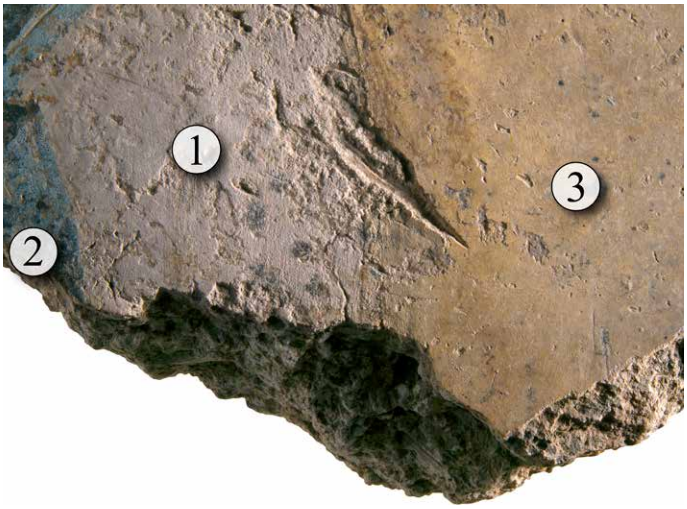

Fig. 9: Detail of fragment F00173 (left part; cf. section A in Fig. 8) showing overlay of colours with numbers (corresponding to the numerical additions of Fig. 8.1–3) indicating the sequence of paint application.

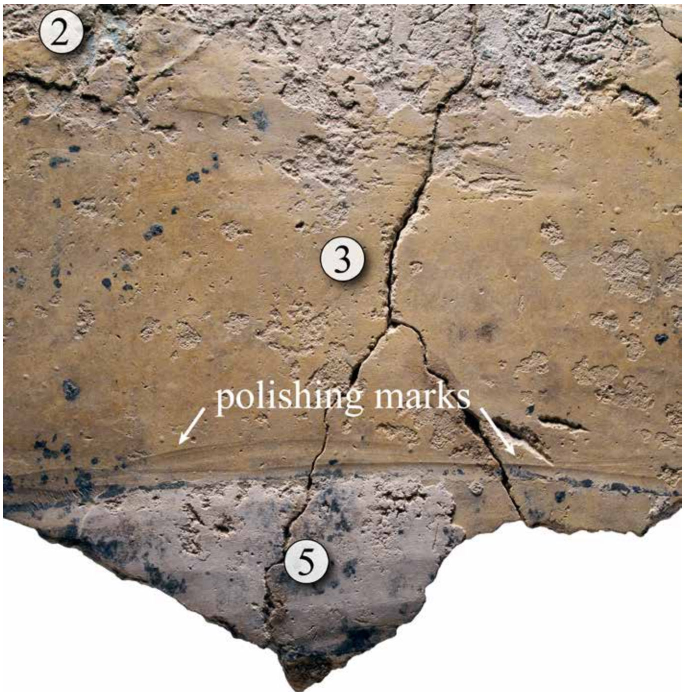

Fig. 10: Detail of fragment F00173 (middle part; cf. section B in Fig. 8) showing overlay of colours with numbers (corresponding to the numerical additions of Fig. 8.2–5) indicating the sequence of paint application and polishing.

they painted the wing of the griffin (Figs. 8.2, 9). In doing so, the outline of the wing was marked with blue lines. These served as intermediate orientation lines and the light ochre background, which the craftspersons executed in the next step, was painted up to the blue lines. In this way, the contour of the wing obtained its final appearance (Figs. 8.3, 9). The light ochre background colour also covers the sketch of the tail (Fig. 4) but ends in the lowermost part of the fragment where the body of the griffin begins. Subsequently, the plant along the right edge of the fragment was completed (Fig. 8.4). In the last step, the artisans painted the white interior and black outlines of the griffin's body (Figs. 8.5, 10). As a result, the white colour for the tail overlaps the floral motif.

Accordingly, this fragment illustrates not only that the craftspersons proceeded from the top of the wall down, but also that the wing and the body of the griffin were executed in different stages of the painting process.

Other fragments assigned to the griffin composition exemplify the same workflow. In the case of the already published fragment F00032,[23] for instance, the light ochre background and the plants in the upper part were finished completely before the wing of the griffin in the lower part was painted.

Accordingly, the craftspersons executed this landscape painting in a consistent and orderly manner. It is reasonable to reconstruct the artisans' approach as follows: The painters worked in consecutive sections from the top of the wall down. In each of these sections, they applied the ground colour first. In doing so, they aligned the borders of the section to the preliminary drawings and reserved the area below from paint. Hereafter, they elaborated the section with details. Only after that, the craftspersons went on to execute the area below by applying the ground colour first and, subsequently, adding the particulars of the respective part of the painting. In this way, they continued until they reached the lower end of the composition.

On the one hand, the craftspersons' approach to start from the top of the wall and continue downwards only seems logical. In this way, the artisans could later conceal colour that accidentally dripped on the lower parts of the wall by applying another layer of paint. Such flaws are observable on fragment F08847 from area H/III (Fig. 11), which due to the different find context and significant technical and iconographical deviations does not belong to the griffin composition but also shows an undulating landscape motif.[24] On this piece, larger red drops were hidden under a thick layer of blue paint and are, therefore, only visible where the background colour flaked off.

On the other hand, the artisans' approach to execute the painting in consecutive sections might have served another purpose. In this context, the thickness of the flat colour coats is crucial. The layers, which form the ground of the sections mentioned above, have a thickness of around 1–2mm and, therefore, were all applied rather thickly. This accounts for the white layers for the body parts of the griffin (Figs. 6, 10) as well as the light ochre colour coats for the background (Figs. 7, 9, 10, 12, 13), which owe their hue to ochre pigment mixed in lime putty. As mentioned above, continuous layers of white lime with a comparable thickness are also discernible under the red paint for the background on fragment F00505 (Fig. 7) and similarly under the blue paint of the griffin's wing on fragment F00173 (Figs. 8.1, 9).[25] A comparison with Renaissance and modern fresco technique might give a hint to approach the function of these layers.

While working in this technique, artisans apply the pigments, which are only mixed with water, to a fresh and still damp lime plaster. While the plaster is drying, a chemical

23 For this fragment see: Becker 2016, 31–33, fig. 7.

24 For a brief introduction to the landscape paintings from area H/III of Tell el-Dab^ca see: Bietak *et al.* 2012/2013, 134, 135.

25 Note that on fragment F00510 (Fig. 3) the string impressed guideline was also covered up with such a thick lime layer on top of which the red background colour was painted.

Fig. 11: Fragment F08847 (area H/III). Highlighted red drops hidden under thick layer of blue paint (left) and preliminary reconstruction (right).

reaction called carbonation[26] fixes the pigments on the surface. Therefore, an additional binder is not necessary as long as the plaster is still damp. Consequently, the artisan only has a limited period to finish these works. To gain time, however, the craftspersons apply a fine lime layer not to the whole surface of the rough-plastered wall but to the area they aim to finish before this final plaster layer is already too dry to be painted *a fresco*.[27] In the finished painting, the junctions between these areas usually remain visible under raking light and the study of the sequence of these so-called '*giornate*' or 'day's works' reveals the different steps in the painting process.[28] Commonly, fresco painters start in the uppermost part of the painting and continue downwards whereby they adjust the *giornate* to the preliminary drawings sketched out on the rough plaster coat of the wall.[29]

Returning to the material from Tell el-Dab^{c}a, it is conceivable that the craftspersons' approach to execute the griffin composition in consecutive sections might be comparable to the procedure chosen by fresco painters. As described above, the artisans of the griffin composition applied layers of lime – either plain white or mixed with ochre pigments – in portions to broader areas of the rough-plastered wall surface. In each of these sections, they added the coloured details before they covered the next area with a final coating. This finding suggests that the craftspersons intended to paint on a surface which was freshly applied. In principle, this does not necessarily prove that they added the coloured details when these layers were still

26 See Weyer *et al.* 2016, 359: „Definition: Chemical reaction in which calcium hydroxide (slaked lime) reacts with carbon dioxide from the air and forms insoluble calcium carbonate."

27 See: Mora *et al.* 1984, 11–12; Knoepfli – Emmenegger 1990, 22–23; Wehlte 2000, 458–459; Doerner 2001, 232–234; Weyer *et al.* 2016, 70.

28 Cf. e.g. Mancinelli 1997, 163, 166, figs. 9, 20.

29 Cf. Mora *et al.* 1984, 140; Doerner 2001, 241; Autenrieth *et al.* 2010/2011, 772.

damp. Other technical details observable on the fragments of the griffin painting, however, demonstrate that this actually was the case.

In addition to the already described string-impressed guidelines of the initial planning, the artisans also used this drafting aid at a later stage.[30] On fragment F00420, which is also assigned to the griffin composition, for instance, string lines are deeply impressed in the thick light ochre background layer (Fig. 12). Since these impressions are also traceable on the blue colour of the leaf depicted on fragment F00420, the craftspersons must have slapped the string on the surface after they had already finished the floral motif. Obviously, the artisans used the formability of the consecutively applied lime layers and, therefore, were well aware that the ground on which they painted was still malleable. This finding supports the assumption that the craftspersons intended to paint on a fresh and still damp surface. Consequently, the way the artisans divided the griffin composition in consecutive painting sections might indeed be comparable to the *giornata* approach of the fresco painters.

Fig. 12: Detail of fragment F00420 showing string lines impressed in the upper paint layers.

Moreover, tool marks left by the final step of the *chaîne opératoire* speak for the same conclusion.

4. Fourth Step: Surface treatment

In this step, the craftspersons partially polished the painted surface using a smooth object such as a pebble. Probably, this measure should ensure a better bonding between the uppermost paint layers and the underlying surface.[31]

This procedure left characteristic work traces, which are observable on various fragments. On fragment F00173, for instance, dented polishing marks are clearly visible along the tail of the griffin (Fig. 10). As stated before, the artisans painted the tail of the griffin only after the plant motif had already been finished. On fragment F00505, similar tool marks are discernible along the upper end of the griffin's body (Fig. 6). In this case, the polishing process did not only affect the light ochre background coat but also the blue paint layer of the leaf depicted in the upper right corner. Moreover, on fragment F00175 signs of polishing are traceable around the green leaves of the floral motifs on light ochre ground (Fig. 13). In this process, the green colour was pressed

30 Although string impressed guidelines on wall paintings from Tell el-Dab^{c}a have already been mentioned, their use as drafting aid at a later stage of the painting process has so far not been described. Cf. e.g. Seeber 2000, 94; Bietak *et al.* 2000, 84–85; Brysbaert 2002, 101–102; Brysbaert 2008, 113, 120.

31 Cf. Cameron *et al.* 1977, 168; Wehlte 2000, 480; Brysbaert 2008, 117.

Fig. 13: Detail of fragment F00175 showing green colour pressed into the surface and polishing marks.

into the surface, which, consequently, must still have been mouldable after the completion of the plant motif.[32]

Since the arrangement of such details will have taken considerable time, we have to assume a longer period between the application of the light ochre background coat and the final polishing. Nonetheless, as polishing marks are deeply impressed in the light ochre coat, this thick layer was still malleable when the craftspersons carried out this step.

5. Conclusions

To conclude, the technical details observable on fragments assigned to the griffin composition from Tell el-Dab^ca give sufficient information to reconstruct the main steps of the artisans' *chaîne opératoire* from the application of the rough plaster coat and the planning of the composition to the execution of the painting and the final polishing of the surface.

In addition, this case study produced substantial arguments that the craftspersons painted the final details on a fresh and still damp surface. As described above, this is indicated by the consecutive application of top lime coats on which the coloured details were executed sequentially, string-impressed guidelines, which were not part of the initial planning of the composition, as well as tool marks, which stem from the polishing of the malleable surface in the final step of the work process.

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32 Ann Brysbaert proposed a similar explanation but favored the interpretation that the surface was left rougher or was roughened intentionally to provide a better key for the larger-grained Egyptian Blue pigment. See: Brysbaert 2002, 97, 100; Brysbaert 2008, 113.

For comparable impression on wall painting fragments from Knossos see: Cameron 1976, Vol. I, 296–299; Cameron *et al.* 1977, 169, pl. 16b.

These observations do not necessarily prove that we are dealing with a 'true' fresco technique which we assume – biased by the textual record – for Renaissance paintings. Since there is at least one significant difference, we should in fact refuse such an equation. As mentioned above, within such an idealised technical practice, fresco painters mix the pigments solely with water. Conversely, in the case of the griffin composition from Tell el-Dab^{c}a, pigments such as Egyptian Blue were mixed with lime putty before their application.[33] Therefore, the two techniques do not correspond entirely, although both were evidently implemented on a damp surface.

Nevertheless, since the craftspersons of the griffin composition obviously intended to paint on a damp surface, it is plausible to assume that their technique based on the same chemical reaction as the fresco technique. The lime putty, which was added to the pigments prior to their application, would have served as a binding agent that fixed the colour on the surface. This does not exclude the possibility that an organic binder was used additionally either to enhance the fixation of the pigments or to finish the painting with secco additions.[34]

Again, a feasible parallel for this assumption is known form medieval and modern times. In the so-called 'lime fresco painting' technique, the fixation of the pigments on the surface primarily or entirely depends on the carbonation of lime water or milk of lime which were mixed with the pigments before painting.[35] However, medieval and modern wall painting techniques merely serve as references to the painterly techniques of the craftspersons working at Tell el-Dab^{c}a. More significant for the reconstruction of the specific technique is the artisans' *chaîne opératoire* itself, which is reflected in technical details observable on the wall painting fragments from Tell el-Dab^{c}a.

References

Aslanidou 2005

K. Aslanidou, The Minoan wall paintings from Tell el-Dab^{c}a/^{c}Ezbet Helmi. The life-size male figures, in: R. Laffineur – E. Greco (eds.), Emporia. Aegeans in the Central and Eastern Mediterranean. Proceedings of the 10th International Aegean Conference in Athens, April 14th–18th 2004, Aegaeum 25 (Leuven 2005) 463–469.

Aslanidou 2007

K. Aslanidou, Some ornamental scenes on the wall paintings from Tell el-Dab^{c}a. Iconography and context, in: M. Bietak – E. Czerny (eds.), The Synchronisation of Civilisations in the Eastern Mediterranean in the Second Millennium B.C. III. Proceedings of the SCIEM 2000 – 2nd EuroConference in Vienna, May 28th – June 1st 2003, Contributions to the Chronology of the Eastern Mediterranean 9, Denkschriften der Gesamtakademie 37 (Vienna 2007) 191–205.

33 This contrasts against an observation made by Ann Brysbaert but is in line with Rudolfine Seeber's results. Cf. Seeber 2000, 95, 102; Brysbaert 2002, 96–97, pl. 3.

34 For the possibility to enhance the bonding properties of slaked lime by adding an organic binder see: Mora *et al.* 1984, 12; Wehlte 2000, 437.

35 For the so-called 'lime fresco painting' (Kalkfreskomalerei) see: Mora *et al.* 1984, 12; Wehlte 2000, 436f; Weyer *et al.* 2016, 70. Cf. the so-called 'lime secco painting' (Kalkseccomalerei) cf. Mora *et al.* 1984, 12–13; Wehlte 2000, 437; Weyer *et al.* 2016, 84.

Autenrieth *et al.* 2010/2011
H. Autenrieth. – M. Koller – E. Wipfler, Fresko, Freskomalerei, in: Zentralinstitut für Kunstgeschichte München (ed.), Reallexikon zur deutschen Kunstgeschichte Vol. 10 (Munich 2010/2011) 715–793.

Becker 2016
J. Becker, The large-scale landscape paintings of Tell el-Dab^ca/Egypt, in: R. A. Stucky – O. Kaelin – H.-P. Mathys (eds.), Proceedings of the 9th International Congress on the Archaeology of the Ancient Near East, June 9th–13th, 2014, University of Basel Vol. 2 (Wiesbaden 2016) 23–35.

Bietak 2005a
M. Bietak, The setting of the Minoan wall paintings at Avaris, in: L. Morgan (ed.), Aegean Wall Painting. A Tribute to Mark Cameron, British School at Athens Studies 13 (London 2005) 83–90.

Bietak 2005b
M. Bietak, Neue Paläste aus der 18. Dynastie, in: P. Jánosi (ed.), Structure and Significance. Thoughts on Ancient Egyptian Architecture, Denkschriften der Gesamtakademie 33, Untersuchungen der Zweigstelle Kairo des Österreichischen Archäologischen Institutes 25 (Vienna 2005) 131–168.

Bietak 2010
M. Bietak, Minoan presence in the pharaonic naval base of Peru-Nefer, in: O. Krzyszkowska (ed.), Cretan Offerings. Studies in Honour of Peter Warren, British School at Athens Studies 18 (London 2010) 11–24.

Bietak *et al.* 2001
M. Bietak – J. Dorner – P. Jánosi, Ausgrabungen in dem Palastbezirk von Avaris. Vorbericht Tell el-Dab^ca/^cEzbet Helmi 1993-2000, Egypt and the Levant 11, 2001, 27–119.

Bietak *et al.* 2000
M. Bietak – N. Marinatos – C. Palyvou, The maze tableau from Tell el-Dab^ca, in: Sherratt 2000, 77–90.

Bietak *et al.* 2007
M. Bietak – N. Marinatos – C. Palyvou, Taureador Scenes in Tell el-Dab^ca (Avaris) and Knossos, Denkschriften der Gesamtakademie 43, Untersuchungen der Zweigstelle Kairo des Österreichischen Archäologischen Institutes 27 (Vienna 2007).

Bietak *et al.* 2012/2013
M. Bietak – C. von Rüden – J. Becker – J. Jungfleisch – L. Morgan – E. Peintner, Preliminary report on the Tell el-Dab^ca wall painting project – Seasons 2011/2012, Egypt and the Levant 22/23, 2012/2013, 131–147.

Brecoulaki *et al.* 2008
H. Brecoulaki – C. Zaitoun – S. Stocker – J. Davis, An archer from the palace of Nestor. A new wall-painting fragment in the Chora Museum, Hesperia 77, 2008, 363–397.

Brysbaert 2002
A. Brysbaert, Common craftsmanship in the Aegean and east Mediterranean Bronze Age. Preliminary technological evidence with emphasis on the painted plaster from Tell el-Dab^{c}a, Egypt, Egypt and the Levant 12, 2002, 95–107.

Brysbaert 2007
A. Brysbaert, A technological approach to the painted plaster of Tell el-Dab^{c}a, Egypt. Microscopy and scientific analysis, in: Bietak *et al.* 2007, 151–162.

Brysbaert 2008
A. Brysbaert, The Power of Technology in the Bronze Age Eastern Mediterranean. The Case of the Painted Plaster, Monographs in Mediterranean Archaeology 12 (London 2008).

Cameron 1976
M. A. S. Cameron, A General Study of Minoan Frescoes with Particular Reference to Unpublished Wall Paintings from Knossos (PhD Diss., Newcastle University, Newcastle upon Tyne 1976). Online <http://hdl.handle.net/10443/302> (last access 15 July 2017).

Cameron *et al.* 1977
M. A. S. Cameron – R. Jones – S. Philippakis, Scientific analyses of Minoan fresco samples from Knossos, Annual of the British School at Athens 72, 1977, 121–184.

Coleman 1973
K. Coleman, Frescoes from Ayia Irini, Keos. Part I, Hesperia 42,3 1973, 284–300.

Doerner 2001
M. Doerner [ed. T. Hoppe], Malmaterial und seine Verwendung im Bilde, 19th edition (Berlin 2001).

Doumas 1992
Ch. Doumas, The Wall-Paintings of Thera (Athens 1992).

García-Moreno *et al.* 2013
R. García-Moreno – F.-P. Hocquet – F. Mathis – E. Van Elslande – D. Strivay – P. Vandenabeele, Archaeometry research on the wall paintings in the tomb chapel of Menna, in: Hartwig 2013, 93–111.

Hartwig 2013
M. Hartwig (ed.), The Tomb Chapel of Menna (TT 69). The Art, Culture, and Science of Painting in an Egyptian Tomb, American Research Centre in Egypt Conservation Series 5 (Cairo, New York 2013).

Hartwig – Leterme 2013
M. Hartwig – K. Leterme, Visual and archaeometric analysis of the paintings, in: Hartwig 2013, 133–161.

Heaton 1912
N. Heaton, On the nature and method of execution of specimens of painted plaster from the palace of Tiryns, in: Rodenwaldt 2012, 211–216.

Jánosi 1996
P. Jánosi, Die Fundamentplattform eines Palastes (?) der späten Hyksoszeit in ᶜEzbet Helmi (Tell el-Dabᶜa), in: M. Bietak (ed.), Haus und Palast im alten Ägypten. Internationales Symposium in Cairo, April 8th–11th 1992, Denkschriften der Gesamtakademie 14, Untersuchungen der Zweigstelle Kairo des Österreichischen Archäologischen Instituts (Vienna 1996) 93–98.

Knoepfli – Emmenegger 1990
A. Knoepfli, – O. Emmenegger, Wandmalerei bis zum Ende des Mittelalters, in: A. Knoepfli, – O. Emmenegger – M. Koller – A. Meyer, Wandmalerei – Mosaik, Reclams Handbuch der künstlerischen Techniken Vol. 2 (Stuttgart 1990) 7–212.

Lang 1969
M. L. Lang, The Palace of Nestor at Pylos in Western Messenia II. The Frescoes (Princeton 1969).

Lucas 1962
A. Lucas [ed. J. R. Harris], Ancient Egyptian Materials and Industries, 4th edition (London 1962).

Majewski – Reich 1973
L. Majewski – M. Reich, Appendix. Technical examination of fresco samples form excavations at Ayia Irini, in: Coleman 1973, 297–300.

Mancinelli 1997
F. Mancinelli, The painting of the Last Judgment. History, technique, and restoration, in: L. Partridge – F. Mancinelli – G. Colalucci, Michelangelo the Last Judgment. A Glorious Restoration (New York 1997).

Marinatos 2010
N. Marinatos, Lions from Tell el-Dabᶜa, Egypt and the Levant 20, 2010, 325–355.

Mora *et al.* 1984
P. Mora – L. Mora – P. Philippot, Conservation of Wall Paintings (London 1984).

Morgan 2010a
L. Morgan, A pride of Leopards. A unique aspect of the hunt frieze from Tell el-Dab^{c}a, Egypt and the Levant 20, 2010, 263–301.

Morgan 2010b
L. Morgan, An Aegean griffin in Egypt. The hunt frieze at Tell el-Dab^{c}a, Egypt and the Levant 20, 2010, 303–323.

Rodenwaldt 1912
G. Rodenwaldt, Tiryns. Die Ergebnisse der Ausgrabungen des Instituts II. Die Fresken des Palastes (Athens 1912).

von Rüden 2015
C. von Rüden, Transmediterranean knowledge and Minoan style reliefs in Tell el-Dab^{c}a. An attempt at paradigm shift, in: S. Cappel – U. Günkel-Maschek – D. Panagiotopoulos (eds.), Minoan Archaeology. Perspectives for the 21st Century. Proceedings of the International PhD and Post-Doc Conference at Heidelberg, 23–27 March 2011 (Louvain 2015) 355–365.

Seeber 2000
R. Seeber, The technique of plaster preparation for the Minoan wall paintings at Tell el-Dab^{c}a, Egypt. Preliminary results, in: Sherratt 2000, 91–102.

Sellet 1993
F. Sellet, Chaîne opératoire. The concept and its applications, Lithic Technology 18, 1993, 106–112.

Sherratt 2000
S. Sherratt (ed.), Proceedings of the First International Symposium 'The Wall Paintings of Thera', Petros M. Nomikos Conference Centre Thera, Hellas, 30 August – 4 September 1997 (Athens 2000).

Wehlte 2000
K. Wehlte [ed. H. Düchting], Werkstoffe und Technik der Malerei (Ravensburg 2000).

Weyer *et al.* 2016
A. Weyer – P. Picazo – D. Pop – J. Cassar – A. Özköse – J.-M. Vallet – I. Srša (eds.), EwaGlos. European Illustrated Glossary of Conservation Terms for Wall Paintings and Architectural Surfaces, Series of Publications by the Hornemann Institute 17, 2nd revised edition (Petersberg 2016). Online <http://193.175.110.9/hornemann/doi/2016ewa2a.pdf> (last access 8 Mar. 2017).

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Architectural Impressions in the 'Aegean'-style Wall Paintings from Tell el-Dab^{c}a

Johannes Jungfleisch[1]

Abstract

The fragmented and dislocated nature of many wall paintings obscures their former architectural context. As an integral part of architecture, painted plaster forms both an aesthetic and protective surface of buildings, by covering brickwork, masonry and other construction materials.

In consequence of this material entanglement, collapsed plaster provides information on once hidden and now bygone architectural features in the form of impressions on their reverse. Additionally, an *inverted perspective* on murals allows us to examine the practical knowledge and technical choices underlying the construction process and the practice of plastering.

In this sense, the analysis of reverse sides opens new perspectives on buildings, showing influences from different architectural traditions as attested for the palatial complex of the 18th dynasty in Tell el-Dab^{c}a/Egypt. The use of an 'Aegean'-style plaster technique within local-specific élite buildings represents in and of itself a new architectural creation. In order to specify this unique mixture, this paper discusses the reverses of the lime plaster fragments from 'Palace G' and 'Palace F' at Tell el-Dab^{c}a with special reference to the local mud brick architecture. Furthermore, the methodological value of this approach for the reconstruction of large-scale murals will be evaluated and demonstrated here in regard to the painted architectural *simulations* from 'Palace G'.

Keywords: Egypt; Aegean; Tell el-Dab^{c}a; ceiling plaster; roof construction; plastering; reconstruction of architectural elements.

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in: J. Becker, J. Jungfleisch and C. von Rüden (eds.) Tracing Technoscapes. The Production of Bronze Age Wall Paintings in the Eastern Mediterranean (Leiden 2018) 191-212.

1. Introduction

The discovery of vast amounts of colourful painted, lime-based plaster fragments within a representative building complex of the 18th dynasty at Tell el-Dabᶜa attracted great interest in Egyptology and Aegean Prehistory during the 1990s and 2000s. From the very beginning, the excavators realised that the murals contrasted with contemporary paintings from New Kingdom Egypt in technical as well as iconographical respects.[2] Instead, the painted plaster fragments showed distinct features of the wall painting 'tradition' known from the Bronze Age Aegean. During the last 25 years archaeometric,[3] technical[4] and iconographical studies[5] supported these first impressions and demonstrated close parallels with murals from different sites of the Aegean.

Nevertheless, the 'Aegean'-style interior design was once an integral part of the 'Egyptian' palatial architecture at Tell el-Dabᶜa. As such, the painted plaster covered brickwork, wooden frames and other materials used in the wall and roof construction. Forming an interface between the local 'Egyptian' mud brick architecture and the 'Aegean'-style painted surface, the evidence of reverses might shed some light on the impact of this encounter. In the light of the scanty architectural remains at Tell el-Dabᶜa only preserved in the form of substructures, the reverse sides and their intrinsic evidence form an important source to approach the former architectural setting of the wall paintings.

With this in mind, this paper discusses the reverses of lime plaster fragments found at Tell el-Dabᶜa. The focus is on their potential to offer an *inverted* and at the same time *connecting* perspective on the local mud brick architecture. Besides the methodological value of this approach for the reconstruction of large-scale murals, the examination of the technical choices underlying the construction process will be of interest.

2. Methodological Value of Plaster Reverses

The analysis of plaster reverses does not form a completely new methodological approach in the study of fragmented wall paintings. As early as 1976, Mark Cameron emphasised the importance of the reverse sides in deducing from this evidence "(…) the place where a painting belonged, the character of the wall it decorated, and the manner of its physical construction."[6] But in order to gain insight into architectural and technical features preserved in the reverse side, it is essential to "know how to "read" the broken pieces aright",[7] as M. Cameron put it.

In this line of thought, the physical state of the reverses gives valuable evidence about the constructional character of former walls and roofs. Whereas flat back surfaces point to either dressed masonry or wall-faces already prepared with some sort of smooth backing plaster, irregular indentations on the reverses indicate rough wall constructions

2 See: Bietak 1994.
3 See: Brysbaert 2007.
4 See: e.g. Becker 2016.
5 See: Bietak *et al.* 2007.
6 Cameron 1976, Vol. I, 301.
7 Cameron 1976, Vol. I, 274.

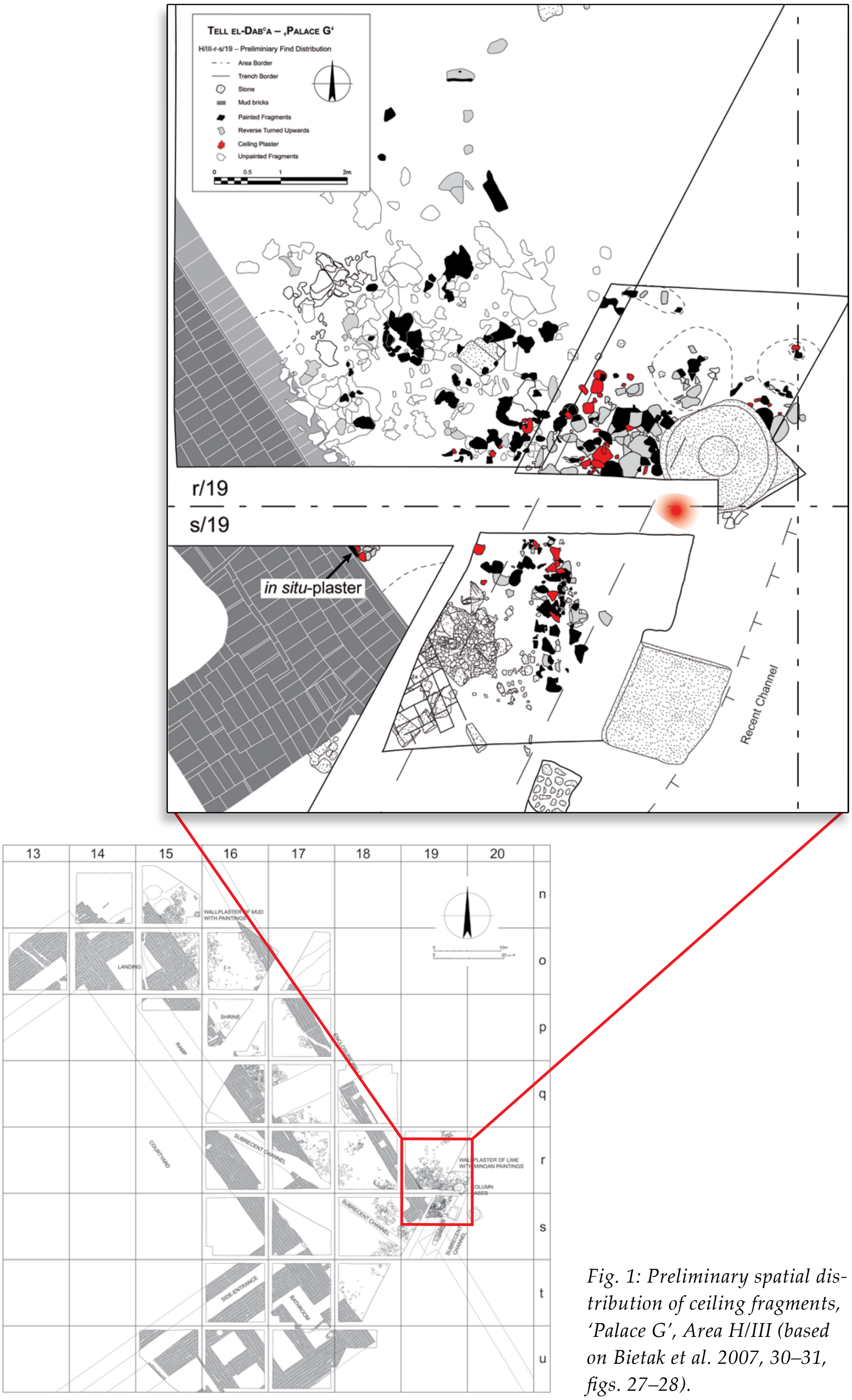

Fig. 1: Preliminary spatial distribution of ceiling fragments, 'Palace G', Area H/III (based on Bietak et al. 2007, 30–31, figs. 27–28).

made of rubble and mud.[8] Furthermore, pieces with triangular sections and elongated, rodlike impressions most probably originated from the ceiling construction.[9]

3. Analysis of the Plaster Reverses from Tell el-Dabᶜa

3.1 Ceiling Plasters from 'Palace G'

As mentioned above, the methodological value of reverses is of great interest for the examination of the wall paintings from Tell el-Dabᶜa. On the one hand, the reverses can provide an insight into the construction techniques and the architectural design of the bygone structures at Tell el-Dabᶜa. On the other hand, they might shed light on the orientation and position of the plaster fragments within their former compositions.

This especially holds true for one group of lime plaster fragments, almost exclusively found in area H/III of 'Palace G'.[10] The find locations of these fragments are limited to a small area beyond 'enclosure wall H' in the former entrance portico of 'Palace G' (Fig. 1).

Their rear sides include a wide range of impressions, apparently deriving from different organic materials. In contrast, the obverses display a uniform appearance of monochrome light red with a coarsely smoothed surface. Judging by the imprints of the rear sides, the craftspeople applied the plaster directly against reeds, poles, limb wood and barely dressed wooden beams. Most probably these plant materials, on which the plaster pieces once rested, formed parts of the original ceiling construction.

However, the combined evidence of reverses, sections and obverses of the pieces allows us to divide the corpus of ceiling plasters from 'Palace G' into six categories which, with one exception, roughly correspond to their former position within the ceiling construction.

The largest group of ceiling plasters ('group a'; 109 pieces) features an uneven obverse with a rough surface treatment and imprints of longitudinal, semi-circular, rodlike materials on their rear sides (Fig. 2).[11] Obviously, the single elements of the latter materials were tightly placed side by side and bound together spirally with string. Parallels for the imprints of the reverses are known from different Bronze Age sites of the Aegean[12] and Egypt.[13] In both regions the materials forming the impressions were identified as culms of local grasses, most probably common reed (*Phragmites australis*)

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8 Cameron 1976, Vol. I, 278–279, fig. 40.

9 See: Cameron 1972, 309, pl. 82d; Shaw 2006, 199 (no. 134), 204–205, pl. 2.31; Kemp – Stevens 2010, 158–169, esp. fig. 2.34 (nos. 17, 315).

10 Although the conservation of the wall painting fragments from 'Palace F' was recently completed, there are only a few comparable fragments, found in this area. The imbalance in distribution might be the accidental result of the depositional processes and/or the state of preservation.

11 The size of the impressions varies between 0.8 and 2.1cm in diameter.

12 Cf. e.g. Wiencke 2000, 279–283 (Lerna, Argolid, EH II); Cameron 1972, 309–310; Rackham 1972, 304 (Myrtos, Crete, EM II); Palyvou 1999, 213–215 (Akrotiri, Thera, LM IA); Militello 2001, 47 (no. F 55°.10m), pl. 2.3 (Phaistos, Crete, MM I–II?); Shaw 2006, 199 (no. 134), 204–205, pl. 2.31 (Kommos, Crete, MM IIIB–LM IA).

13 Cf. e.g. Peet – Woolley 1923, 42, 57–58 ('Eastern Village', Tell el-Amarna, Middle Egypt, Amenhotep IV); Watanabe 1993, pl. 9c; Kemp 2000, 94 fig. 3.8b ('Site E', Malqata, Upper Egypt, Amenhotep III); Weatherhead – Kemp 2007, 90–112 ('Main Chapel', 'Workmen's Village', Tell el-Amarna, Middle Egypt, Amenhotep IV); Kemp – Stevens 2010, 158–169 ('House of Ranefer', Tell el-Amarna, Middle Egypt, Amenhotep IV).

Fig. 2: Ceiling plaster fragment, central area, F09711, 'group a' (Technical drawing: M. A. Negrete Martínez).

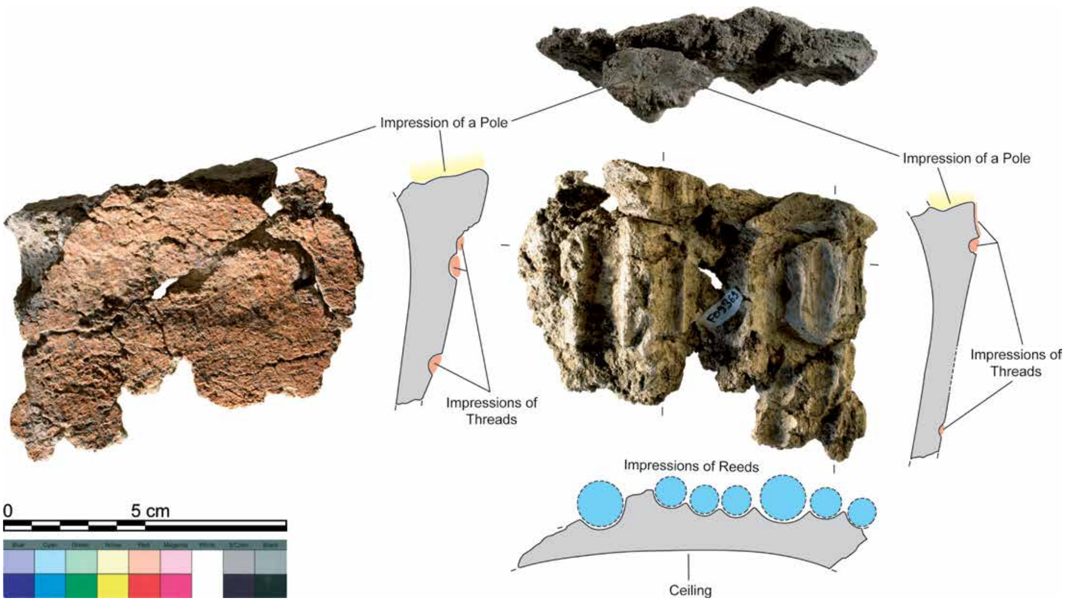

Fig. 3: Transition fragment between ceiling and beam, F09369, 'group b' (Technical drawings: M. A. Negrete Martínez).

and/or giant cane (*Arundo donax*).[14] However, in contrast to the roofing of Bronze Age Aegean buildings, which often featured single reeds loosely laid next to each other,[15] Egyptian ceiling constructions could additionally consist of bundled reeds,

14 For Egypt see: Weatherhead – Kemp 2007, 110–112; for the Aegean see: Rackham 1972, 304.
15 Cf. Palyvou 1999, fig. 113.

placed crosswise upon the rafters.[16] Therefore, it seems reasonable to assume that the lime plaster fragments with the imprints from 'Palace G' at Tell el-Dab^ca most probably faced bundles of reeds, which covered the central spaces between the supporting wooden beams of the roofing construction (Fig. 8).

An additional group of ceiling plaster with a total of 16 fragments ('group b') shows besides the already-mentioned impressions of cylindrical bundles of reeds the imprint of another architectural element. This imprint often exhibits a roughly circular cross-section, running at right angles to the reeds (Fig. 3). Judging by the general form and the possible impressions of plant fibres/wavy grain, a wooden architectural feature such as a pole or a narrow beam might have been the cause of the imprint. Excavations at several Aegean and Egyptian sites, for example at Akrotiri/Thera[17] and Tell el-Amarna/Middle Egypt,[18] revealed similarly shaped lime and mud plaster fragments with analogous arrangements of impressed reeds and wooden features. Apparently, these fragments preserve the transition zone, where the ceiling met the load-bearing rafters (Fig. 8).

The physical evidence of 32 ceiling plaster fragments ('group c') appears rather complex and diverse. The rear sides have either a slightly curving or an even surface with minor indentations. Analogous to the shape of the reverses, the obverses might form a convexly curved or flat surface. Furthermore, the sections of some of these fragments illustrate that the plaster layers curve down and mould in this way a radiused corner at right angles. Their makeup resembles to some extent the sculptured plaster layers of relief paintings, which were found within the areas H/II and H/VI of 'Palace G'.[19] In contrast to the polished, polychrome surfaces of the relief paintings, the mentioned pieces only have roughly smoothed obverses and show the typical plainly applied light red paint of the ceiling plasters from the entrance portico of 'Palace G'. In some cases, the paint application ends and the white hue of the unpainted plaster surface follows. A better-preserved example (Fig. 4) might provide a clearer understanding. This fragment features two slightly elevated sides, which are roughly perpendicular to each other and create a rounded corner. Both surfaces show a light red paint application, but the colour ends halfway through on the side edge, leaving the upper part white. The impression of the reverse indicates the former presence of an elongated architectural feature, displaying a subrectangular cross-section with a rounded corner (3.8cm × 5.8cm). In the context of a ceiling construction, a ceiling beam made of barely dressed wood would be a feasible explanation for the imprint. Due to the lack of impressions of reeds along the upper edge, the fragment might have disguised the lower part of a ceiling beam. However, the above-mentioned heterogeneous-looking pieces most probably represent smaller segments of similar corner fragments. Therefore, it seems plausible that the 31 fragments of this group have to be located in the transition zone between ceiling and rafters and formed the lower part of the beam casing (Fig. 8). Even though a secure identification of the wood species, which left its impressions in

16 Cf. esp. Kemp 2000, fig. 3.8b; Kemp – Stevens 2010, fig. 2.29.
17 See: Palyvou 1999, fig. 113.
18 See: Kemp – Stevens 2010, 159 fig. 2.34 (nos. 118, 170, 315); 168.
19 Cf. von Rüden 2015, fig. 2 (F00037).

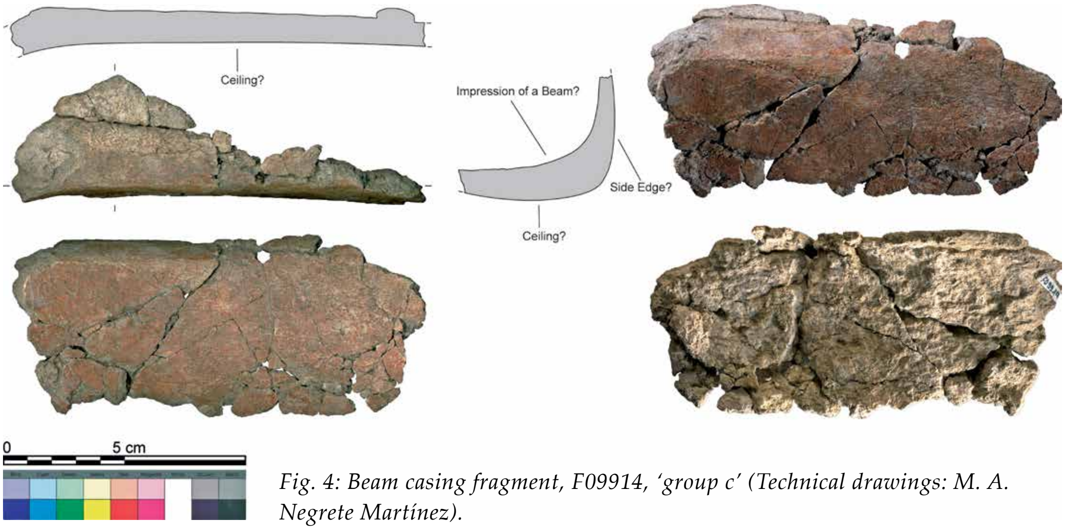

Fig. 4: Beam casing fragment, F09914, 'group c' (Technical drawings: M. A. Negrete Martínez).

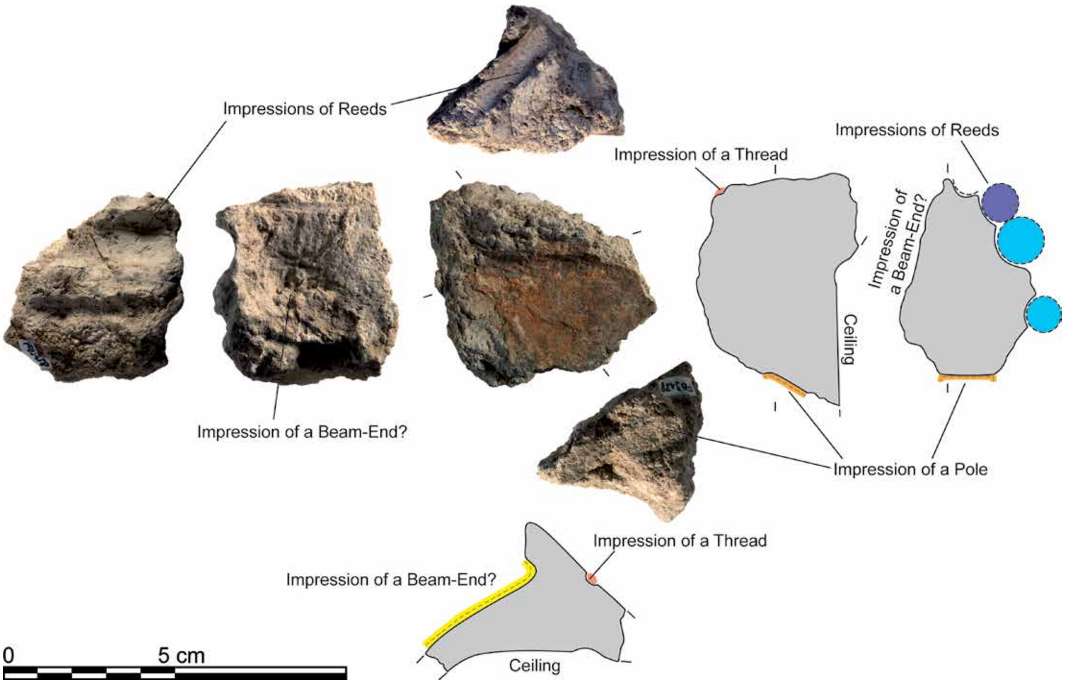

Fig. 5: Corner fragment, F09138, 'group d' (Technical drawings: M. A. Negrete Martínez).

the plaster, is hardly possible, the texture of some of the imprints brings to mind the surface of a barely dressed palm tree trunk.[20]

20 The reverse of F09914 shows two shallow depressions and a slightly elevated line, running crosswise to the course of the beam. The arrangement of these imprints resembles in my opinion to some extent the 'scaled' texture of palm tree trunks with their numerous leaf scars.

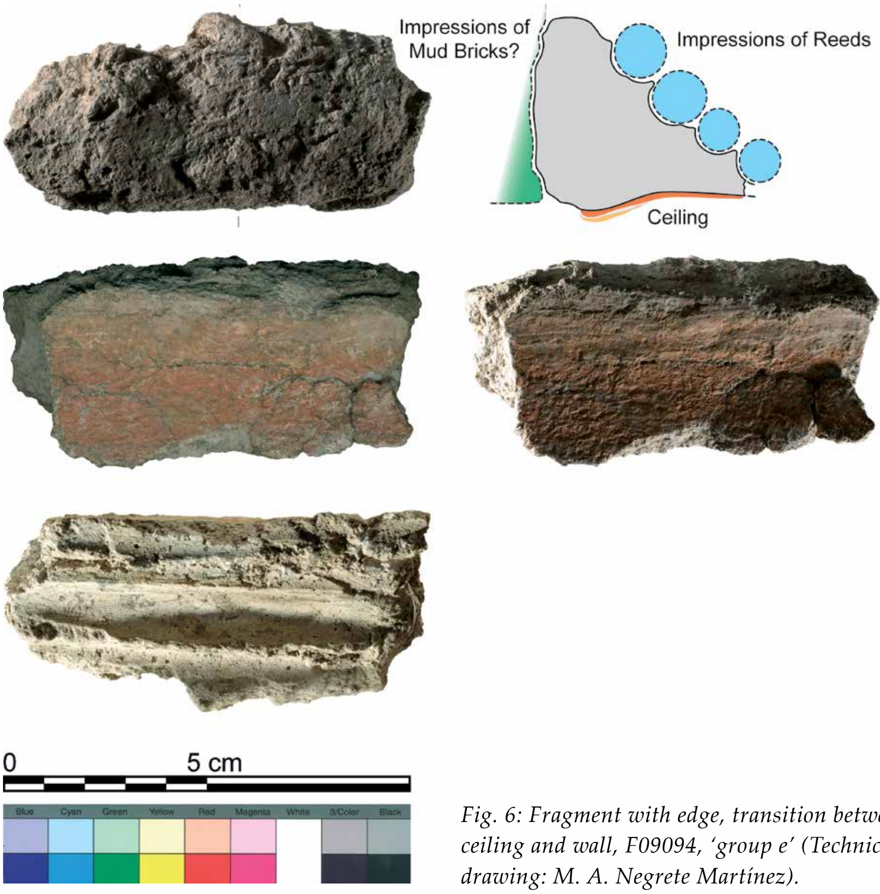

Fig. 6: Fragment with edge, transition between ceiling and wall, F09094, 'group e' (Technical drawing: M. A. Negrete Martínez).

Archaeological findings from different sites in Egypt might offer some comparisons to confirm the suggested spatial assignment of the discussed pieces from Tell el-Dabᶜa. Especially the excavations at Tell el-Amarna, but also at Malqata revealed plenty of evidence concerning the treatment of the ceiling beams. Evidently, the craftspersons rendered the rafters with several layers of mud plaster, disguising the underlying wooden beams by means of box-like casings. Subsequent to the plaster works, the ceiling beams received a pinkish-brown or orange paint application, contrasting with the white colour of the general ceiling decoration.[21] The beams were obtained from different wood species such as acacia,[22] palm,[23] and tamarix.[24]

Going back to the evidence from Tell el-Dabᶜa, a fourth group of ceiling plasters consists of only eight fragments, which display a complex structure of impressions ('group d'). The imprints derive from different architectural features such as wooden

21 See: Peet – Woolley 1923, 9–10, esp. fig. 2; Kemp 2000, fig. 3.8b; Kemp – Stevens 2010, pl. 2.27, 167–169, fig. 2.35 (nos. 1, 5, 43, 52, 61, 433), fig. 2.36 (nos. 67, 94, 153, 295), col. pl. 3 (no. 295).

22 Cf. El-Saidi – Cornwell 1986, 8–11 ('Walled Village', Tell el-Amarna, Middle Egypt, Amenhotep IV); Shartzer 1990, 8 ('House E', Deir el-Ballas, Upper Egypt, 17th dynasty).

23 In fact, people in Egypt use unworked palm wood in the construction of their houses until today. For the archaeological findings from Deir el-Ballas, cf. Lacovara 1996, 142.

24 Cf. Weatherhead – Kemp 2007, 110–111 (sample nos. 18, 20, 25).

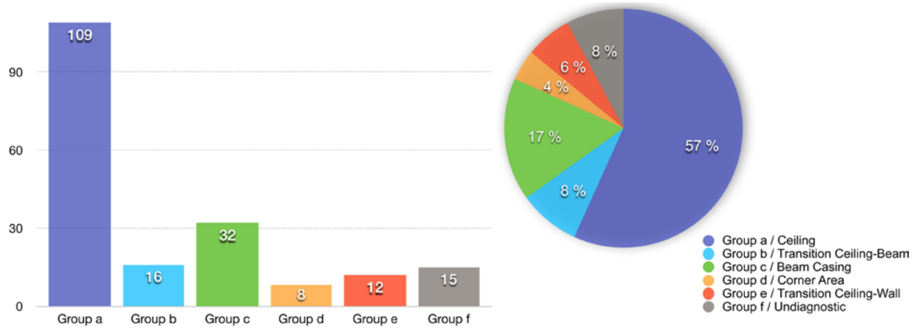

Fig. 7: Categories of ceiling plaster and piece numbers.

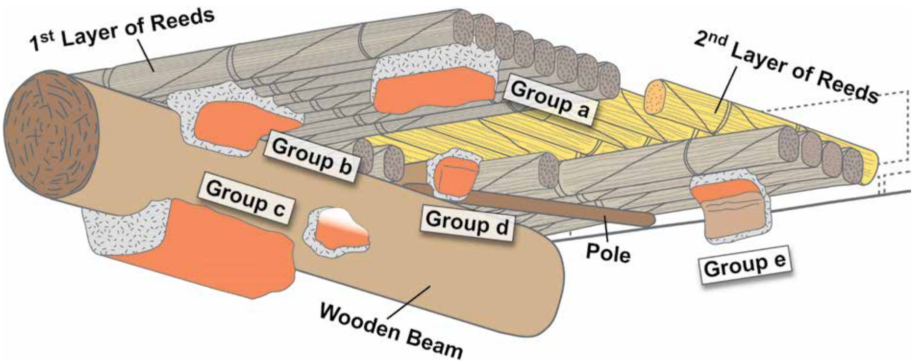

Fig. 8: Illustration of possible positions of the ceiling plaster fragments (based on Kemp 2000, fig. 3.8b).

poles, beams and tied up reeds, covering every single side except the obverse. The plaster layers slightly thin out and curve in to the upper and the adjacent left or right edge, depending on the specific fragment. In this way, the plaster forms an upper and a lateral corner. Shallow ridges are visible on the surface along both edges (Fig. 5). Although the original architectural location is highly difficult to assess, the combined evidence of both, reverses and obverses, most likely point to a position in a corner area between ceiling, beam and wall (Fig. 8).

The fifth and last diagnostic category of ceiling plasters consists of 12 fragments ('group e', Fig. 6). All samples present three faces, forming a roughly right-angled triangle in profile view. The slightly concave obverse generally has a light red-painted surface which was painted over in some cases with orange colour in the fragment's lower part. The latter colour application usually occurs in the upper part of the disc design, discussed at a later point of this paper. Based on their colour applications both groups seem to be directly related to each other. The physical evidence of the remaining two sides points to the presence of different architectural features. Evidently, one face abutted on bundled reeds, leaving distinct rodlike impressions on the reverse sides of the pieces. The other side shows a flat, more regular surface which might have originated in a perpendicular structural component such as a wall. In addition, some pieces show either slightly elevated vertical straps or a fine texture of wavy lines on this side.

Whereas the former possibly derive from the heading joints between the mud bricks, the latter could come from the wood grain of beams, incorporated into the wall construction. Summing up the overall characteristics of this group, it seems reasonable to suggest that the plaster was packed into the gap between the reed bundles of the ceiling and the mud bricks of the wall (Fig. 8). Furthermore, wooden components such as rafters of adjacent spatial units or longitudinal structural beams on top of the walls could have caused the impressions of wood grain.

The last 15 pieces do not show specific physical features which would allow a more detailed classification.

Regarding the frequency of the different types of ceiling plasters (Fig. 7), it is striking that most of the fragments belongs to the central part of the ceiling ('group a'), whereas other areas of the ceiling, for example the transitions to the walls or beams, are underrepresented in the sample. Possibly, the quantitative distribution correlates with the dimensions of the areas that the fragments originally covered.

Putting the evidence of all ceiling plasters together, it is possible to get an idea of the former ceiling construction and its making (Figs. 7, 8): Apparently, the ceiling consisted of rafters, reaching from one side of the room to the other,[25] and several layers of reed bundles, tied together by plant-fibre ropes. The first layer of reed bundles ran crosswise to the rafters and parallel to the walls, the second one was orientated vice versa. Unfortunately, it remains an open question whether a longitudinal ceiling beam carried the transversal rafters.[26]

After the construction of the ceiling was finished, the craftspersons applied several layers of lime plaster mixed with animal hair to the underside of the reed bundles and coated the protruding wooden beams with box-like casings. The latter approach might have served to disguise the irregularities of the used tree trunks or large limbs as in Tell el-Amarna.[27] Contrary to the murals, the ceiling plasters only received a rough smoothing which is evident in slightly elevated drag marks on the plaster surfaces. In a final working step, the plastered surface of the ceiling was painted light red.

3.2 From the Ceiling to the Wall

Occasionally, the roofing construction left its impressions not only in the casing of the ceiling, but also in the lime plaster of the walls. This especially holds true for some wall plaster fragments from 'Palace G' at Tell el-Dab^{c}a, which belong to the so-called 'architectural simulations'. These iconographic groups consist mostly of large-scale painted reproductions of 'Aegean'-style architecture such as colourful veined stone slabs and wooden elements.[28]

25 Unfortunately, it is not possible to reconstruct the distance between the single beams on the basis of the available evidence. However, findings from the 'Walled Village' at Tell el-Amarna give at least an idea of the distances: Based on the evidence of the preserved poles, which had been cut roughly to same length, the excavators were able to determine the maximal width of the spaces between the rafters, which was about 70.0cm. El-Saidi – Cornwell 1986, 10.

26 In contrast, the excavations at Tell el-Amarna yielded mud plaster fragments whose arrangement in relation to the plaster casings of the rafters points to the presence of a longitudinal main beam. A column in the middle of the spatial unit might have supported the latter. See: Frankfort – Pendlebury 1933, 28–29, fig. 4.

27 Cf. Kemp – Stevens 2010, 167.

28 Jungfleisch 2016, esp. 42–46.

Fig. 9: Oblique view from above on the left side of F07446 ('beam-end'-frieze).

A large subgroup of the architectural 'simulations' shows a distinct decorative scheme with rows of alternating black and red solid circles on white ground. A streaky orange area above and a blue area below frame this frieze. The pieces of this group were found next to the ceiling plasters in the area of the former entrance portico of 'Palace G'.[29]

In the context of Aegean wall paintings, rows of discs are usually interpreted as stylised depictions of wooden beam-ends, representing either rafters of the ceiling/roofing construction or parts of the wooden framework.[30] Large-scale examples of these architecturally-inspired motifs were found at Pylos/Mainland Greece. Many fragments of this Pylian 'beam-end'-frieze show a straight upper edge which derives either from a

29 Jungfleisch 2016, 45–46, figs. 3, 6.

30 For miniature representations of beam-ends, see: Morgan 1988, 75–77; for large-scale examples, see: Lang 1969, 145, 153–154, 207–208; Aravantinos – Fappas 2015, 334–335, fig. 13.

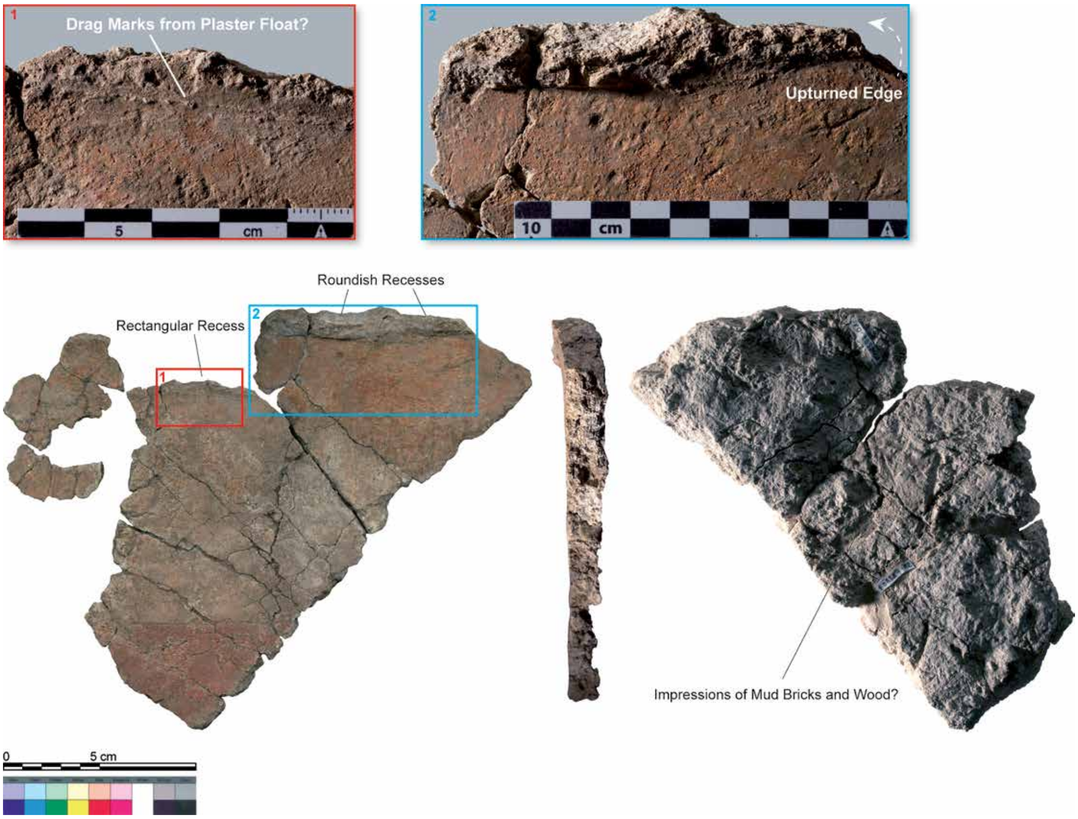

Fig. 10: Obverse, profile, reverse and detailed views of F08387 (probably belonging to the 'beam-end'-frieze).

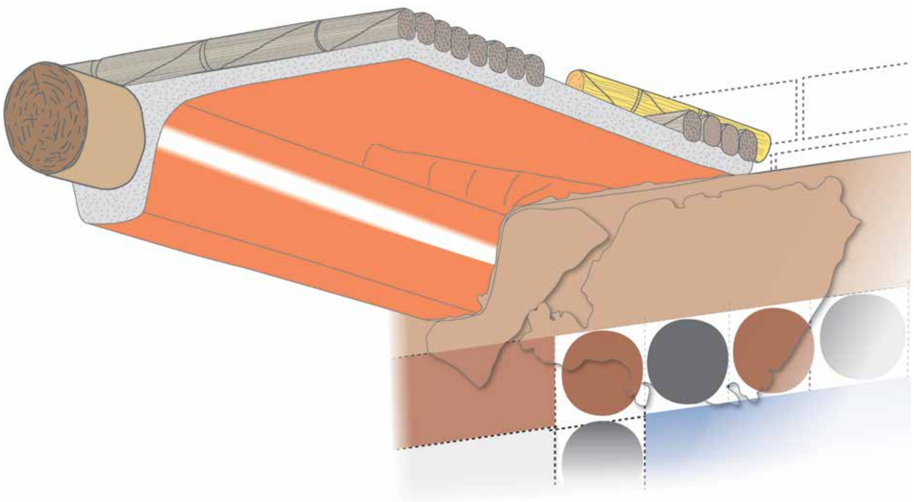

Fig. 11: Visualisation of possible spatial relations between the ceiling plasters and pieces of the 'beam-end'-frieze (based on Kemp 2000, fig. 3.8b).

wooden beam or the ceiling itself. Therefore, these pieces most probably decorated the upper parts of the walls immediately below the ceiling.[31]

Based on this comparison, the rows of black and red circles from Tell el-Dabᶜa similarly represent the depiction of a 'beam-end'-frieze. Since some of the related pieces also feature a straight edge along the upper border of the orange area (Fig. 9), this identification is further supported. The plaster layers slightly curve in and subsequently end along the edge, as if the fragments abutted on an architectural element such as a beam on top of the wall construction or the actual ceiling. Additionally, the reverses once more give evidence for the original orientation of the fragments: Besides different organic materials such as wood and vegetable fibres, horizontal courses of mud bricks left faint traces on the backs of the fragments, predetermining their horizontal alignment parallel to the edge.

A few fragments lack the distinctive disc design but display similar orange and/or red paint applications which connect them to the 'beam-end'-frieze (Fig. 10). From a technical point of view, these associated pieces present a well-defined top edge, curving plaster layers and angular shaped or roundish recesses along their upper borders. Occasionally, drag marks and plaster remains accompany these recesses on the surfaces of the obverses. Murals with similar impressions along the upper edges are, for instance, known from Akrotiri on Thera. In this case, the circular imprint reflects the former position of a ceiling beam, protruding from the wall.[32] Based on this comparison, the above-mentioned fragments from Tell el-Dabᶜa could also derive from roughly squared limbs or trunks, set into the mud brick walls in order to carry the weight of the ceiling.

Belonging to the transition zone between wall and ceiling construction, some ceiling plasters preserve a change in colour along the edge on the side of the former mural.[33] The micro-stratigraphy of the surface reveals that firstly a thin white plaster layer and secondly an orange paint application follows on the light red of the ceiling (Fig. 6). It is important to note that the orange colour matches the pigments of the orange-painted areas of the 'beam-end'-frieze in hue and composition perfectly. Judging from this evidence, the workflow of the craftspeople was as follows: In a first step, they provided the ceiling with a light red-painted plaster casing. Only after its compeltion, they continued with the plastering works of the walls (Fig. 11). During this working step, they spread some of the wall plaster on the already finished surface of the ceiling. To correct these stains of wall plaster on the ceiling, the painters extended the orange paint application of the murals onto the surface of the ceiling along the junction to the wall. Consequently, the craftspeople pursued a top-down approach in the planning of their work. The workmanship of the plaster floors at Tell el-Dabᶜa support this conclusion. Their construction followed only after the rendering of the walls.[34] Therefore, the analysis of the technical characteristics provides valuable information for the craftspersons' general work organisation in the creation of the decoration system at Tell el-Dabᶜa.

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31 See: Lang 1969, 153–154 (no. 14F45), 208.
32 See: Doumas 1992, figs. 86, 90.
33 See also: Jungfleisch 2016, 46.
34 Winkels 2007, 288.

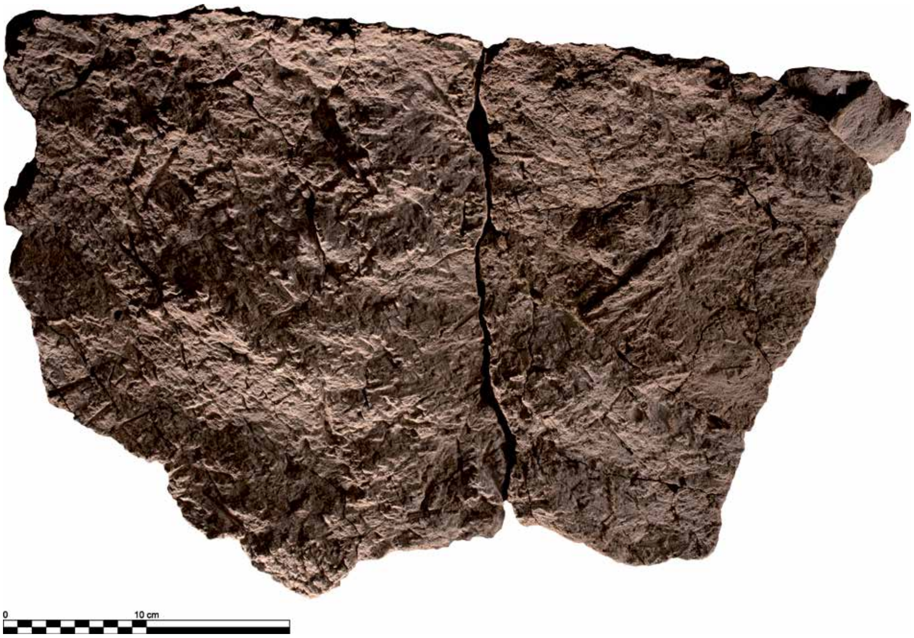

Fig. 12: Reverse of F09797 with impressions of organic materials, possibly deriving from the mud backing plaster.

3.3 Wall Plasters from 'Palace G' and 'Palace F'

In some instances of the so-called architectural 'simulations', the reconstruction of the compositions proved rather difficult. Due to their large scale and fragmented state of preservation, the reproductions of 'Aegean'-style architecture from Tell el-Dab^{c}a mostly appear as isolated mono- or bichrome pieces. In contrast to the more comprehensible figural depictions,[35] the painted surfaces of the architectural simulations do not give a hint to their former orientation. Even the examination of the sporadic string impressions, which most probably run in vertical or horizontal direction, restricts their alignment to four different possibilities.

The reverses and their impressions potentially assist us in determining the original position of the fragments. Usually, the workers in ancient Egypt deployed different types of brick bondings with regular mud brick courses,[36] which might have left consistent patterns of negative imprints on the reverses of the lime plaster fragments. Ideally, the impressions of brickwork would reduce the options of alignment to two possibilities. In practice, however, the reverse sides of a majority of fragments recovered from area H/III are far from being clear. In fact, many rear sides have a rather flat surface with minor indentations and local elevated areas (Fig. 12), which to some extent contradict the assumed regular patterns of stretchers and/or headers. Instead, the rear sides often feature a furrowed surface with imprints of vegetable fibres and other materials, eventually small pieces of wood and pottery sherds.

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35 Cf. e.g. Bietak *et al.* 2007, figs. 39–40, figs. 59a–b; 60, 69.
36 For the bondings of New Kingdom official architecture, see e.g.: Spencer 1979, 84–89, esp. 88–89.

In summary, the organic and inorganic imprints of the reverses and the faint, almost indiscernible impressions of mud bricks point to the usage of a rough mud backing plaster, which contained different organic components and inorganic tempering materials such as pottery fragments. Apparently, this plaster layer served as a first coat of the walls, on which the craftspersons subsequently rendered multiple layers of lime plaster. Similar technical approaches to the plastering works are present within the corpus of Aegean wall paintings.[37]

In contrast, the reverses of the wall paintings found at area H/I, 'Palace F', differ from the above-mentioned evidence of area H/III.[38] Evidently, the murals from 'Palace F' exhibit projecting ridges on their rear sides, which possibly reflect the joints between mud bricks and therefore their former layout as positive casts. Besides the clearly articulated impressions of brickwork, the plaster body of the pieces from 'Palace F' is rather thick and in some cases reaches up to 12.0 centimetres.[39]

The distinct mud brick impressions of pieces from areas H/I could have been the result of a specific approach in the practice of plastering. In place of using an additional mud backing plaster as observed for the pieces from area H/III, the craftspersons possibly spread the lime plaster directly on the mud bricks and, in doing so, filled it into the slightly depressed joints of the brickwork.[40] It might be the case that the artisans tried to intensify this effect and scraped out the interstices before the plastering works.[41] In this way, the lime plaster penetrated the gaps in-between the mud bricks even deeper and ensured a better adhesion of the murals to the wall construction. Interestingly, modern reference books of painting techniques advise similar approaches for the substitution of an old lime plaster coating by a new one.[42]

Although the analyses of Aegean wall painting revealed different methods of anchoring, which include the intentional scoring of the backing plaster or the insertion of wooden pegs, sherds and stones into the lower layers, the above-mentioned technique from Tell el-Dab^{c}a seems to be without Aegean parallels so far. Instead, similar evidence of clearly impressed mud bricks is known from the reverses of wall paintings on mud plaster found at other sites in Egypt such as the Meroitic 'Temple Complex' of Qasr Ibrim.[43]

However, the attested differences between the practices of plastering at 'Palace G' and 'Palace F' are all the more surprising as both structures were probably set up in the course of the same building programme.[44]

37 See: Cameron 1976, Vol. I, fig. 40.

38 Although such clear imprints of mud bricks are missing within the plaster corpus of area H/III, a few examples with similar evidence on their reverse sides originated from area H/VI. This site is located along the southeastern side of 'Palace G' which is why the wall painting finds from this findspot most probably also belonged to the interior design of 'Palace G'.

39 Seeber 2000, 94; see also Becker this volume.

40 See: Seeber 2000, fig. 7.

41 Bietak *et al.* 2001, 40.

42 Cf. Doerner 2001, 235.

43 See: Pyke 2007, 64 with fig. 12.15.

44 Cf. Bietak *et al.* 2007, 20.

4. Concluding Thoughts on the Practice of Plastering at Tell el-Dab^ca

From the varied evidence of the rear sides from 'Palace F' and 'Palace G' the question arises regarding which reasons might have affected the different choices in the practice of plastering.

The architectural impressions on the fragments' rears enable us to differentiate in general between wall- and ceiling plasters. In the latter case the negative impressions mostly derive from bundled reeds, limbs and coarsely dressed wooden beams. The combination of specific building materials on the rears coincides with the fragment's former position within the ceiling. Therefore it is possible to reconstruct the ceiling's construction technique and making: Egyptian-style tied up bundles of reeds served as the main building material of the ceiling. The craftspersons placed these bundles crosswise on the rafters which were roughly circular or rectangular in section. Subsequently the craftspersons spread the lime plaster without any interlayer directly on the surfaces of the ceiling construction. Obviously the identified building materials of the ceiling provided irregular, but rough, surfaces, well-suited for receiving lime plaster. After a rough smoothing of the ceiling the craftspeople executed a light red paint application. Only after the completion of the ceiling, they continued with the plastering of the walls.

At this point, it is important to draw attention to the constructional characteristics of mud brick architecture on alluvial ground. Hard lime plaster, as noted by Manfred Bietak, is rather unsuitable for thick walls made of soft building material like mud bricks.[45] Compaction processes as well as expansion and shrinkage cycles result in mechanical tensions within the brickwork, which affect the coating of the wall construction to a great extent. Contrary to the more elastic mud plaster, the hard lime plaster forms cracks.

In this context, the varying manners of preparing the wall surfaces may indicate that the craftspeople considered the environmental constrains and constructional demands of the mud brick architecture on alluvial ground. By testing different ways of anchorage, they could have tried to find specific solutions for the incompatibilities between the different yet entangled materials. Understood in this sense, the purpose of mud backing plaster in the case of 'Palace G' was to prevent the plaster from cracks. The softer mud mortar and the tempering materials could have distributed and at the same time reduced the mechanical tensions, emerging from the moving brickwork.[46] In addition, the organic aggregates of the mud plaster projected into the lime coat and ensured a firm adhesion of the latter.[47] At 'Palace F' and to a lesser extent at 'Palace G', the craftspersons sought another approach instead: Possibly, they left blank or scraped out the joints of the (settled) mud brick walls and threw the plaster into the gaps. In consequence, the lime plaster firmly clung to the underlying wall construction.

Whereas the use of mud mortar as backing plaster was common in Egypt, the Levant[48] and the Aegean, this specific method of anchoring the lime plaster to the brickwork might form a situational adaption of the original technique in the context

45 Bietak *et al.* 2007, 38–39.
46 Cf. Homsher 2012, 3.
47 Cf. Cameron 1976, Vol. I, 280.
48 Cf. Woolley 1955, 225 (Alalakh); Niemeier – Niemeier 2002, 266, 268, pl. XX (Tel Kabri); von Rüden 2011, 89–90, pl. 26b, d (Qaṭna, Tel Sakka).

of Egyptian mud brick architecture. This interpretation of the reverses of fragments from 'Palace F' introduces different (temporal) scenarios, in which the alteration of technique could have occurred: On the one hand, the craftspeople possibly anticipated the impact of the mud brick architecture on the hard lime plaster and consequently chose a technique adjusted to the local circumstances right from the beginning of the plastering work at 'Palace F'. On the other hand, it seems possible that the craftspeople faced unscheduled problems with cracks in the plaster surfaces during their works in the palatial district and subsequently tried to respond with ad hoc-modifications of the technique. However, the manifold evidence of reverses reveals the craftspeople's creative ways in coping with environmental constrains and resulting constructional problems at the site of Tell el-Dabᶜa.

To sum up, a close examination of the reverses of lime plaster fragments revealed valuable information not only on the positioning of the fragments but also on the ceiling construction techniques. Moreover, on this *inverted* reading, the 'Aegean'-style wall paintings on the 'Egyptian' mud brick architecture represent in and of itself an innovation, exactly where both, murals and architecture, encounter – between plaster and wall/ceiling. This unique architectural creation emerges from the new interdependences of the different involved materials and techniques within a particular environmental setting. But in the end, all the creative efforts to accommodate and overcome the incompatibilities within the new material entanglements possibly did not work out, as the large secondary deposits of plaster fragments in front of both palaces bear witness.

References

Aravantinos – Fappas 2015

V. Aravantinos – I. Fappas, The Mycenaean wall paintings of Thebes. From excavation to restoration, in: H. Brecoulaki – J. L. Davis – S. R. Stocker (eds.), Mycenaean Wall Painting in Context. New Discoveries, Old Finds Reconsidered. Proceedings of an International Workshop Held February 10–11, 2011 at the National Hellenic Research Foundation, Μελετήματα 72 (Athens 2015) 316–353.

Becker 2016

J. Becker, The large-scale landscape paintings of Tell el-Dabᶜa/Egypt, in: R. A. Stucky – O. Kaelin – H.-P. Mathys (eds.), Proceedings of the 9th International Congress on the Archaeology of the Ancient Near East, June 9th–13th, 2014, University of Basel Vol. 2 (Wiesbaden 2016) 23–35.

Bietak 1994

M. Bietak, Die Wandmalereien aus Tell el-Dabᶜa/ᶜEzbet Helmi. Erste Eindrücke, Egypt and the Levant 4, 1994, 44–58.

Bietak *et al.* 2001

M. Bietak – J. Dorner – P. Jánosi, Ausgrabungen in dem Palastbezirk von Avaris. Vorbericht Tell el-Dabᶜa/ᶜEzbet Helmi 1993–2000, Egypt and the Levant 11, 2001, 27–120.

Bietak *et al.* 2007

M. Bietak – N. Marinatos – C. Palyvou (eds.), Taureador Scenes in Tell el-Dab^{c}a (Avaris) and Knossos, Denkschriften der Gesamtakademie 43, Untersuchungen der Zweigstelle Kairo des Österreichischen Archäologischen Institutes 27 (Vienna 2007).

Brysbaert 2007

A. Brysbaert, A technological approach to the painted plaster of Tell el-Dab^{c}a, Egypt. Microscopy and Scientific Analysis, in: Bietak *et al.* 2007, 151–162.

Cameron 1972

M. A. S. Cameron, Appendix IV. The plasters, in: Warren 1972, 305–314.

Cameron 1976

M. A. S. Cameron, A General Study of Minoan Frescoes with Particular Reference to Unpublished Wall Paintings from Knossos (PhD Diss., Newcastle University, Newcastle upon Tyne 1976). Online <http://hdl.handle.net/10443/302> (last access 15 July 2017).

Doerner 2001

M. Doerner [ed. T. Hoppe], Malmaterial und seine Verwendung im Bilde, 19th edition (Berlin 2001).

Doumas 1992

Ch. Doumas, The Wall-Paintings of Thera (Athens 1992).

El-Saidi – Cornwell 1986

I. M. El-Saidi – A. Cornwell, Report on the 1985 excavations work inside the walled village, in: B. J. Kemp (ed.), Amarna Reports 3 (London 1986) 1–33.

Frankfort – Pendlebury 1933

H. Frankfort – J. D. S. Pendlebury, The City of Akhenaten. Part II. The North Suburb and the Desert Altars. The Excavations at Tell el Amarna during the Seasons 1927–1932 (London 1933).

Homsher 2012

R. S. Homsher, Mud bricks and the process of construction in the Middle Bronze Age southern Levant, Bulletin of the American Schools of Oriental Research 368, 2012, 1–27.

Jungfleisch 2016

J. Jungfleisch, When Aegean wall paintings meet Egyptian architecture. Simulations of architecture from 'Palace G' at Tell el-Dab^{c}a/Egypt, in: R. A. Stucky – O. Kaelin – H.-P. Mathys (eds.), Proceedings of the 9th International Congress on the Archaeology of the Ancient Near East, June 9th–13th, 2014, University of Basel Vol. 2 (Wiesbaden 2016) 37–50.

Kemp 2000
B. J. Kemp, Soil (including mud-brick architecture), in: P. T. Nicholson – I. Shaw (eds.), Ancient Egyptian Materials and Technology (Cambridge 2000) 78–103.

Kemp – Stevens 2010
B. J. Kemp – A. Stevens, Busy Lives at Amarna. Excavations in the Main City (Grid 12 and the House of Ranefer, N49.18). Vol. 1. The Excavations, Architecture and Environmental Remains, Egypt Exploration Society Excavation Memoir 90 (London 2010).

Lacovara 1996
P. Lacovara, Deir el-Ballas and New Kingdom royal cities, in: M. Bietak (ed.), Haus und Palast im Alten Ägypten, Denkschriften der Gesamtakademie 14, Untersuchungen der Zweigstelle Kairo des Österreichischen Archäologischen Institutes 14 (Vienna 1996) 139–147.

Lang 1969
M. L. Lang, The Palace of Nestor at Pylos in Western Messenia II. The Frescoes (Princeton 1969).

Militello 2001
P. Militello, Gli affreschi minoici di Festòs, Studi di Archaeologia Cretese 2 (Padova 2001).

Morgan 1988
L. Morgan, The Miniature Wall Paintings of Thera. A Study in Aegean Culture and Iconography (Cambridge 1988).

Niemeier – Niemeier 2002
W.-D. Niemeier – B. Niemeier, The frescoes in the Middle Bronze Age palace, in: N. Scheftelowitz – R. Oren (eds.), A. Kempinski, Tel Kabri. The 1986–1993 Excavation Seasons, Monograph Series of the Institute of Archaeology, Tel Aviv University 20 (Tel Aviv 2002) 254–298.

Palyvou 1999
C. Palyvou, Ακρωτήρι Θήρας. Η οικοδομική τέχνη. Βιβλιοηήκη της εν Αθήναις Αρχαιολογικής Εταιρείας 183 (Athens 1999).

Peet – Woolley 1923
T. E. Peet – L. Woolley, The City of Akhenaten. Part I. Excavations of 1921 and 1922 at el-'Amarneh (London 1923).

Pyke 2007
G. Pyke, The fragmentary wall plaster, in: P. Rose (ed.), The Meroitic Temple Complex at Qasr Ibrim, Egypt Exploration Society Excavation Memoir 84 (London 2007) 44–68.

Rackham 1972
O. Rackham, Appendix III. Charcoal and plaster impressions, in: Warren 1972, 299–304.

von Rüden 2011
C. von Rüden, Die Wandmalereien aus Tall Mišrife/Qaṭna im Kontext überregionaler Kommunikation, Qaṭna Studien 2 (Wiesbaden 2011).

von Rüden 2015
C. von Rüden, Transmediterranean knowledge and Minoan style reliefs in Tell el-Dab^c^a. An attempt at paradigm shift, in: S. Cappel – U. Günkel-Maschek – D. Panagiotopoulos (eds.), Minoan Archaeology. Perspectives for the 21st Century. Proceedings of the International PhD and Post-Doc Conference at Heidelberg, 23–27 March 2011 (Louvain 2015) 355–365.

Seeber 2000
R. Seeber, The technique of plaster preparation for the Minoan wall paintings at Tell el-Dab^c^a, Egypt. Preliminary results, in: S. Sherratt (ed.), Proceedings of the First International Symposium 'The Wall Paintings of Thera', Petros M. Nomikos Conference Centre Thera, Hellas, 30 August – 4 September 1997 (Athens 2000) 91–102.

Shartzer 1990
C. L. Shartzer, House E, in: P. Lacovara (ed.), Deir el-Ballas. Preliminary Report on the Deir el-Ballas Expedition, 1980–1986, American Research Center in Egypt Reports 12 (Winona Lake) 6–10.

Shaw 2006
M. C. Shaw, Plasters from the monumental Minoan buildings. Evidence for painted decoration, architectural appearance, and archaeological event, in: J. Shaw – M. C. Shaw (eds.), Kommos V. The Monumental Buildings at Kommos (Princeton 2006) 117–229, 249–258.

Spencer 1979
A. J. Spencer, Brick Architecture in Ancient Egypt (Warminster 1979).

Warren 1972
P. M. Warren, Myrtos. An Early Bronze Age Settlement in Crete, British School at Athens Supplement 7 (Oxford 1972).

Watanabe 1993
Y. Watanabe, Studies on the Palace of Malqata. Investigations at the Palace of Malqata, 1985–1988 (Tokyo 1993).

Weatherhead – Kemp 2007

F. Weatherhead – B. J. Kemp, The Main Chapel at the Amarna Workmen's Village and its Wall Paintings, Egypt Exploration Society Excavation Memoir 85 (London 2007).

Wiencke 2000

M. H. Wiencke, The Architecture, Stratification, and Pottery of Lerna III. Part 1. Architecture and Stratification, Lerna. A Preclassical Site in the Argolid. Results of Excavations Conducted by the American School of Classical Studies at Athens 4 (Princeton 2000).

Winkels 2007

A. Winkels, Restauratorisch-naturwissenschaftliche Untersuchung von tuthmosidischen Putzen aus ᶜEzbet Helmi / Tell el-Dabᶜa. Ein Beitrag zur Erforschung altägyptischer Kalkputztechnik, Egypt and the Levant 17, 2007, 273–293.

Woolley 1955

L. Woolley, Alalakh. An Account of the Excavations at Tell Atchana in the Hatay, 1937–1949, Reports of the Research Committee of the Society of Antiquaries of London 18 (Oxford 1955).

Between Common Craft Tradition and Deviation

The Making of Stucco Reliefs in the Eastern Mediterranean

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Abstract

For a length of time Bronze Age stucco reliefs have been brought to light almost exclusively at sites in the Aegean with the 'palace' of Knossos as the most important example. Since the 1990s the palatial district of Helmi/Tell el-Dabᶜa in the eastern Nile delta is now the first site beyond the Aegean which has produced such a kind of three-dimensional artistic expression within its élite architecture. Hence it seems very likely to assume an interrelation in the way this complex craft has been executed in both regions, but the question arises how and to which extent. Through an analysis of the involved raw materials and a reconstruction of the craft's *chaîne opératoire*, this paper therefore aims at a better understanding of the characteristic technical choices and habitualized procedures of the craftsperson in the Nile delta. A comparison of these results with practices traceable in the Aegean should help us to carve out common craft tradition, as well as deviations, to finally approach the possible enmeshment of both craft activities.

Keywords: stucco reliefs; technique; work flow; Tell el-Dabᶜa; skill; knowledge transfer; Egypt; Aegean.

1. Introduction

The site of Tell el-Qirqafa/ᶜEzbet Helmi west of Tell el-Dabᶜa in the Eastern Nile delta is well known for the large amount of Aegean type wall paintings, excavated since

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in: J. Becker, J. Jungfleisch and C. von Rüden (eds.) Tracing Technoscapes. The Production of Bronze Age Wall Paintings in the Eastern Mediterranean (Leiden 2018) 213-232.

1989. Thousands of lime plaster fragments were found dispersed in front of the entrances of two palaces of the Thutmosid period[3] on the eastern bank of the former Pelusiac branch of the Nile. Beneath were also some stucco reliefs, excavated below the ramp of 'Palace F' as well as in a levelling layer south of 'Palace G'.[4] As it is also the case for the paintings on flat surfaces of this corpus, their production technique, motifs and stylistic execution are rather unusual in Egypt. But while parallels of the flat paintings are widely spread in the Aegean and in the Eastern Mediterranean, stucco reliefs seemed to have been so far mainly concentrated on Crete, distinctively at Knossos.[5] Hence, while Tell el-Dabᶜa already stands out from the other find spots due to the sheer amount of painting fragments, the stucco reliefs are one major reason for the site's special relation to Crete.

Because of their find context in an intensely exploited agricultural area, mostly used for cereal and rice cultivation and its necessary ample irrigation, the stucco reliefs from Tell el-Dabᶜa are not only very fragmented, but often badly preserved. Despite of these rather bad auguries, the corpus bears a treasure trove of information which allows us to approach the technical skill involved in this craft and how this might differ from or resemble its Cretan counterpart. Thus, the aim of this paper is to firstly trace the different raw materials and technical choices in the production process at Tell el-Dabᶜa itself and secondly to approach the specific nature of enmeshment of these technical practices with those on Crete.[6]

2. From Archaeological Data to the *chaîne opératoire*

Beneath the circa 350 stucco reliefs was a rather well preserved fragment which, along which the *chaîne opératoire* of relief making, will be mainly discussed within the frame of this paper. This piece can be identified as the lower leg of a white figure on red ground (Fig. 1) with the blue lower part indicating the footgear; the latter probably represents a blue textile which was kept together by a brownish-ochre cording, as it is known to us from acrobats or bull leapers in the Aegean and in Tell el-Dabᶜa.[7] The section of the fragment allows us to macroscopically identify nine layers of lime plaster: Five compose the ground, while another three build up the elevated part, on top of which a very fine, slip-like layer covers the whole surface. At both lateral edges of the three-dimensional shaped leg, red preliminary drawings can be observed in the section on the back plane layer, below the elevated parts of the relief (Fig. 2).

The limited frame of this article does not allow to discuss all the working steps involved in the making of stucco reliefs, and several aspects, as for instance the acquisition

3 Bietak *et al.* 2007, 26–40.

4 For a first identification see Bietak – Marinatos 1995, 54, fig. 5; furthermore Bietak *et al.* 2007, 41–42, fig. 40.

5 Exceptions are at least one fragment from the Argolis and an example from Akrotiri on Thera. For the Argolis: cf. Kaiser 1976, 303. For Akrotiri: cf. e.g. Doumas 1983, 74, 108, pl. 5. For Knossos: cf. Kaiser 1976, 157–298. For the rest of Crete: cf. Kaiser 1976, 299–302.

6 For a first essay to approach these question for the Tell el-Dabᶜa material, see von Rüden 2015. For a more general discussion of this topic, see e.g. Marchand 2010.

7 Evans 1930, pl. XXI; Cameron 1970, 163–166; Cameron 1976, Vol. I, 340; Cameron 1987, 321–327, fig. 12; Marinatos – Palyvou 2007, 115–141, esp. 121, fig. 108; 123, fig. 110; 137, cat. no. 15 (fragment with legs with blue footgear today in the Ashmolean Museum).

Fig. 1: Fragment (F00037) of a stucco relief with depiction of a lower foot with blue footgear, photo and digitally enhanced version.

and production of lime, have to be omitted at this point. Thus the discussion will be restricted to the making of the lime putty, the application of the plaster layers and some aspects of the pigments and surface treatment, the latter with a special focus on the use of talc.

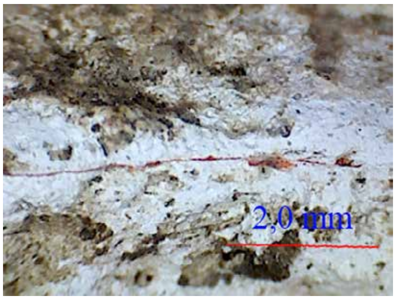

Fig. 2: Lateral preliminary drawing below the relief.

Aggregates, no matter if intentionally added or not, certainly play a key role in the process of plaster making. They can regulate the weight of the relief, avoid cracks in the surface, or can either speed up or postpone the plaster's setting process. For the evaluation of suitable lime plaster for fresco painting the importance of aggregates such as sand, gravel or limestone has been therefore always emphasised. Beyond their function as stabilisation, these particles also form ducts through which air can flow, and thus they assist the crystallisation of the calcium carbonate and allow a hardening process also below the immediate surface.[8] Pure lime plaster, in contrast, is considered as having much residual porosity and no great strength.[9] Moreover, the latter would immensely loose volume and consequently cause cracks during the setting process, especially in the case of thicker applications.[10] Today these considerations have often led to a recommendation of three portions of aggregates to one portion of lime.[11] While all these aspects are already of great importance for the manufacture of plaster for flat surfaces, a suitable mixture and treatment of the lime putty cannot be underestimated for a craftsperson who aims to build up a three-dimensional stucco relief.

Against this background it is not very surprising that the low amount of aggregates traceable in 'Minoan' plaster already puzzled Noel Heaton in 1911.[12] Then,

8 Hansen 2002, 71.
9 Kingery *et al.* 1988, 221.
10 This is especially true for the application of very thick plaster layers, for which one needs to take into account an excessive shrinkage, cf. Hansen 2002, 70.
11 Blackman 1982, 113.
12 Heaton 1911, 699.

Fig. 3a: Compartments with lime plaster (Janosi 2002, pl. 4).

the archaeometric methods surely did not allow an identification of all types of aggregates, but despite great advances in this field during the last decades the rather huge percentage of lime contents and few aggregates in different Cretan and Eastern Mediterranean plaster still remains remarkable.[13] As for instance the XRD[14] analysis conducted by Ann Brysbaert on Tell el-Dab^ca material have shown a lime content of between 86 and 100% with an only small to moderate amount of quartz and dolomite;[15] a composition which can be well compared to other recent examinations in the Aegean.[16] This high percentage of lime raises the question of which additional methods the ancient craftspeople used to strengthen the plaster and to avoid cracks during the setting process. One method was to add crushed murex shells with their sharp-edged breaks as a temper to the lime putty. These shells have not only been identified in the Tell el-Dab^ca lime plaster,[17] but also in the matrix of lime plaster and clay or earthen floors in the Aegean and on Cyprus, as well as in the wall paintings from Qatna in Syria and the Greek mainland.[18] In the Levant and the Aegean crushed murex shells are easily available as a by-product of the flourishing local dyeing industry, but judging from the present archaeological data, this can hardly be assumed for Egypt.[19] Hence, we need to take into consideration that these shells were not necessarily available and then spontaneously appropriated, but indeed brought to the site with the intention to be used as temper of the then produced lime plaster. This procedure itself is mirrored in the findings of the construction site of the palatial district, where crushed shells have been found in three small

13 For a summery, see Evely 2000, 478, referring to Shaw 1971, 210–211, fn. 2; Cameron *et al.* 1972, 132; Cameron *et al.* 1977, 132, 150.

14 Unluckily we do not precisely know from which fragments or contexts the analysis has been precisely taken as it is not noted in the publication by Ann Brysbaert. Only a table has been published with approximate statements for the find spots of area H/III and the magazine's box numbers for H/I, without taking into account that these include different find context, cf. Bietak *et al.* 2007, 151–152, tab. 1.

15 Brysbaert 2007a, 153; see also Skowronek 2016, 20–27.

16 Brysbaert 2007a, 153.

17 Brysbaert 2002, 99.

18 For a summary, see Brysbaert 2007b; moreover, Reese 1987. For Akrotiri: cf. Doumas 1983, 117; Karali 1999, 43–44. For Hala Sultan Tekke on Cyprus: cf. Reese 1987, 205–206. In 2008 Ann Brysbaert has published a chart (Brysbaert 2008, 114, tab. 6.1) in which it is marked where crushed shells have been used as aggregates (Milet, Tell el-Dab^ca, Mycenae, Tiryns, Thebes, Phylakopi, Palaikastro and to a certain extent in Knossos), but unluckily no references or more detailed data have been provided.

19 Brysbaert 2007b.

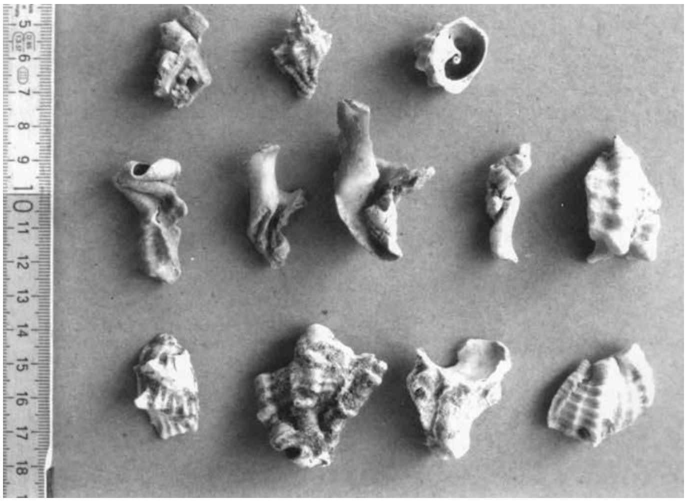

Fig. 3b: Crushed murex shell found close-by the compartments (Janosi 2002, pl. 8).

deposits near some compartments with incompletely slaked lime (Fig. 3a–b).[20] But this was not the only choice the people made to optimise the lime putty for their needs. Moreover, the negative imprints in the cross sections speak for the addition of organic fibres, as for instance hair or straw (Fig. 4).[21] Again, they seem to have been added to avoid cracks and stabilise the plaster, but their use is also known from Byzantine texts where they are described for their ability to slow down the setting process,[22] which would permit a longer time span for the painting on damp plaster.

All these ingredients hint at a very careful and skilful preparation of the lime plaster. Such a kind of preparation aimed to avoid cracks and too much residual porosity, while it generates the qualities of stability and an even and perhaps slowed setting process. Moreover, it seems that the craftspeople in Tell el-Dab^ca and in the Aegean aimed to produce a relatively pure lime plaster, in which aggregates are hardly visible with the naked eye. It remains an open question whether this was due to the preference of a white and clear surface, which does not hinder the colours to appear in their full brilliance, or possibly also to antagonise a too quick hardening of the plaster. In any case to achieve such a goal its inherent structural weakness had to be counteracted not with the amount, but with a specific choice of aggregates and a skilful application of the plaster in thin layers. A precise attunement of these aspects is already essential for the lime plaster of flat surfaces, but it is of even greater importance for the three-dimensional stucco reliefs for which the plaster needed to gain stability without becoming too heavy or setting too quickly.

As the next step, several layers of lime plaster are applied wet in wet to produce the flat surface of the background. For modern fresco painting Max Doerner recommends to add the next plaster layer after approximately 20 minutes.[23] But of course his instruction also depends on several factors, as for instance the composition of the

20 Jánosi 2002; Winkels 2007, 286–288.
21 Brysbaert 2007a, 155–157, pl. 5; Skowronek 2016, 42.
22 Doerner 2001, 235.
23 Doerner 2001, 236–237.

plaster or the climatic conditions. For M. Doerner a practical way to ascertain the right moment for the next layer is to sensually test it: if the plaster does not give way to the pressure of a finger, but allows to impress it, then the next layer can be applied.[24] To spread the layers on the surface the bare fingers are employed as well as different other tools. Hereby the use of wooden trowels is very probable. Several stone examples of such tools have been found in 'Minoan' contexts[25] and in a preceding Hyksos layer in Tell el-Dabᶜa itself. Due to their weight the stone versions were probably used to smooth floors and not walls,[26] but their shape nonetheless allows us a good insight into this type of Bronze Age tool with its great similarity to modern examples. With very similar trowels modern fresco artists and plasterers in general are still smoothing such surfaces, and conduct with soft pressure slightly circling or eight-shaped movements[27] to successively apply the plaster layer by layer.

An even more challenging work step follows after the background layers have been finally applied: the application and shaping of the elevated sculptured parts. Fortunately for us as archaeologists, most of the reliefs from Tell el-Dabᶜa have been recovered separated from the ground plane. Their backs, to which they have been originally attached on the flat background plane, are generally even with thin crossing ridges, around 1–3mm high and sometimes arranged in the shape of a net (Fig. 5a). On some examples, remains of red lines can be additionally observed along the relief's edges, where the sculptured parts have originally passed into the backplane (Fig. 5b). They are obviously the imprints of the red preliminary drawings, which are also visible in the section of the above mentioned relief foot (cf. Fig. 2).

Altogether, these observations give us a very good idea of the planning method of the stucco relief: obviously, the outline of the sculptured figure was firstly drawn as a red preliminary sketch on the freshly plastered and hence moist background plane (Fig. 6a). Then, thin lines were incised within the interspace on the still damp surface (Fig. 6b). These incisions served on the one hand as anchorages for the application of the sculptured material, and on the other hand they offer the advantage to remove already slightly sintered parts of the surface, which could have hindered the chemical process for connecting both plaster elements.[28] Bernd Kaiser describes a similar, but not identical procedure for Knossos. Instead of a preliminary line drawing he has observed that in Knossos at least in some cases a fine layer of reddish lime has been spread on those parts of the surface, on which the elevated parts of the reliefs were planned; hence instead of a line drawing, a thin coloured plaster layer covers the parts of the planned figure. The later step, the way the surface was afterwards incised for the preparation of the sculptured plaster, is then again almost identical to the Tell el-Dabᶜa material.[29]

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24 Doerner 2001, 237.

25 Shaw 2009, 145, fig. 145.

26 Shaw 2009, 145–150.

27 Personal communication Marion Stille, fresco artist, Berlin.

28 This has been also described for the plastering of ceilings and vaults, for which the plaster is usually kept less wet and less thick. To apply the next layer the craftsperson usually waits until the next day, then the surface should be roughened to remove the sinter, and occasionally also a limewash is added (Doerner 2001, 238).

29 Kaiser 1976, 296, fig. 451b.

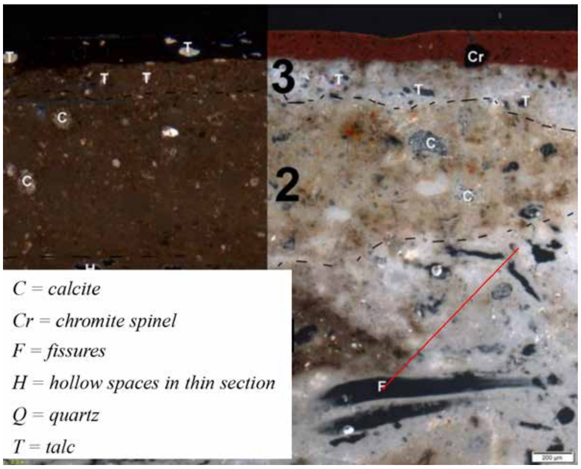

Fig. 4: Cross section with voids.

Fig. 5a: Rear side of a relief (F01489) with crossing ridges.

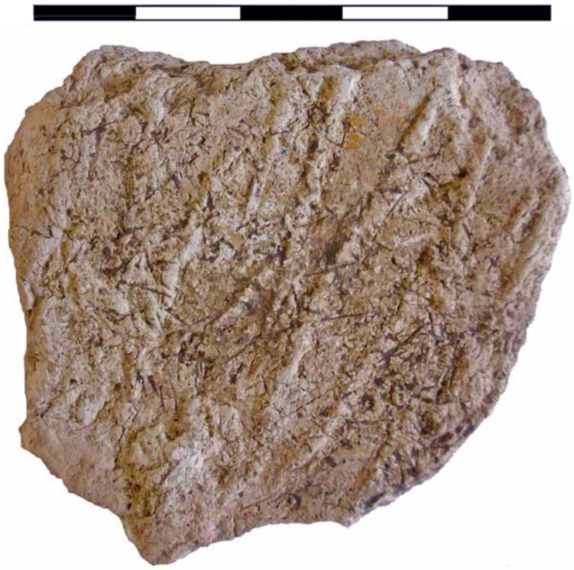

Fig. 5b: Rear side of a relief with ridges and imprints of red preliminary paintings.

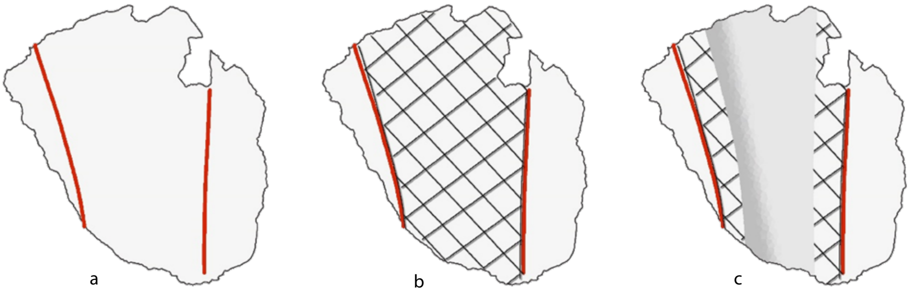

Fig. 6a–c: Reconstruction of the application of the relief layers on the flat plaster surface of F00037.

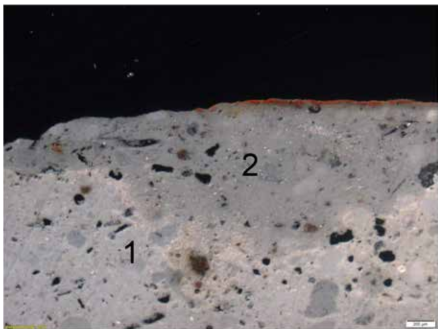

Fig. 7: Cross section of a relief with irregular confined plaster layers.

Subsequently, the craftsperson built up the sculptured plaster in single layers. The first layer was applied in the central part of the foot (Fig. 6c), which was then coated by the following layers, each with a convex surface. The subsequent layers successively increase in height and width until an uppermost layer slightly covers the above described preliminary sketch at the lateral edges, whose colour has been absorbed by the moist plaster resulting in the above described red imprints on the back.[30]

A question which remains to be discussed is how these three-dimensional relief parts were shaped. No traces or imprints of casts, templates or other aids as they are known from later gypsum stucco manufacture have been discovered so far; only a few marks of what might be a scraper. It is therefore very probable that the three-dimensional parts were applied by free shaping, likely with some application tool in combination with bare hands. For the understanding of this forming procedure it is very interesting that the single three-dimensional layers of the sculptured parts have rather irregular and less well confined surfaces than those of the ground plane (Fig. 7).[31] Therefore, it seems as if the application of these sculptured relief layers was not only conducted in a more irregular manner, but also much faster than the background plane. The setting process of the single layers obviously had been less advanced than in the case of the background plane at the moment when the next layer was applied, which results in less confined differentiation of the single layers in the section. This would have tied the layers more strongly onto each other. Here again, to realise when to apply the next plaster layer is a crucial aspect of relief making. The already applied layer has to be firm and stable enough to carry the weight of another one, but at the same time still quite damp and, if possible, slightly uneven to permit a better adhesion due to the chemical process during the hardening of the stucco. One fragment shows that this was not always successful: here the uppermost coat has flaked off and only the surface of the coarser,

30 Cf. von Rüden 2015, 360–361.
31 Skowronek 2016, 24, fig. 22a.

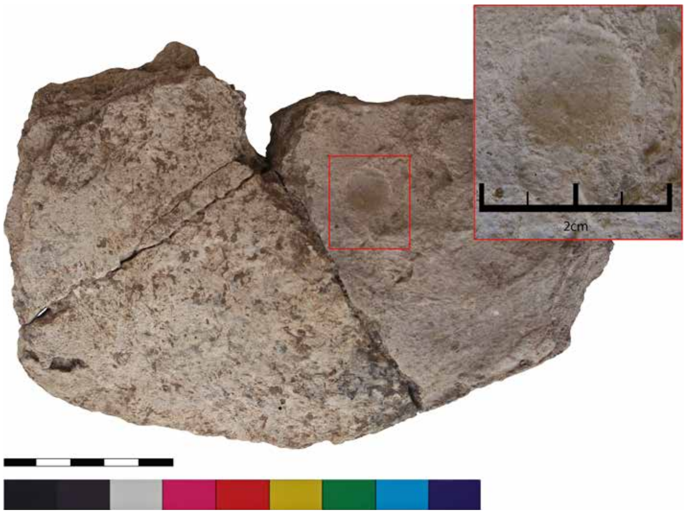

Fig. 8: Fragment with a flaked off upper coat, on whose subjacent layer a fingerprint is preserved.

subjacent layer is preserved (Fig. 8). A fingerprint on the latter possibly indicates how the craftsperson tested the flexibility and humidity of the surface and tried to adjust this with her or his experiences. This tiny imprint would therefore reflect this crucial gesture in the craft process and allows us a wonderful insight into how the craftsperson indeed embodied his or her skill.

That people were aware of these challenges in the manufacturing process of the reliefs is also evident by the findings from Knossos. There, the very deep and heavy stucco reliefs were sometimes scored with wooden pegs to provide them with a key to counteract the danger of separation from the backplane.[32] That similar supports are absent in Tell el-Dab^ca might be related to the fact that most of the reliefs are comparably flat and thus such a measure was perhaps considered as less necessary. This raises the question of why they choose such flat stucco reliefs. Did they perhaps not dare to make higher reliefs because of the environmental circumstances in the Nile delta, as for instance the humidity or the specific geological ground of the alluvial plain? Or was this simply not desired due to the seeing habits in Egypt, where the local stone reliefs are rather flat and internally less structured?

After the stucco relief has been built up, the craftsperson was devoted to the surface treatment and the successive colour application. Again this is not as simple as it seems. For example to achieve a very opaque, dark and shiny colour as it is the case for the background plane of our example is not an easy undertaking, as a damp lime plaster surface usually tends to a more transparent colour appearance. One possibility to achieve an opaque colour on moist plaster is to add several layers of colour on top of each other, but this affords a certain patience and, at the same time, bears the danger to produce an inhomogeneous colour appearance. Of course, also an organic binder as for example gummi arabicum or milk has to be taken into consideration.[33] But it seems that at least one secret of such an opaque and at the same time deep and shiny colour is also owed to the very specific characteristics of the last thin and very fine plaster layer,

32 Evans 1928, 333, fig. 188.
33 Seeber 2000.

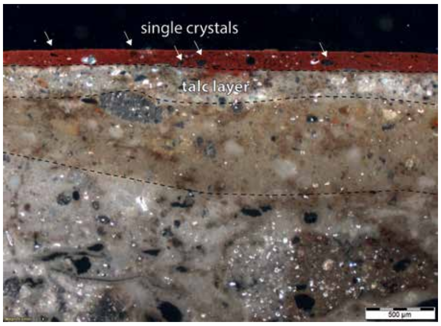

Fig. 9a: Cross section with different plaster and paint layers of F00037.

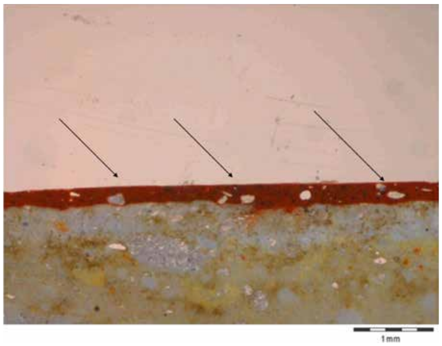

Fig. 9b: Higher resolution of the cross section with the talc contending layer beneath and the red paint layer and small ellipsoid talc minerals in the paint layer.

which has been called in renaissance fresco painting *intonaco.* It covers the sculptured parts as well as the background and constitutes the base for the colour application.

During X-Ray diffraction measurement, talc, a sheet silicate appearing in metamorphic rocks, which have gone through hydrothermal conversion, has been observed.[34] It can form monomineral rocks, which are widely known as soapstone or steatite.[35] In order to take a look at the mineral's nature and form, thin sections have been prepared, which revealed that talc appears as both single crystals in the painting and as a thin separate layer underneath (Fig. 9a–b). This thin separate slip on top of the uppermost plaster layer consists of approximately 50% calcite and 50% talc. During the painting process, single crystals appear to have been uplifted from the subjacent, most probably still moist thin slip and entered the paint layer. The minerals have a roughly ellipsoid shape with a size of up to 200x100µm which contradicts their natural streaky character. Thus the talc flakes seem to have been crushed and ground to their present size, while there are no calcite crystals visible. The difference in grain size speaks for the fact that the talc flakes were deliberately added to the lime putty of the slip and are not an accessory to calcite. In such a case they would have changed into its high-temperature modification (enstatite) during the creation of quicklime[36] and this particular mineral has not been detected using XRD.

Talc inherits several characteristics for which the craftspeople might have chosen it as an addition to the *intonaco*. Today the mineral is known to have reinforcing properties. For instance, it protects pigments from degeneration and prevents fissures and cracks of the colours.[37] Under the name 'feather white' it is also used for plaster and moulding where it causes a certain lustre.[38] It is therefore no surprise that Tell el-Dab^{c}a

34 As an indicator mineral for value 1 on the Moh's Hardness Scale, it can be scratched by fingernail and appears as a green, silver, greyish mineral with transparent nacreous blaze. Cf. Okrusch – Matthes 2005, 101.

35 Tröger 1969, 499.

36 For the stability field of talc, see Okrusch – Matthes 2005, fig. 27. For the required temperature of quicklime, see Aston *et al.* 2000, 22.

37 For an overview, see Kremer Pigmente no date.

38 Vierl 1984, 182.

is not the only archaeological site where talc has been identified. It has been also reported from several Palaeolithic paintings. An example is the Grotte de la Vache in Niaux in France, where Jean Clottes *et al.* were able to chemically characterise pigments and interpreted the use of talc as an extender to obtain better adhesion qualities and to prevent the colouring pigments from degeneration.[39] As a white pigment on crusted ware, Eleni Aloupi has identified the mineral at the late Neolithic settlement of Ftelia on Mykonos.[40] Finally Walter Noll *et al.* identified in 1975 one of the most prominent uses of talc during the Bronze Age for the characteristic white colour on Middle Minoan Kamares ware, called "talc-white"[41]. According to Noll, talc-white is a brighter and more precious pigment than lime–silicate, which can appear yellowish rather than white.[42] Talc was not only used as a pure pigment, it was also mixed to red ochre in order to obtain a lighter red.[43] This observation has been recently re-examined by Lighea Pappalardo *et al.* who analysed Kamares sherds, using Particle-Induced X-ray Emission.[44] Of special interest to our observations in Tell el-Dab^{c}a is the way talc was used in the production of Late Cycladic White Pottery. In 1990 Eleni Aloupi and Yannis Maniatis re-examined W. Noll's study of Theran pottery and realised that the thin base coat of this pottery group also consists of talc,[45] which was obviously used to obtain a smooth and soapy surface easy to paint on.[46]

While it is generally accepted that talc was used as a pigment in pottery decoration, the situation is more complex when it comes to wall paintings. The mineral talc has been reported for many Aegean Bronze Age wall paintings, but it is generally considered as accessory to amphiboles used for pigments and is therefore little discussed.[47] For instance in the course of provenancing magnesioriebeckite from Akrotiri Sophia Sotiropoulou *et al.* discovered that riebeckite is indeed associated with talc and chlorite on many Aegean islands.[48] Of course such an association could be an explanation for why it occurs in grey and blue colours, but it does not explain why it occurs in usually lime-based white[49] or in hematite-related red colours.[50] Both pigments do not have any connection to metamorphic rocks as they derive from igneous and sedimentary rocks. Therefore, talc cannot be accessory to them. Thus, the presence of talc in these colours needs further explanation. Due to the fact that thin sections of Aegean wall painting samples are still scarcely published, the precise way talc has been involved in the production of wall paintings has to remain open to discussion. It is nonetheless remarkable that talc has been used

39 Clottes *et al.* 1990, 178–179.
40 Aloupi 2002, 283.
41 Noll 1982, tab. 9; Noll *et al.* 1971. W. Noll proposed that this kind of pigment was used on Crete in a palatial context only, while provincial potters would not have access to this expensive pigment and would use lime silicate instead (Noll 1982, 193).
42 Noll 1982, 192.
43 Noll 1982, 191.
44 Pappalardo *et al.* 2010; Pappalardo *et al.* 2015.
45 Aloupi – Maniatis 1990, 463.
46 Aloupi – Maniatis 1990, 469. A first analysis of talc use on Theran pottery has been conducted by W. Noll (Noll *et al.* 1975, 88).
47 Perdikatsis *et al.* 2000, 113.
48 Sotiropoulou *et al.* 2012.
49 Perdikatsis 1998, 103.
50 Westlake *et al.* 2012, tab. 2.

in the wall paintings from Tell el-Dab^c^a in a very similar manner as on Cycladic pottery. Moreover, the often observed strong relation in style and motif choice of the paintings on Cycladic pottery and the wall paintings of the same regions[51] raises the question whether a possible cross-craft interaction involves not only the way the brushes are guided during the execution of the motif, but also how the surfaces are prepared in both media. What would that mean if both would be comparable to the practice in Tell el-Dab^c^a?

But how was talc used in Egypt, and can this be related to the findings from Tell el-Dab^c^a? The mineral was well known since the Badarian period and frequently used to manufacture scarabs, beads and other small objects.[52] Moreover, the raw material itself is widely distributed in the Eastern Desert as it has been recently shown by James A. Harrell and V. Max Brown.[53] In contrast to the various implementations of talc in the Aegean, the mineral has never been identified in one of the several major studies about pigment use in wall paintings.[54] This might be related to several aspects: that either Egyptian wall paintings were mostly executed in *secco* technique[55], that the use of talc for such a purpose was either socially not adequate, or perhaps that its supportive properties for this craft were simply unknown. For the latter case might speak a locally produced Kamares-type jar from Assuan.[56] In the case of a Cretan import one would expect talc as the pigment for the white colour, but instead W. Noll has detected lime silicate[57] and therefore argues that the jar had been made by Cretan artisans working with local raw materials.[58] No matter whether this assumption is indeed true or not, it seems that despite of the large talc deposits in the Eastern Desert the mineral had, until the time of the fragments discussed here, never been used for painting in Egypt, no matter if this was as a pigment or due to its supportive characteristics.

3. Conclusion

The aim of the paper was to explore the making of stucco relief; a technique occurring mainly on the island of Crete and in Tell el-Dab^c^a in the eastern Nile delta in Egypt. What we can conclude up to now is that in both areas the craftspeople employed similar methods and ingredients for the very skilful preparation of lime plaster to successfully avoid cracks in the surfaces and perhaps even to propound the setting process. The knowledge about the right composition and the alchemy of producing the suitable plaster is surely tightly connected with the sensual experience of the craftsperson. To simply exchange a recipe is hardly enough to explain the similarities in both regions, as the necessary amounts of aggregates always depend on the qualities of the available

51 Marthari 2013.
52 Lucas 1962, 421.
53 Harrell – Brown 2008, fig. 3.1.
54 Jacksch 1985; El Goresy 2000; Lee – Quirke 2000.
55 Lee – Quirke 2000, 117.
56 Kemp – Merrillees 1980, 215–216.
57 Noll 1982, fig. 22.
58 Noll 1982, 194.

lime or the character of the architecture. The similar composition must have been spread by sharing bodily experiences between craftspeople, by showing each other how the right plaster feels.

Moreover, to choose the right moment to apply the next plaster layer as well as the skill to execute the three-dimensional parts are both practices traceable in the archaeological records of Crete and Tell el-Dab^{c}a. Not to lose sight of the general design of the figure, while one has to add the single plaster layers in detail and under time pressure, needs a high degree of incorporation of the working procedures (cf. von Rüden 2015). This awareness can be seen as the craftsperson's most sophisticated skill: an ability which needs to be incorporated by perpetual repetition – probably by mimicking an experienced master in an apprenticeship. As a result, the craftsperson does not have to consciously think about the application of plaster layers; he or she is simply acting it and hence can concentrate on the design itself. These similarities in the procedures can be hardly exchanged by descriptions or any other discursive medium transferred between both places.

Furthermore, the strong relation to Crete is supported by the very specific choice of talc as an ingredient to the final thin plaster layer. The mineral is well known from painting on Cretan Kamares or Cycladic pottery, but was not used in Egyptian painting. We have shown that talc minerals appear both as single crystals in the paint layer and within the slip underneath. This indicates that talc was used intentionally, likely because of its reinforcing properties, its brilliance and maybe colouring effect. This technique seems to be foreign to Egypt, but is comparable to the painting tradition traceable on Late Cycladic White Ware, where talc was used in exactly the same way as in the wall painting of Tell el-Dab^{c}a: as a base coat to paint on, and for white ornamental applications. Although the exact nature of the use of talc minerals in Aegean wall paintings remains to be studied in more detail, we have to take into consideration that this practice is a crucial aspect of an 'Aegean craft tradition'.

All these relations speak for a strong enmeshment of the stucco relief craft tradition on Crete and in Tell el-Dab^{c}a. However, there are also some divergent details, as for instance the different executions of the draft: the reddish plaster layer filling the whole space of the planned figure in Knossos contrasts with the line drawing in Tell el-Dab^{c}a. This might be an argument that they did not share exactly the same community of practice in the sense of Etienne Wenger[59]; perhaps this variability is the result of an experimental phase within a specific subgroup or an adjustment to the local Egyptian respective Cretan draft execution. The same might be true for the tendency to produce lower and less detailed reliefs in Tell el-Dab^{c}a, not reinforced by wooden pegs as we know it from Knossos. Such an interwoven craft tradition can be surely understood as the result of some kind of migration and periods of communal embodied learning. But we will probably never know if the creators of the different mentioned artistic expression were indeed part of the same community of practice, which developed new strains of subtraditions – perhaps by adjusting to local environmental and social needs – or if maybe their forefathers were in contact and deviations developed during a much later process.

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59 Wenger 1999.

References

Aloupi 2002
E. Aloupi, Pottery analysis from the Late Neolithic settlement at Ftelia, Mykonos (Cyclades). Provenance, technological and functional considerations, in: A. Sampson (ed.), The Neolithic settlement at Ftelia, Mykonos (Rhodes 2002) 279–297.

Aloupi – Maniatis 1990
E. Aloupi – Y. Maniatis, Investigation of the technology of manufacture of local LBA Theran Pottery. The body and pigment analysis, in: D. A. Hardy – C. G. Doumas – J. A. Sakellarakis – P. M. Warren (eds.), Thera and the Aegean World III. Proceedings of the Third International Congress Vol.1 (London 1990) 459–469.

Aston *et al.* 2000
B. Aston – J. Harrell – I. Shaw, Stone, in: Nicholson – Shaw 2000, 5–77.

Bietak – Marinatos 1995
M. Bietak – N. Marinatos, The Minoan wall paintings from Avaris, Egypt and the Levant 5, 1995, 49–62.

Bietak *et al.* 2007
M. Bietak – N. Marinatos – C. Palyvou, Taureador Scenes in Tell el-Dab^ca (Avaris) and Knossos, Denkschriften der Gesamtakademie 43, Untersuchungen der Zweigstelle Kairo des Österreichischen Archäologischen Institutes 27 (Vienna 2007).

Blackmann 1982
M. J. Blackman, The manufacture and use of burned lime plaster at Proto-Elamite Anshan (Iran), in: T.A. Wertime – S.F. Wertime (ed.), Early Pyrotechnology. The Evolution of the First Fire-Using Industries (Washington 1982) 107–116.

Brysbaert 2002
A. Brysbaert, Common craftsmanship in the Aegean and East Mediterranean Bronze Age. Preliminary technological evidence with emphasis on the painted plaster from Tell el-Dab^ca, Egypt, Egypt and the Levant 12, 95–107.

Brysbaert 2007a
A. Brysbaert, A technological approach to the painted plaster of Tell el-Dab^ca, Egypt. Microscopy and scientific analysis, in: Bietak *et al.* 2007, 151–162.

Brysbaert 2007b
A. Brysbaert, Murex uses in plaster features in the Aegean and Eastern Mediterranean Bronze Age, Mediterranean Archaeology and Archaeometry 7,2, 2007, 29–51.

Brysbaert 2008
A. Brysbaert, The Power of Technology in the Bronze Age Eastern Mediterranean. The Case of the Painted Plaster, Monographs in Mediterranean Archaeology 12 (London 2008).

Cameron 1970
M. A. S. Cameron, New restorations of Minoan frescoes from Knossos (Summary), Bulletin of the Institute of Classical Studies 17, 1970, 163–166.

Cameron 1972
M. A. S. Cameron, Appendix IV. The plasters, in: P. M. Warren, Myrtos. An Early Bronze Age Settlement in Crete, British School at Athens Supplement 7 (Oxford 1972) 305–314.

Cameron 1976
M. A. S. Cameron, A General Study of Minoan Frescoes with Particular Reference to Unpublished Wall Paintings from Knossos (PhD Diss., Newcastle University, Newcastle upon Tyne 1976). Online <http://hdl.handle.net/10443/302> (last access 15 July 2017).

Cameron 1987
M. A. S. Cameron, The 'palatial' thematic system in the Knossos murals. Last notes on Knossos frescoes, in: R. Hägg – N. Marinatos (eds.), The Function of the Minoan Palaces. Proceedings of the Fourth International Symposium at the Swedish Institute in Athens, 10–16 June 1984, Swedish Institute in Athens Series 4 (Stockholm 1987) 320–328.

Cameron *et al.* 1977
M. A. S. Cameron – R. E. Jones – S. E. Philippakis, Scientific analyses of Minoan Fresco samples from Knossos, Annual of the British School at Athens 72, 1977, 121–184.

Clottes *et al.* 1990
J. Clottes – M. Menu – P. Walter, La préparation des peintures magdaléniennes des cavernes ariégeoises, Bulletin de la Société Préhistorique Francaise 87,6, 1990, 170–192.

Doerner 2001
M. Doerner [ed. T. Hoppe], Malmaterial und seine Verwendung im Bilde, 19th edition (Berlin 2001).

Doumas 1983
Chr. Doumas, Thera. Pompeii of the Ancient Aegean (London 1983).

El Goresy 2000
A. El Goresy, Polychromatic wall painting decorations in monuments of Pharaonic Egypt. Compositions, chronology and painting techniques, in: Sherratt 2000, 49–70.

Evans 1928
A. J. Evans, The Palace of Minos. A Comparative Account of the Successive Stages of the Early Cretan Civilization as Illustrated by the Discoveries at Knossos Vol. II (London 1928).

Evans 1930
A. J. Evans, The Palace of Minos. A Comparative Account of the Successive Stages of the Early Cretan Civilization as Illustrated by the Discoveries at Knossos Vol. III (London 1930).

Evely 2000
R. D. G. Evely, Minoan Crafts. Tools and Techniques. An Introduction Vol. II, Studies in Mediterranean Archaeology 92,2 (Göteborg 2000).

Friedrich 2009
W. L. Friedrich, Santorini. Volcano, Natural History, Mythology (Aarhus 2009).

Hansen 2002
E. F. Hansen, Ancient Maya Burnt-Lime Technology. Cultural Implications of Technological Styles (PhD Diss., University of California, Los Angeles 2002).

Harrell – Brown 2008
J. A. Harrell – V. M. Brown, Discovery of a medieval Islamic industry for steatite cooking vessels in Egypt's Eastern Desert, in: Y. M. Rowan – J. R. Ebeling (eds.), New Approaches to Old Stones. Recent Studies of Ground Stone Artifacts (London 2008) 41–65.

Heaton 1911
N. Heaton, Minoan lime-plaster and fresco painting, Journal of the Royal Institute of British Architects 18, 1911, 697–710.

Jaksch 1985
H. Jaksch, Farbpigmente aus Wandmalereien altägyptischer Gräber und Tempel. Technologien der Herstellung und mögliche Herkunftsbezeichnungen (PhD Diss., University of Heidelberg, 1985).

Jánosi 2002
P. Jánosi, Bericht über die im Frühjahr 2001 erfolgten Sondagen im Dorf [c]Ezbet Helmi (Grabungsfläche H/I), Egypt and the Levant 12, 2002, 195–210.

Kaiser 1976
B. Kaiser, Untersuchungen zum minoischen Relief, Habelts Dissertationsdrucke. Reihe Klassische Archäologie Heft 7 (Bonn 1976).

Karali 1999
L. Karali, Shells in Aegean Prehistory (Oxford, 1999).

Kemp – Merrillees 1980
B. J. Kemp – R. S. Merrillees, Minoan Pottery in Second Millennium Egypt (Mainz 1980).

Kingery *et al.* 1988
W. E. Kingery – P. B. Vandiver – M. Prickett, The beginnings of pyrotechnology, part II. Production and use of lime and gypsum plaster in the Pre-Pottery Neolithic Near East, Journal of Field Archaeology 15,2, 1988, 219–244.

Kremer Pigmente no date
Kremer Pigmente, Talkum. Online <https://www.kremer-pigmente.com/media/pdf/58400-58420.pdf> (last access June 9th 2017).

Lee – Quirke 2000
L. Lee – S. Quirke, Painting materials, in: Nicholson – Shaw 2000, 104–120.

Lucas 1962
A. Lucas [ed. J. R. Harris], Ancient Egyptian Materials and Industries, 4th edition (London 1962).

Marthari 2013
M. Marthari, 'The attraction of the pictorial' reconsidered. Pottery and wall-paintings in LC I Thera in the light of the most recent research, in: A. Vlachopoulos (ed.), Paintbrushes. Wall-Painting and Vase-Painting of the 2nd Millennium BC in Dialogue (Athens 2013) 78–81.

Marchand 2010
T. H. J. Marchand, Introduction. Making knowledge. Exploration of the indissoluble relation between mind, body, and environment, in: T. H. J. Marchand (ed.), Making Knowledge. Explorations of the Indissoluble Relation Between Mind, Body and Environment, Journal of the Royal Anthropological Institute Special Issue Book Series 4 (London 2010) 1–21.

Marinatos – Palyvou 2007
N. Marinatos – C. Palyvou, The Taureador Frescoes from Knossos. A new study, in: Bietak *et al.* 2007, 115–126.

Nicholson – Shaw 2000
P. T. Nicholson – I. Shaw (eds.), Ancient Egyptian Materials and Technology (Cambridge 2000).

Noll 1982

W. Noll, Mineralogie und Technik der Keramiken Altkretas, Neues Jahrbuch für Mineralogie. Abhandlungen 143, 1982, 150–199.

Noll *et al.* 1971

W. Noll – L. Born – R. Holm, Chemie und Technik altkretischer Vasenmalerei vom Kamares-Typ, Naturwissenschaften 58, 1971, 615–618.

Noll *et al.* 1975

W. Noll – L. Born – R. Holm, Keramiken und Wandmalereien der Ausgrabungen von Thera, Naturwissenschaften 62, 1975, 87–94.

Okrusch – Matthes 2005

M. Okrusch – S. Matthes, Mineralogie. Eine Einführung in die spezielle Mineralogie, Petrologie und Lagerstättenkunde (Berlin, Heidelberg, New York 2005).

Pappalardo *et al.* 2010

L. Pappalardo – G. Pappalardo – F. Rizzo – F. P. Romano – V. La Rosa, Non-destructive, 'in situ' characterization of pigments in Minoan pottery at the stratigrafical museum of Phaistos (Crete), X-Ray Spectrometry 39,3, 2010, 230–232.

Pappalardo *et al.* 2015

L. Pappalardo – V. La Rosa – F. Rizzo – F. P. Romano, Non-destructive PIXE-alpha characterisation of pigments in Kamares pottery (1850–1700 BC) from Phaistos (Crete), X-Ray Spectrometry 44,4, 2015, 276–281.

Perdikatsis 1998

V. Perdikatsis, Analysis of Greek Bronze Age wall painting pigments, in: S. Colinart – M. Menu (eds.), La couleur dans la peinture et l'émaillage de l'Égypte ancienne. Actes de la table ronde, Ravello, 20–22 Mars 1997 (Bari 1998) 103–108.

Perdikatsis *et al.* 2000

V. Perdikatsis – V. Kilikoglou – S. Sotiropoulou – E. Chryssikopoulou, Physicochemical characterisation of pigments from Theran wall paintings, in: Sherratt 2000, 103–118.

Reese 1987

Palaikastro Shells and Bronze Age Purple-Dye Production in the Mediterranean Basin, Annual of the British School at Athens 82, 1987, 201–206.

von Rüden 2015

C. von Rüden, Transmediterranean knowledge and Minoan style reliefs in Tell el-Dab^ca. An attempt at paradigm shift, in: S. Cappel – U. Günkel-Maschek – D. Panagiotopoulos (eds.), Minoan Archaeology. Perspectives for the 21st Century. Proceedings of the International PhD and Post-Doc Conference at Heidelberg, 23–27 March 2011 (Louvain 2015) 355–365.

Seeber 1994
R. Seeber, Minoische Fresken in Ägypten, Restauratorenblätter 14, 1994, 12.

Seeber 2000
R. Seeber, The technique of plaster preparation for the Minoan wall paintings at Tell el-Dab^{c}a, Egypt. Preliminary results, in: Sherratt 2000, 91–102.

Shaw 1971
J. W. Shaw, Minoan Architecture. Materials and Techniques, Annuario della Scuola Archeologica di Atene e delle missioni Italiane in Oriente 49, 1971, 7–256.

Shaw 2009
J. W. Shaw, Minoan Architecture. Materials and Techniques, Studi di archaeologia cretese 7 (Padua 2009).

Sherratt 2000
S. Sherratt (ed.), Proceedings of the First International Symposium 'The Wall Paintings of Thera', Petros M. Nomikos Conference Centre Thera, Hellas, 30 August – 4 September 1997 (Athens 2000).

Skowronek 2016
T. Skowronek, The Wall Paintings of Tell el-Dab^{c}a. New Evidence for non-Egyptian Influences (B.A. Thesis, Ruhr-University Bochum 2016).

Sotiropoulou *et al.* 2012
S. Sotiropoulou – V. Perdikatsis – K. Birtacha – C. Apostolaki – A. Devetzi, Physicochemical characterization and provenance of colouring materials from Akrotiri-Thera in relation to their archaeological context and application, Archaeological and Anthropological Sciences 4,4, 2012, 263–275.

Tröger 1969
W. Tröger, Optische Bestimmung der gesteinsbildenenden Minerale (Stuttgart 1969).

Vierl 1984
P. Vierl, Putz und Stuck. Herstellen, Restaurieren (Munich 1984).

Wenger 1999
E. Wenger, Communities of Practice. Learning, Meaning and Identity (Cambridge 1999).

Westlake *et al.* 2012
P. Westlake – P. Siozos – A. Philippidis – C. Apostolaki – B. Derham – A. Terlixi – V. Perdikatsis – R. Jones, Studying pigments on painted plaster in Minoan, Roman and Early Byzantine Crete. A multi-analytical technique approach, Analytical and Bioanalytical Chemistry 402, 2012, 1413–1432.

Winkels 2007

A. Winkels, Restauratorisch-naturwissenschaftliche Untersuchung von tuthmosidischen Putzen aus [c]Ezbet Helmi / Tell el-Dab[c]a. Ein Beitrag zur Erforschung altägyptischer Kalkputztechnik, Egypt and the Levant 17, 2007, 273–293.

Younger 1995

J. G. Younger, Bronze Age representations of Aegean bull-games III, in: R. Laffineur – W.-D. Niemeier (eds.), Politeia. Society and State in the Aegean Bronze Age. Proceedings of the 5[TH] International Aegean Conference, University of Heidelberg, Archäologisches Institut, 10[th]–13[th] April, Aegaeum 12 (Louvain 1995) 507–545.

The Aegean

Forming the Image

Approaches to Painting at Ayia Irini, Kea and Tell el-Dab^ca

Lyvia Morgan[1]

Abstract

This paper compares the techniques and approaches used in painting a frieze at two different sites: Ayia Irini, on the Cycladic island of Kea, and Palace F at Tell el-Dab^ca in the Nile Delta. Preparation of the surface (plaster) and the issue of how the pigments were bonded to the wall (*fresco* versus *secco*) are briefly considered. This is followed by an examination of the process of painting: how each image was planned, what pigments were used for what part of the image, the order in which the paints were applied, how they were manipulated to vary hue, tone and intensity, and what final touches were used to delineate form and detail. This comparative study of the process of painting provides insights into the network of artistic interconnections. Despite differences in location, architectural context, relative scale, and probably date, it is clear that the artists of these two friezes belonged to the same tradition of craftsmanship, not only in their use of materials and techniques, but, significantly, in their approaches to forming the image.

Keywords: wall paintings; frieze; Kea; Tell el-Dab^ca; techniques; process.

One of the advantages of working intensively on wall paintings from different sites is the opportunity this provides to compare how artists formed their images: what approaches and techniques they used to make a painting. This paper focuses on the Miniature Frieze from the Northeast Bastion at Ayia Irini on Kea[2] and the Hunt Frieze from Palace F at Tell el-Dab^ca.[3] Both were executed in Aegean mode, yet both

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1 London; email: lyviamorgan@aol.com.
2 Morgan in press; cf. Morgan 1998; Morgan 2013.
3 Marinatos 2000; Morgan 2004; Marinatos – Morgan 2005; Morgan 2006; Marinatos 2010; Morgan 2010a; Morgan 2010b; Morgan, in: Bietak *et al.* 2012/2013, 139–142.

in: J. Becker, J. Jungfleisch and C. von Rüden (eds.) Tracing Technoscapes. The Production of Bronze Age Wall Paintings in the Eastern Mediterranean (Leiden 2018) 235-252.

were far from the pivotal centre of Aegean culture, Knossos on Crete. Both friezes would have covered several walls, at Ayia Irini all four, at Tell el-Dabᶜa perhaps three, on the fourth most likely being the Taureadors Frieze.[4] Both were found in hundreds of small fragments, making it necessary to conceptualize the scenes in reconstructions in order to make sense of them. The Kea fragments had fallen to the ground close to their walls, so the architectural context can be visualized. The Tell el-Dabᶜa fragments were thrown out near the entrance to the palace, mixed with other paintings in a dump, so we can only surmise where the frieze lay, perhaps near, in, or above the throne room.

Of course, the context differs: Ayia Irini was a fortified Cycladic town and, uniquely, these paintings were inside a bastion; Tell el-Dabᶜa was an Egyptian palatial complex and Palace F was a small ceremonial palace.[5] Yet both appear to have had a formal function: banqueting in the bastion, and perhaps in both the reception of foreign visitors. Significantly, both sites were harbours, outward looking rather than inward, and these two buildings were strategically placed to reflect that role.[6]

Physically, the paintings differ in one significant factor: their scale. The Kea frieze was c. 50–55cm high and the numerous male figures were 8–9cm; the Tell el-Dabᶜa frieze was c. 88cm high and the few men were around 28cm tall.[7] Space and the size of figures have implications for the planning of scenes, so there are significant differences between approaches to large-scale wall paintings and narrow friezes.[8] Yet, as both these paintings took the format of a narrow frieze, they provide a good case study for comparative techniques and approaches to image formation.

I begin by briefly considering preparation and approach: plaster and the question of *fresco* versus *secco*. These issues have been much discussed.[9] However, technical studies of wall paintings tend to deal with samples from across a site, in other words from different paintings in different contexts and sometimes even of different dates. It is clear to me, however, that approaches to forming images vary according to the area of wall to be covered and the scale of the elements in the picture, not to mention the particular team involved in the process. In this paper, I examine the technical approaches to forming images in two specific friezes, one from each site. The main part of the paper examines how the image was planned and the paints applied.

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4 Bietak *et al.* 2007.

5 See Bietak 2005; Bietak 2007; Bietak 2013 (with reconstructed plans of the palace).

6 Cf. Morgan 2007; for the position of Palace F: Bietak 2010, 14, figs. 2.2–2.3; Bietak 2013, fig. 1.

7 In the miniature paintings from the Cyclades and Crete, dating to LM IA, figures range from 6–9cm (Thera: Morgan 1988; Doumas 1992, pls. 26–48; Televantou 1994; Tylissos: Shaw 1972; Knossos: Hood 2005, 63–64). In early Mycenaean paintings from the mainland, dating to LH IIIA, figures are c. 20–25cm (Mycenae: Tournavitou 2015; Argos: Tournavitou – Brecoulaki 2015). The Tell el-Dabᶜa frieze, between the two in date (equivalent to LM IB/LH IIA), is comparable to the latter in scale.

8 At Akrotiri on Thera, for example, those working on the large-scale paintings have identified the use of incised lines (e.g. Asimenos 1978, 575), preliminary wash brushstrokes preceding the sketch beneath the fine lime slip (Angelidis *et al.* 2018), and perhaps the use of templates (Birtacha – Zacharioudakis 2000) for the planning stages, none of which is evident in the miniature paintings of the West House.

9 Specifically on Tell el-Dabᶜa: Seeber 2000; Brysbaert 2002; Brysbaert 2007; Winkels 2007.

1. Preparing the Surface

As with all Aegean murals, the plaster of both paintings was lime, despite the fact that at Ayia Irini the walls were of stone, at Tell el-Dab^{c}a mud-brick. An initial layer of mud mixed with straw and tiny stones was applied to smooth the irregular surface of the wall, and striations (Kea) or keying ridges (Tell el-Dab^{c}a) on the backs of the plaster were made for anchorage.[10] The plaster is in two main layers: a thicker core and a thinner top layer of 0.5–0.7cm (Kea) or 0.4–0.5cm (Tell el-Dab^{c}a). A fine lime slip was then applied in preparation for the reception of the paints.[11]

At both sites, the architecture was local in structure and materials, at Ayia Irini allied to but distinct from Crete, at Tell el-Dab^{c}a purely Egyptian. Both friezes were constructed by applying the plaster within a frame of two parallel wooden beams set within the wall, evidenced by the bulging profile and flattened edge of many fragments. In both, the plaster and its application were generically Aegean, but locally sourced ingredients were used in its composition.

2. Bonding the Paint

Elsewhere, I have discussed the controversial issue of whether Aegean artists used *fresco* or *secco* technique.[12] Here, I will summarize, with reference to these specific paintings. While in *buon fresco* pigment is applied to fresh plaster, bonding by chemical reaction as it dries, in *mezzo fresco* the surface is dampened after the plaster has dried or the pigment is mixed with lime water.[13] An organic binder may be used with the latter and is essential for *secco* technique, a clear indication of which is the flaking of paint layers as the organic material disintegrates. Most scholars recognize a mixed technique in Aegean painting.[14] What is little discussed is whether artists used *buon* or *mezzo fresco* technique and at what point an organic binder was added. Identification of *fresco* in fragments of plaster is highly problematic.[15] Until recently, organic binders had not been identified in Aegean painting, but new analyses of samples from Phaistos and Pylos have revealed clear traces.[16] At Tell el-Dab^{c}a, in separate samples, egg and casein / glue binders have been tentatively identified.[17]

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10 Cf. Seeber 2000, 96–97, figs. 7–11.

11 Ayia Irini: Morgan in press, pl. 69f; Tell el-Dab^{c}a (not the frieze): Brysbaert 2007, pls. 15–16. This fine slip, also known as *intonaco*, has been noted in the paintings of several, but not all, Aegean sites, and is also a feature of some Levantine sites with 'Aegeanized' wall paintings: Brysbaert 2008, 151, table 7.2.

12 Morgan in press, Chapter 9.

13 Technique: Seymour 2007, 437–454; historical context: Mora *et al.* 1984, 69–161.

14 See esp. Dandrau 2001; and for a summary of the debate: Jones 2005, 217–220. To these should now be added Brysbaert 2008, esp. 111–128 (a proponent of the use of *buon fresco*); Brecoulaki *et al.* 2008 and Brecoulaki *et al.* 2012 (on the layering of paints in *secco* technique).

15 Cf. Perdikatsis 1998, 106–107. Sampling invariably involves tiny pieces of single colours, usually taken from fragments from different buildings, rather than pieces with multiple colours from a single painting (cf. Chryssikopoulou *et al.* 2000, 129; Brysbaert 2008, 63, 126).

16 Phaistos: Jones 2005, 219; Pylos: Brecoulaki *et al.* 2008, 384; Colombini, in: Brecoulaki *et al.* 2012; Brecoulaki *et al.* in press. Significantly, the samples were of single colours, paint onto plaster, rather than layers of colour.

17 Seeber 2000, 99, table 2 (Seeber comments on the difficulty of analysis owing to the constituents of the soil). The glue was probably gum arabic from the acacia tree (Seeber 2000, 95), one of several binders identified in Egyptian paintings (Lucas 1962, 5–6).

In the Kea frieze, there are signs that the plaster was damp or dampened in the *planning stages* of the painting: in disturbance of the plaster surface visible in the brush strokes of guide lines and the use of string impressions. The yellow ground may have been applied to damp(ened) plaster, but not subsequent colours.[18] At Tell el-Dab^{c}a, string impressions or incised lines were applied into damp plaster at the planning stages of some paintings,[19] tool marks have been identified in the reliefs, and occasional fingerprints or disturbance of the plaster layer in brush strokes have been noted.[20] However, none of these observations apply to the Hunt Frieze. Microscopic observations by the conservator Erico Peintner suggested that the red background, in two separate layers of paint over the slip, was mixed with lime but did not appear to have penetrated the plaster, which would indicate that it was applied when the latter was dry or dampened rather than freshly made.[21] Both yellow ground and blue rocks were painted on top of the slip and have partially disintegrated. There are no indications in either frieze of guide lines (*sinope*) beneath the plaster slip (*intonaco*), as would be the case had *fresco* been the main technique.[22] In summary, in both cases, planning may have taken place on damp(ened) plaster, but the majority of the painting process was undertaken in *secco* technique.

3. Planning the Image

Once the wall is prepared, the image must be planned out on its surface. Regardless of painting technique, this crucial step is the driving force of the composition.

3.1 Guide Lines and Sketches

In the Kea Miniature Frieze and in the Tell el-Dab^{c}a Taureadors Frieze short string impressed guide lines were used for marking out specific elements: buildings in the former, a maze in the latter. However, no incised or impressed guide lines were used

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18 Perdikatsis' analysis revealed secondary calcite in the pigment layer of most of the Kea samples, which implies that the surface had dried before it was applied (Perdikatsis in press, table 6). The secondary calcite would have been formed by lime water used to dilute the pigment and facilitate binding or by adding lime to the pigment to lighten the hue.

19 Seeber 2000, 94; Bietak *et al.* 2007, 47–50.

20 Seeber 2000, 95 (tool marks); Brysbaert 2002, 96 (finger/knuckle prints); Brysbaert 2007, 160 (brush strokes). Brysbaert also cites penetration of Egyptian Blue pigment into the plaster (something that does not easily occur under osmotic pressure as it does for ochres and hence can be a sign of fresco technique). It is unclear from which painting this was observed, but it is not the case in the fragments of the Hunt Frieze. Comparable observations on Cretan paintings have been made (see esp. Cameron *et al.* 1977, 167–169; Brysbaert 2008, 111–128).

21 Personal communication 2012. These microscopic observations were made on site and would need to be confirmed by thin sections. Measurement of the penetration of pigment into the plaster is no longer considered a good criterion for identifying *buon fresco*, which is rather dependent on even diffusion of calcium throughout the thickness of the plaster (Dandrau – Dubernet 2006, 246). Penetration is dependent on the porosity of the plaster in combination with the properties of the pigment, and can also occur to some extent with *secco* technique under post-depositional osmotic pressure (Perdikatsis *et al.* 2000, 115–116; Jones 2005, 219). The opposite case – no penetration of pigment into the plaster – would, however, be a clear indication of *secco* technique.

22 Brysbaert (2002, 99) writes of "colouration of the surface below the painted surface at Tell el-Dab^{c}a (…) evident where the top surface (painted *intonaco*) had flaked off or was eroded away (…)". In my observations of the Hunt Frieze, sketches are painted <u>onto</u> the *intonaco*, not beneath them, and the flaking is of the pigment rather than the slip.

in the Hunt Frieze, as there are no architectural or geometric elements. On the other hand, preliminary painted sketches are observable in both friezes under discussion. At Kea, pink sketches mark the buildings, often adjacent to the tiny string impressions. At Tell el-Dab^ca, pink, light red or pinkish ochre sketches define the juncture between rocks and ground and mark the contours of animals and men.

3.2 Applying the Ground Colours

In both friezes, the background colours were applied in a specific order, with attention to the relationship between plaster surface and the adhesive qualities of pigments. The Kea ground is yellow ochre, with blue for sea below; the Tell el-Dabᶜa ground is red and yellow, with mainly blue for the rocks below. Ground colours were applied first to smooth plaster (red before yellow in the case of Tell el-Dabᶜa[23]), while, for technical reasons, blue was applied onto rougher plaster. Blues have a larger grain size than the earth colours of red and yellow (see below), and therefore adhere less effectively to a smooth surface, regardless of the method of bonding.[24]

Transitions between ground and blue were planned. At Kea, the yellow was diluted to a faint hue at the intended juncture, creating a smooth and unobtrusive transition, while avoiding a green appearance in places where the relatively thin blue paint overlaps yellow. At Tell el-Dabᶜa, the juncture was marked by sketch lines and the paints were applied more thickly, precluding a subtle transition.

In both, certain areas were left as reserved plaster when the ground colour was painted: at Kea, the buildings, at Tell el-Dabᶜa, the animals and the white boots of the men. These are the areas that were planned with sketches. Planning and reserving the figurative was crucial for the Hunt Frieze, owing to the larger scale and the dark red ground, which would be harder to paint over than light yellow.

4. Choosing the Colours

There is close accord in the pigments, but there are also some distinctions.[25] It should be noted that analyses at both sites were taken from samples across different paintings, not all from the friezes in question. White is calcium carbonate, matching the lime plaster; black is carbon from soot or charcoal; red and yellow are ochres, primarily haematite or goethite; blue is Egyptian Blue (cuprorivaite). There are some differences in the subsidiary components of the ochres (eg. illite and kaolinite at Kea, limonite at Tell el-Dabᶜa), as is to be expected given that the source would have been local. At Ayia Irini only, amphiboles were identified mixed with Egyptian Blue in one sample, and in

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23 Red was painted first at the top, continuing down or contrasting with yellow below, then rocks at the bottom. Cf. Becker 2016, 33; Becker this volume, on the large-scale animals and plants in F00505 from Palace F. He observes that the painters started at the top with yellow ground, but, in contrast to the Hunt Frieze, it appears that the griffin was painted next, before the ground below.

24 Lucas 1962, 351; Mora *et al.* 1984, 142–143. This applies to all blue pigments. Cf. Arts Council 1969, 15: blues had to be *secco*, bound with glue (not egg yolk, which would discolour the blue), applied to a rough surface for better adhesion. For identification of roughened surfaces for blue pigment in Aegean plasters, cf. Brysbaert 2002 (Tell el-Dabᶜa); Brysbaert 2008, 113.

25 Kea: Majewski – Reich 1973; Peredikatsis 1998; Perdikatsis in press. Tell el-Dabᶜa: Brysbaert 2007, 155–160.

two, pyrolusite, a manganese mineral, was identified as an alternative black.[26] However, neither of these results came from samples of the Miniature Frieze.

At Tell el-Dab^c^a the mixing of several ochres was reported, with haematite and calcite to create pink, or haematite and goethite to produce orange.[27] While mixing also occurred at Ayia Irini, the discovery of many pieces of raw ochre in the site revealed an extraordinary variety of natural hues, from pale pink through yellows, orange and reds.[28] There are no such remains of raw ochre from Tell el-Dab^c^a to compare.

Making allowance for differences in subject matter, the use of individual colours for particular elements is comparable. However, in the Kea frieze there is a wider range of colour in the landscape of plants, river, marsh, rocks, sea and sky than in the rocky landscape and plants of the Tell el-Dab^c^a frieze (Pl. 1.1–4); while in the Tell el-Dab^c^a frieze, there is more variety of colour in the depiction of animals (white, pink, black, or dappled dogs, versus white at Kea, and ochre or pink deer, versus ochre at Kea, Pl. 1.5–6) and men (red or pink depending on the background colour, versus only red, Pl. 1.7–8).

5. Applying the Paints

Some paints were applied over another colour, others adjacent. In the former, the order of painting is clear, since the top colour frequently flakes revealing the one beneath; in the latter, minimal overlapping at the edges of the colour allow one to observe the order of painting under magnification.

In the Kea frieze, there is more consistency in the order of painting landscape than there is in the painting of figures. A distinct, though not inviolable, order of painting the rocks is discernible (Pl. 1.1): blue-grey, then pink, red, and ochre, in that order. Black was painted at the end, white blobs on top of the blue-grey, and ochre plants last. On the whole, landscape was painted before the figures. Limbs were sometimes painted after clothing, sometimes before. Women's skin was applied thickly in white over the ground, not reserved in the plaster.

In the rocks of the Tell el-Dab^c^a frieze (Pl. 1.2), a thin white slip, smoother than the plaster on which blue was painted, was applied to those areas that were to be pink or ochre. The rock was mostly (but not invariably) painted in the following order: blue, pink, red and ochre, white, red or black veining and black delineation. Rockwork higher in the picture plane was painted over the ground colour, with a thin white slip between the red ground and the blue, facilitating adhesion and lightening the hue. Rocks were painted before animals. Dogs were sometimes painted in two layers (Pl. 1.8), first pale pink or pale ochre over the reserved plaster, then a coat of white. Lions and leopards also have a thin layer of white over the reserved plaster for manes and underbellies, painted after the yellow ochre body, occasionally over it. Ungulates sometimes have their white legs painted over the red ground, even though the bodies were reserved. The men were painted over the red or yellow ground, though in Pl. 1.8 the white boot began as reserved plaster, over which white was added. Here the man's boot (right) overlaps the white of the dog, demonstrating

26 Perdikatsis 1998, tables 2–3.
27 Brysbaert 2007, 155, 157.
28 Morgan in press, Chapter 9, pls. 72–74.

that the animal was painted first. Details (red collars or blood, blue claws, white clothing) were painted over the colours of bodies. Black outlines and details were added last. On a lion, for example, the order of painting would be: pink outline sketch / red ground reserving the body of the lion / yellow ochre body / white mane and underbelly, pale blue eye, blue claws / red hairs of the mane, nose, outline to the eye / black outline to the body. For the plants, painted over the ground colour, red stems usually preceded blue leaves.

There are, then, distinctly similar patterns of artistic behaviour in the order of applying paints. Both began with colour at the top of the frieze, followed by blue at the bottom. In both, the main elements of the landscape appear to have preceded the human action. The pattern of painting red stems before blue leaves in the Tell el-Dabᶜa Hunt Frieze is matched in the Plant Panels in the room adjacent to the Miniature Frieze at Kea. Remarkably, the order of painting the rocks is closely matched: blue, then pink, red, ochre, white (or white, ochre). Black details were consistently added last.

6. Varying Hue and Luminosity

Pictorially, landscape lends itself to the varying of hue (colour), tone (light and dark) and intensity (opacity and translucency) through the technical processes of combining, layering, and diluting pigments. The Kea and Tell el-Dabᶜa painters (like those of Thera and Crete) were masters of these techniques, notably in the multicoloured rock. Red overlapping dilute pink (mixed with water or perhaps gum to achieve translucency and luminosity) creates a sense of depth. In the Kea frieze, remarkably, dilute pink is applied to parts of the sky's horizon, as well as to descending and ascending rocks (Pl. 1.1). In the riverine grasses, a sense of movement and depth is achieved through varying degrees of dilution of the yellow ochre, and by contrasting pale blue and blue-black blades of grass, the former lightened through the addition of lime or through differential grinding of the silicate pigment,[29] the latter darkened through the addition of black and dilution of the resultant tone (Pl. 1.3). The blue of the rocks is toned down through layers of pigment – blue then dilute black – especially along the upper contours of the rockwork, which creates an illusion of depth (Pl. 1.1) while distinguishing it from the brighter blue of the sea. In the Tell el-Dabᶜa frieze, black also overlies the blue of the rocks (which is brighter than at Kea), but as streaks, as though delineating the interiors of the stone, rather than as a layer to manipulate tone (Pl. 1.2). Black over blue, as observed at both sites, is less common in Aegean painting than blue over black as a darkening device.[30]

White was applied for certain details in *impasto* technique, using a spatula or brush, as the penultimate act of painting, prior to black outlines. *Impasto* is a particular feature in the Kea frieze, used for highlights on the rock (Pl. 1.1) and spume on the sea. It is seen in Cretan painting, but not in Theran, and at Tell el-Dabᶜa it was used only for the white inflorescence of certain plants.

29 See esp. Tite *et al.* 1987, 42, 45.

30 Besides Kea and Tell el-Dabᶜa it is known at Akrotiri (Vlachopoulos – Sotiropoulou 2013, 254, 'Porter's Lodge') and Miletus (Brysbaert 2008, 116). Blue-black over lighter blue, which would have the same effect, has been observed at Chania (Photos-Jones *et al.* 2003, 311–315, 371).

Green, which was not used as a pigment in either painting, is perceptually achieved by overlaying blue on yellow (or vice versa) in a relatively translucent layer, or by mixing the two. This is a particular feature of the plants in the Tell el-Dabᶜa frieze and was also used to effect in the large-scale plants at Kea. In the Tell el-Dabᶜa frieze, blue reeds on red ground have an undercoat ranging from white through buff to ochre, providing alternate contrasting light blue and blue-green (Pl. 1.4), while for the rocks, irregular strips of intense blue are contrasted with ones of dull greenish-blue (Pl. 1.2).

Layering or mixing was commonly used in the Tell el-Dabᶜa frieze to achieve variety of hue: lions, leopards and deer have subtly different hues through the mixing or layering of ochres, some more pink (Pl. 1.6), others more orange (Pl. 1.4); white dogs and some ungulates have a buff hue created by layering dilute pink or pale ochre then white (Pl. 1.8); men's skin is distinguished from the red ground by a top layer of pink (Pl. 1.8, top right); black was painted over red to darken it on a few plant stems; and occasionally diluted black was used for leaves, a greenish hue being a result of the yellow ground beneath. The orange-pink hue of some of the rocks, like that of the deer, was achieved by layering two hues, while a few rocks have an unusual light plum colour, probably the result of mixing pink-red with a hint of blue.

7. Completing the Image

A notable difference is that the Tell el-Dabᶜa men are outlined in black (consistently when on red ground, sometimes on yellow), while those of Kea are not (Pl. 1.7–8). One likely reason is scale, the former being larger;[31] another may be date, black outlining being a feature of Mycenaean painting; or influence from Egyptian wall painting, in which figures are outlined in dark red (occasionally in black).[32]

In the Kea frieze, the white skins of two women and parts of their garments are outlined in black, while another (against a blue-black window) has her arm partially outlined in yellow ochre. The men's white garments are outlined in black, often with internal folds or creases. Architectural features (windows, masonry, cornices etc.) are defined in black. There are no women or buildings in the Tell el-Dabᶜa frieze to compare.

In the Tell el-Dabᶜa frieze, red and black outlines were used: black for men and white animals (dogs (Pl. 1.8), goats, griffin), red for a black dog and for lions (on yellow ground). Calf muscles of men and features of white animals are delineated in black, while ears, ankles, claws etc. of lions are defined in red (Pl. 1.4), as is the antler of a fallow deer.[33] Red lines demarcate the white belly of leopards and lion and the head of the griffin. Eyes are outlined in red (deer, lions, leopards) or black (griffin).

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31 The life-size male figures from Palace F are also outlined in black: Aslanidou 2005, 464, 467.

32 It is difficult to gauge the dating of the less frequent use of black outlines, given that in older publications of tombs the illustrations are not in colour. I have not made a study of this, but on the whole it seems that black was used from the mid rather than early 18th Dynasty, so later than the Tell el-Dabᶜa paintings. A good example is the Tomb of Menna (TT 69), datable to Thutmose IV–Amenhotep III, in which the outlines of the figures range from pinkish dark red through to black (Hartwig 2013, 19 (dating), 144). Cf. Mekhitarian 1978, 54 (Kenamun, TT 93), 77, 87 (Menna, TT 69), 110 (Nebseny, TT 108). Black outlines are more common in 19th Dynasty painting: e.g. Mekhitarian 1978, 147 (Ipy, TT 217), 149, 151 (Senedjem, TT 1).

33 Morgan, in: Bietak *et al.* 2012/2013, fig. 7.

Finally, the painted surface of some of the Tell el-Dab^ca fragments has a slight gleam. It is unlikely that the painting was polished, as this would have damaged the upper layers of paint.[34] Resin was used in the conservation of the fragments,[35] and it is unclear whether the gleam is due to that, or whether wax or a varnish such as acacia gum was applied at the end of the painting process to intensify the saturation of colours.[36]

8. Conclusions

A comparison such as this, between two paintings of the same format (albeit with minor differences in scale and date), should ideally be set within the context of a wide range of sites. It is, however, not common in studies of ancient wall paintings to find analyses of the *process* of painting – how the artists formed the image as a whole. This brief comparative study could, therefore, potentially provide insights into the network of artistic interconnections between painters and patrons of the time. There is no implication here that the artists of Kea and Tell el-Dabᶜa were the same, but that they belonged to the same tradition of craftsmanship is clear.

Plaster and pigments are closely comparable. More striking are the correspondences in planning the picture and applying the colours. When craftsmen travel, they use materials and methods common to their cultural milieu, sourcing equivalents locally as needed. But how they proceed in planning and building up an image is more revealing as to training, workshops, and specific traditions. At the planning stages, there is fundamental accord as to approach, with individual differences rooted in discrepancies in scale and subject matter. Both made preliminary markings on the plaster as guides for the composition, pink brush sketches for large figurative areas (Tell el-Dabᶜa) and buildings (Kea), the latter also with incised lines. Both separated areas above and below into ochre ground and predominantly blue beneath, and both began painting at the top of the frieze. In both, the areas of plaster destined for red or yellow was smoothed, while that destined for blue was roughened to facilitate bonding. In both, areas that were to be white were left reserved, the ground colour painted around them. At Tell el-Dabᶜa this principle extended to ochre animals. Differences are due to scale: tiny figures and animals were painted *after* the ground (Kea); larger animals were sketched *before* (Tell el-Dabᶜa).

Allowing for differences in subject elements, the range and use of colours is comparable. There is, however, greater subtlety in the variety of hues in the landscape of Kea, and a wider range of hues for animal skin at Tell el-Dabᶜa. Significantly, there are distinctly similar patterns of artistic behaviour in applying the paints. Landscape was usually painted before figures. Green is absent as a pigment but subtly achieved perceptually by layering of yellow and blue. The order of applying the colours of rocks is strikingly closely matched. Black is applied over blue to tone down the hue (Kea)

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34 Cf. Chryssikopoulou *et al.* 2000, 123, 125 on experimental replication of the painting process, in which polishing at the end was unsuccessful, contra Cameron's experience (Cameron *et al.* 1977, 165–166). These experiments were with *fresco*, not *secco* technique.

35 Brysbaert 2007, 152.

36 Wax has been identified as a method of providing sheen on some 18th dynasty paintings (Lee – Quirke 2009 [2000], 110). Erico Peintner (personal communication 2012) suggests that gum arabic (acacia) may have been used on parts of the painting as a varnish, aiding cohesion of the blues in particular as well as providing a light gloss; cf. note 17 re. gum arabic as a binder.

or to define internal details. Black was consistently applied last. Both the outlining and the larger scale of the Tell el-Dab^ca frieze are intimations of a slightly later date than the Kea frieze. That the artists of the two sites belonged to the same tradition of craftsmanship is clearly visible, not only in the materials and techniques used, but also, significantly, in their common approaches to forming the image.

References

Angelidis *et al.* 2018

P. Angelidis – L. Kalambouki – S. Sotiropoulou – M. Hamaoui, Τα προσχέδια στις τοιχογραφίες του Ακρωτηρίου (The preliminary designs in the Akrotiri wall-paintings), in: A. Vlachopoulos (ed.), ΧΡΩΣΤΗΡΕΣ. PAINT BRUSHES. Wall-Painting and Vase-Painting of the 2nd Millennium BC in Dialogue. Workshop held at Akrotiri, Thera, 24–26 May 2013 (Athens 2018), 359–369.

Arts Council 1969

The Arts Council of Great Britain. Frescoes from Florence. An exhibition organized by the Soprintendenza alle Gallerie per le Provincie di Firenze e Pistoia. Hayward Gallery, London, 3 April to 15 June 1969 (London 1969).

Asimenos 1978

K. Asimenos, Technological observations on the Thera wall-paintings, in: C. Doumas (ed.), Thera and the Aegean World I. Papers Presented at the Second International Scientific Congress, Santorini, Greece, August 1978 (London 1978) 571–578.

Aslanidou 2005

K. Aslanidou, The Minoan wall paintings from Tell el-Dabca/cEzbet Helmi. The life-size male figures, in: R. Laffineur – E. Greco (eds.), Emporia. Aegeans in the Central and Eastern Mediterranean. Proceedings of the 10th International Aegean Conference in Athens, April 14th–18th 2004, Aegaeum 25 (Leuven 2005) 463–469.

Becker 2016

J. Becker, The large-scale landscape paintings of Tell el-Dabca/Egypt, in: R. A. Stucky – O. Kaelin – H.-P. Mathys (eds.), Proceedings of the 9th International Congress on the Archaeology of the Ancient Near East, June 9th–13th, 2014, University of Basel Vol. 2 (Wiesbaden 2016) 23–35.

Bietak 2005

M. Bietak, The setting of the Minoan wall paintings at Avaris, in: Morgan 2005, 83–90.

Bietak 2007

M. Bietak, Bronze Age paintings in the Levant. Chronological and cultural considerations, in: M. Bietak – E. Czerny (eds.), The Synchronisation of Civilisations in the Eastern Mediterranean in the Second Millennium B.C. III. Proceedings of the SCIEM 2000 – 2nd EuroConference in Vienna, May 28th – June 1st 2003, Contributions to the Chronology of the Eastern Mediterranean 9, Denkschriften der Gesamtakademie 37 (Vienna 2007) 269–300.

Bietak 2010
M. Bietak, Minoan presence in the pharaonic naval base of Peru-nefer, in: O. Krzyszkowska (ed.), Cretan Offerings. Studies in Honour of Peter Warren, British School at Athens Studies 18 (London 2010) 11–24.

Bietak 2013
M. Bietak, The impact of Minoan art on Egypt and the Levant. A glimpse of palatial art from the naval base of Peru-nefer at Avaris, in: J. Aruz – S.B. Graff – Y. Rakic (eds.), Cultures in Contact. From Mesopotamia to the Mediterranean in the Second Millennium B.C., The Metropolitan Museum of Art Symposia (New York, New Haven, London 2013) 188–199.

Bietak *et al.* 2007
M. Bietak – N. Marinatos – C. Palyvou, Taureador Scenes in Tell el-Dab^ca (Avaris) and Knossos, Denkschriften der Gesamtakademie 43, Untersuchungen der Zweigstelle Kairo des Österreichischen Archäologischen Institutes 27 (Vienna 2007).

Bietak *et al.* 2012/2013
M. Bietak – C. von Rüden – J. Becker – J. Jungfleisch – L. Morgan – E. Peintner, Preliminary report of the Tell el-Dabca wall painting project – Season 2011/2012, Egypt and the Levant 22/23, 2012/2013, 131–147.

Birtacha – Zacharioudakis 2000
K. Birtacha – M. Zacharioudakis, Stereotypes in Theran wall paintings. Modules and patterns in the procedure of painting, in: Sherratt 2000, 159–172.

Brecoulaki *et al.* 2008
H. Brecoulaki – C. Zaitoun – S. R. Stocker – J. L. Davis, An archer from the Palace of Nestor. A new wall-painting fragment in the Chora Museum, Hesperia 77, 2008, 363–397.

Brecoulaki *et al.* 2012
H. Brecoulaki – A. Androetti – I. Bonaduce – M. P. Colombini – A. Lluveras, 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, Journal of Archaeological Science 39, 2012, 2866–2876.

Brecoulaki *et al.* 2015
H. Brecoulaki – J. L. Davis – S. R. Stocker (eds.), Mycenaean Wall Painting in Context. New Discoveries, Old Finds Reconsidered, Μελετήματα 72 (Athens 2015).

Brecoulaki *et al.* in press
H. Brecoulaki – A. Karydas – M.P. Colombini, Re-presenting in colours at the 'Palace of Nestor'. Original polychromy and painting materials, in: J. Bennett – M.S. Peters (eds.), Technologies of Representation in the Aegean Bronze Age (Oxford in press).

Brysbaert 2002
A. Brysbaert, Common craftsmanship in the Aegean and east Mediterranean Bronze Age. Preliminary technological evidence with emphasis on the painted plaster from Tell el-Dab^c^a, Egypt, Egypt and the Levant 12, 2002, 95–107.

Brysbaert 2007
A. Brysbaert, A technological approach to the painted plaster of Tell el-Dab^c^a, Egypt. Microscopy and scientific analysis, in: Bietak *et al.* 2007, 151–162.

Brysbaert 2008
A. Brysbaert, The Power of Technology in the Bronze Age Eastern Mediterranean. The Case of the Painted Plaster, Monographs in Mediterranean Archaeology 12 (London 2008).

Cameron *et al.* 1977
M. A. S. Cameron – R. E. Jones – S. E. Philippakis, Scientific analyses of Minoan fresco samples from Knossos, Annual of the British School at Athens 72, 1977, 121–184.

Chryssikopoulou *et al.* 2000
E. Chryssikopoulou – V. Kilikoglou – V. Perdikatsis – S. Sotiropoulou – K. Birtacha – M. Zacharioudakis, Making wall paintings. An attempt to reproduce the painting techniques of Bronze Age Thera, in: Sherratt 2000, 119–129.

Dandrau 2001
A. Dandrau, La peinture murale minoenne, III. Méthodes et techniques d'exécution, Bulletin de Correspondance Hellénique 125,1, 2001, 41–66.

Dandrau – Dubernet 2006
A. Dandrau – S. Dubernet, Appendix 2.2. Plasters from Kommos. A scientific analysis of fabrics and pigments, in: J. Shaw – M. C. Shaw (eds.), Kommos V. The Monumental Minoan Buildings at Kommos (Princeton 2006) 236–248, 258–260.

Doumas 1992
Ch. Doumas, The Wall-Paintings of Thera (Athens 1992).

Hartwig 2013
M. Hartwig (ed.), The Tomb Chapel of Menna (TT 69). The Art, Culture, and Science of Painting in an Egyptian Tomb, American Research Center in Egypt Conservation Series 5 (Cairo, New York 2013).

Hood 2005
S. Hood, Dating the Knossos frescoes, in: Morgan 2005, 45–81.

Jones 2005
R. E. Jones, Technical studies of Aegean Bronze Age wall painting. Methods, results and future prospects, in: Morgan 2005, 199–224.

Lee – Quirke 2009 [2000]
L. Lee – S. Quirke, Painting materials, in: P. T. Nicholson – I. Shaw (eds.), Ancient Egyptian Materials and Technology (Cambridge 2009 [2000]) 104–120.

Lucas 1962
A. Lucas [ed. and rev. J. R. Harris], Ancient Egyptian Materials and Industries, 4th edition (London 1962).

Majewski – Reich 1973
L. J. Majewski – M. Reich, Appendix. Technical examination of fresco samples from excavations at Ayia Irini, in: K. Coleman, Frescoes from Ayia Irini, Keos. Part 1, Hesperia 42,3, 1973, 297–300.

Marinatos 2000
N. Marinatos, A hunting scene from Tell el-Dab'a. Hunting in a pink landscape, in: A. Karetsou – T. Detorakis – A. Kalokairinos (eds), Πεπραγμένα του Η' Διεθνούς Κρητολογικού Συνεδρίου, Τόμος Α2 (Iraklion 2000) 259–265.

Marinatos 2010
N. Marinatos, Lions from Tell el-Dabᶜa, Egypt and the Levant 20, 2010, 325–355.

Marinatos – Morgan 2005
N. Marinatos – L. Morgan, The dog pursuit scenes from Tell el Dabᶜa and Kea, in: Morgan 2005, 119–122.

Mekhitarian 1978
A. Mekhitarian, Egyptian Painting (Geneva 1978).

Mora *et al.* 1984
P. Mora – L. Mora – P. Philippot, Conservation of Wall Paintings (London 1984).

Morgan 1988
L. Morgan, The Miniature Wall Paintings of Thera. A Study in Aegean Culture and Iconography (Cambridge 1988).

Morgan 1998
L. Morgan, The wall paintings of the North-East Bastion at Ayia Irini, Kea, in: L. G. Mendoni – A. Mazarakis Ainian (eds.), Kea – Kythnos. History and Archaeology. Proceedings of an International Symposium Kea – Kythnos, 22–25 June 1994 (Athens 1998) 201–210.

Morgan 2004
L. Morgan, Feline hunters in the Tell el-Dab[c]a paintings. Iconography and dating, Egypt and the Levant 24, 2004, 285–298.

Morgan 2005
L. Morgan (ed.), Aegean Wall Painting. A Tribute to Mark Cameron, British School at Athens Studies 13 (London 2005).

Morgan 2006
L. Morgan, Art and international relations. The hunt frieze at Tell el-Dab[c]a, in: E. Czerny – I. Hein – H. Hunger – D. Melman – A. Schwab (eds), Timelines. Studies in Honour of Manfred Bietak Vol. II, Orientalia Lovaniensia Analecta 149 (Leuven 2006) 249–258.

Morgan 2007
L. Morgan, Paintings, harbors, and intercultural relations, in: P. Betancourt – M. C. Nelson – H. Williams (eds.), Krinoi kai Limenes. Studies in Honor of Joseph and Maria Shaw, Prehistory Monographs 22 (Philadelphia 2007) 117–129.

Morgan 2010a
L. Morgan, A pride of leopards. A unique aspect of the hunt frieze from Tell el-Dab[c]a, Egypt and the Levant 20, 2010, 263–301.

Morgan 2010b
L. Morgan, An Aegean griffin in Egypt. The hunt frieze at Tell el-Dab[c]a, Egypt and the Levant 20, 2010, 303–323.

Morgan 2013
L. Morgan, The power of paint. Kea and beyond, Bulletin of the Institute of Classical Studies 56,1, 2013, 126–127.

Morgan in press
L. Morgan, KEOS XI. Ayia Irini. The Wall Paintings of the Northeast Bastion. Social Context and the Miniature Frieze (Philadelphia in press).

Perdikatsis 1998
V. Perdikatsis, Analysis of Greek Bronze Age wall painting pigments, in: S. Colinart – M. Menu (eds.), La couleur dans la peinture et l'émaillage de l'Égypte ancienne. Actes de la Table Ronde, Ravello, 20–22 mars 1997 (Bari 1998) 103–108.

Perdikatsis in press
V. Perdikatsis, Scientific analyses of painted plasters from Ayia Irini, in: Morgan in press, Appendix 2 and Table 6.

Perdikatsis *et al.* 2000
V. Perdikatsis – V. Kilikoglou – S. Sotiropoulou – E. Chryssikopoulou, Physicochemical characterisation of pigments from Theran wall paintings, in: Sherratt 2000, 103–118.

Photos-Jones *et al.* 2003
E. Photos-Jones – R. E. Jones – A. J. Hall, Appendix 4. Technical report on painted plaster fragments from the Greek-Swedish excavations at Kastelli, Khania, Crete, in: E. Hallager – B. P. Hallager (eds.), The Greek-Swedish Excavations at the Agia Aikaterini Square Kastelli, Khania 1970–1987 and 2001 Vol. III.1. The Late Minoan IIIB:2 Settlement, Acta Instituti Atheniensis Regni Sueciae. Series in Quarto 47,3,1 (Stockholm 2003) 306–320.

Seeber 2000
R. Seeber, The technique of plaster preparation for the Minoan wall paintings at Tell el-Dab[c]a, Egypt. Preliminary results, in: Sherratt 2000, 91–102.

Seymour 2007
P. Seymour, The Artist's Handbook. A Complete Professional Guide to Materials and Techniques (London 2007).

Shaw 1972
M. C. Shaw, The miniature frescoes of Tylissos reconsidered, Archäologischer Anzeiger 1972, 171–188.

Sherratt 2000
S. Sherratt (ed.), The Wall Paintings of Thera. Proceedings of the First International Symposium, Petros M. Nomikos Conference Centre Thera, Hellas, 30 August – 4 September 1997 (Athens 2000).

Televantou 1994
C. A. Televantou, Ακρωτήρι Θήρας. Οι Τοιχογραφίες της Δυτικής Οικίας (Akrotiri Thera. The wall paintings of the West House), Βιβλιοθήκη της εν Αθήναις Αρχαιολογικής Εταιρείας 143 (Athens 1994).

Tite *et al.* 1987
M. S. Tite – M. Bimson – M. R. Cowell, The technology of Egyptian Blue, in: M. Bimson – I. C. Freestone (eds.), Early Vitreous Materials, British Museum Occasional Paper 56 (London 1987) 39–46.

Tournavitou 2015

I. Tournavitou, Sport, prestige, and ritual outside the palaces. Pictorial frescoes from the West House at Mycenae, in: Brecoulaki *et al.* 2015, 144–169.

Tournavitou – Brecoulaki 2015

I. Tournavitou – H. Brecoulaki, The Mycenaean wall paintings from Argos. A preliminary presentation, in: Brecoulaki *et al.* 2015, 212–245.

Vlachopoulos – Sotiropoulou 2013

A. Vlachopoulos – S. Sotiropoulou, The blue colour on the Akrotiri wall-paintings. From the palette of the Theran painter to the laboratory analysis, Talanta. Proceedings of the Dutch Archaeological and Historical Society 44/2012, 2013, 245–272.

Winkels 2007

A. Winkels, Restauratorisch-naturwissenschaftliche Untersuchung von tuthmosidischen Putzen aus cEzbet Helmi / Tell el-Dabca. Ein Beitrag zur Erforschung altägyptischer Kalkputztechnik, Egypt and the Levant 17, 2007, 273–293.

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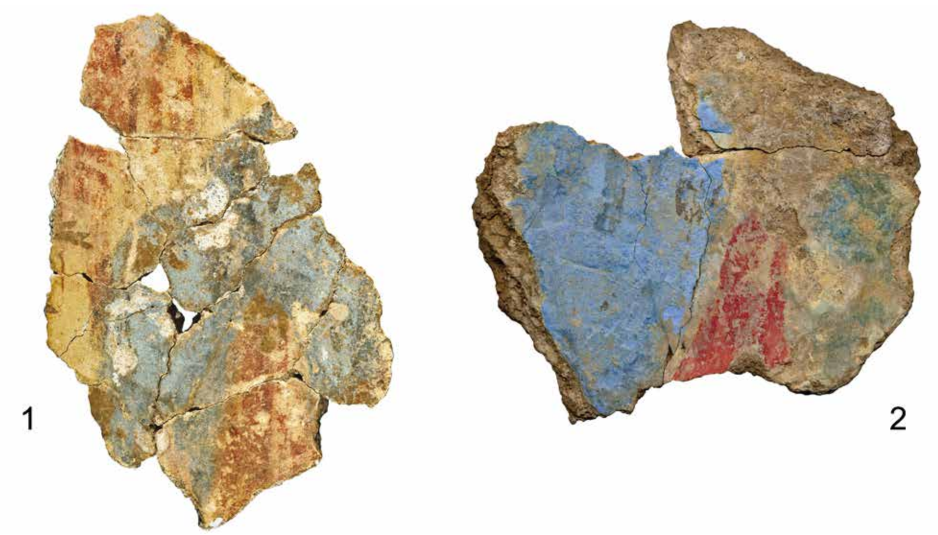
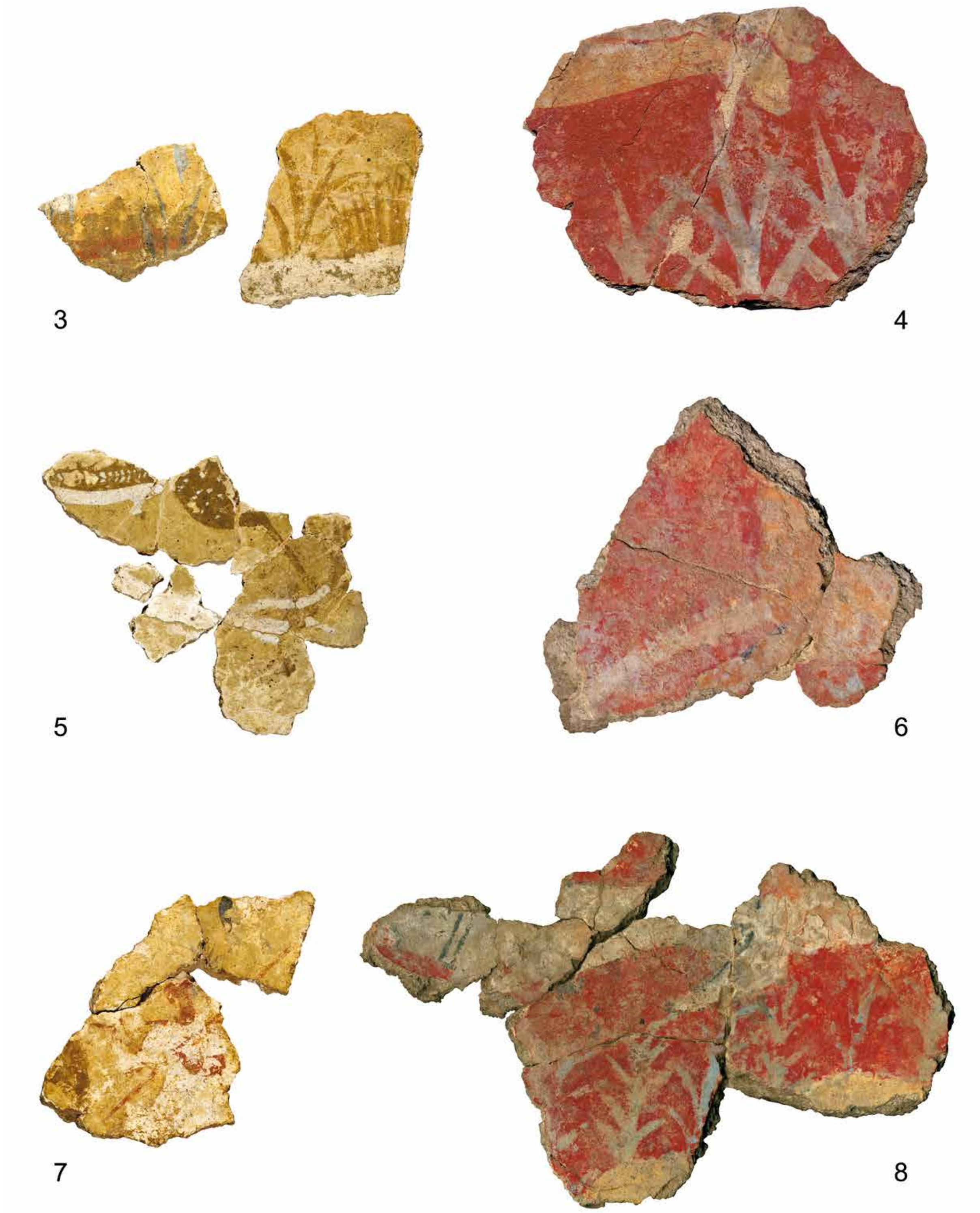


Pl. 1: Fragments of the Kea Miniature Frieze (left) and Tell el-Dabca Hunt Frieze (right). Scale 1:2.



Pl. 1: Fragments of the Kea Miniature Frieze (left) and Tell el-Dab^{c}a Hunt Frieze (right). Scale 1:2.

The Find Contexts of Knossian Relief Wall Paintings

Some Ramifications

Matthew Haysom[1]

Abstract

The palace at Knossos hosts one of the largest corpora of Late Bronze Age wall paintings in the Aegean. It was also one of the earliest corpora to be uncovered. As a result it holds a unique position within the historiography of Aegean wall painting. This paper focuses on the relief wall paintings from the palace. Over the history of scholarship these have been given widely divergent dates from the 17th century BC all the way down to the 14th century BC. This paper returns to the original excavation records of the palace's wall paintings to explore what can and cannot be said about their original find contexts. It then goes on to discuss the ramifications of the information and the lacunae for our understanding of the place of these wall paintings in the broader history of Aegean wall decoration.

Keywords: Knossos; Neopalatial; Final Palatial; fresco; wall painting; relief; chronology; Lily Prince; Priest King; bull relief; North Entrance Passage; high relief.

1. Introduction

The wall paintings from the palace of Knossos are extraordinary in a number of ways. More wall paintings come from the palace than from any other Bronze Age building on Crete. Indeed, depending on precisely how the corpus is enumerated, it could be stated that there are nearly as many wall paintings from the palace as there are from

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in: J. Becker, J. Jungfleisch and C. von Rüden (eds.) Tracing Technoscapes. The Production of Bronze Age Wall Paintings in the Eastern Mediterranean (Leiden 2018) 253-278.

Phase:	PROTOPALATIAL			NEOPALATIAL			FINAL PALATIAL	
Pottery dates:	MM IB	MM II	MM IIIA	MM IIIB	LM IA	LM IB	LM II	LM IIIA
High chronology:	1950–1900	1900–1800	1800–1750	1750–1675	1675–1580	1580–1490	1490–1430	1430–1320
Low chronology:	2000–1900	1800–1700	1700–1640	1640–1600	1600–1510	1510–1430	1430–1390	1390–1330

Tab. 1: Chronological scheme of the Cretan palatial Bronze Age.

all other contexts on the island put together.[2] Across all variables – theme, style and technique – the palatial Knossian wall paintings demonstrate a greater diversity than any other site in the Aegean. As a result, in several cases wall paintings from the palace remain unparalleled elsewhere. These extraordinary characteristics make the palatial corpus an inescapable reference point in all studies of wall painting in the Bronze Age eastern Mediterranean. Unfortunately, as reference points go, the corpus of palatial Knossian wall paintings is also extremely slippery.

The other Minoan palaces and the vast majority of Minoan sites were destroyed at the end of the period known as the Neopalatial period, or around 1450 BC according to the traditional chronology (Tab. 1).[3] Knossos uniquely carried on for another 100 years, into the period known as the Final Palatial period.[4] Evans, being the pioneer excavator, did not realise this and, as a result, in his formative account of Minoan civilisation and material culture he conflated the periods now known as the Neopalatial and Final Palatial periods. This posed a major problem for Minoan studies since the single greatest dislocation in Minoan history – involving both the disappearance of the vast majority of settlements and the introduction of new forms of material culture – went unrecognised by the foundational text of the discipline. As a result one of the primary themes in the historiography of Minoan civilisation has been the sorting out of this problem.[5]

When it comes to wall painting another factor in Evans' scholarship has also had a formative impact on the debate about their development on Crete. Evans was convinced that the palace at Knossos enjoyed a golden age at the beginning of the Neopalatial period, around 1700 BC, and tended to believe that wall paintings survived on the walls of the palace for very long periods of time, usually dating them to the earliest conceivable point in any time frame.[6] This meant his dates for wall paintings clustered at the beginning of the Neopalatial period.

2 The most complete listing is in Cameron 1976a where there are about 67 figurative wall paintings from the palace, 22 from the town of Knossos and 33 from the rest of Crete. These figures are only a rough indication as it is not always clear in the case of fragments how many compositions they originally constituted and in the time since Cameron's work the Knossian palatial corpus has remained constant but further figurative wall paintings have been found elsewhere.

3 For the sake of simplicity in the text of this paper I will use the traditional absolute chronology (the low chronology) found in Warren – Hankey 1989 with absolute dates rounded to the nearest half century.

4 A good introduction to the changes witnessed in the Final Palatial period, which contains previous bibliography, is Preston 2008.

5 The route the debate took as this error was gradually, but never completely, resolved can be traced through the key waypoints of Blegen 1958; Palmer – Boardman 1963; Popham 1970; Hallager 1977; Driessen 1990.

6 These views run throughout the volumes of the *Palace of Minos at Knossos* but are particularly discussed in volumes 1 (Evans 1921) and 3 (Evans 1930).

These have been the primary problems facing the study of Knossian palatial wall paintings. Not only did Evans completely misunderstand the later phases of the building, he also consistently placed wall paintings at the earliest point in their possible date range. As a result the debate surrounding the date of Knossian frescoes has been a sort of tug of war between attempts to down date wall paintings and attempts to defend the early dates that Evans initially gave to them. To give one example, the so-called 'Saffron Gatherer' fresco was dated by Evans to the dawn of Minoan representational wall painting, before the beginning of the Neopalatial period (MM II).[7] Mark Cameron found both stratigraphic and stylistic reasons to move its date right down to the Final Palatial period (LM II–IIIA) – in other words to after the great dislocation in Cretan archaeology and, therefore, much later than other familiar images of this theme, like the blue monkeys from Akrotiri.[8] Immerwahr then responded by moving the dating back to a much earlier period (MM IIIB/LM IA), though not so early as that first suggested by Evans.[9]

This is the background against which one needs to understand the most recent contribution to this debate: two articles by Sinclair Hood.[10] He seems to have been struck by a problem. If we accept both the traditional Evans date for a wall painting like the Saffron Gatherer but we also take its prima-facie stratigraphic date, which is Final Palatial, then we are left with the problem that this means it must have been on the walls of the palace for a period of 200 to 300 years. Crete is a tectonically active island. Small earthquakes are frequent and in the course of the Neopalatial period there were several that were sufficiently destructive to have left evidence in the archaeological record.[11] Even minor earthquakes cause plaster to crack and substantial portions of the palace were built using a wood frame technique. This would have benefited earthquake resistance as the walls would move in response to shocks but this would surely be detrimental to the longevity of wall paintings. Hood knew of a multitude of instances around the palace where walls built in the Neopalatial period had to be patched, repaired or shored up in the course of their lifetime.[12] He, therefore, had very good reason to doubt that a wall painting could have been on the walls for extended periods of time, but he also had a sympathy for the Evans' early dates for Knossian wall paintings. The bulk of his contribution was an attempt to argue that some key wall paintings had come off the walls of the palace already in the course of the Neopalatial period, were in closed Neopalatial deposits and were not in Final Palatial destruction horizon of the palace. This would remove the need for us to envision unrealistically long lives on the walls, while preserving traditional dates. The aim of this paper is to reassess this argument on the basis of the raw contextual data preserved in the primary excavation records.

Obviously, in the space available there is not room to consider all of the problematic wall paintings. Instead, the focus will be on some wall paintings that are of particular interest to the wider eastern Mediterranean context and particularly to the relationship

7 Evans 1921, 265–266.
8 Cameron 1976a, Vol. I, 460–462.
9 Immerwahr 1990, 41–42, 170, Kn. No. 1.
10 Hood 2000; Hood 2005.
11 Preserved destruction horizons in the palace are summarised in Hood 2005, fig. 2.2; on seismic destruction see Macdonald 2017.
12 Hood *et al.* 1994, 146–147; Hood 2005, 45, 48–56.

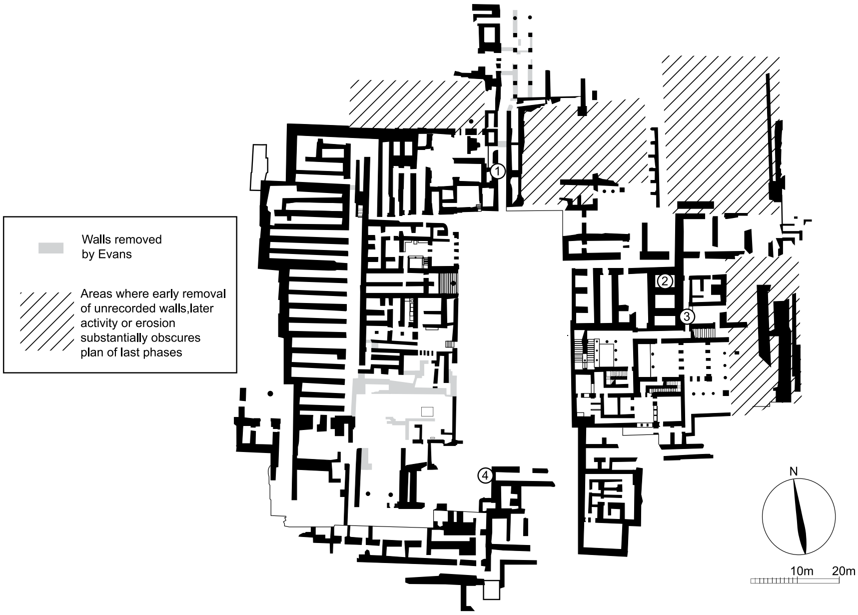

Fig. 1: Locations of main wall painting groups dealt with in the text. 1 = bull reliefs in and alongside the North Entrance Passage; 2 = high reliefs; 3 = bull reliefs above the Loomweight Basement; 4 = the 'Lily Prince' (plan of palace adapted from Hood – Taylor 1981, with additions and amendments in the light of the earliest excavation plans, for a list and discussion of the latter, see Hood – Taylor 1981, 5–6).

between Knossos and Tell al Dab^{c}a. That is to say, the palace's corpus of figurative relief wall paintings. There are four main groups of these: a set of bull reliefs found in the North Entrance Passage; a set of reliefs depicting bulls and athletes from the east wing; the so-called high reliefs also from the east wing; and the so-called Lily Prince from the south wing (Fig. 1). In addition, there were a number of isolated fragments found in the palace and the surrounding town.[13]

These relief wall paintings have followed the general historiographical trajectory outlined above.[14] Evans dated their production to the earliest phases of the Neopalatial period (MM III), around 1700 BC, but believed they had remained on the walls of the palace all the way down to its final destruction, which would now be placed around 1350 BC. Kaiser re-dated a substantial proportion of them to at least as late as the end of the Neopalatial period (LM IB), which means to around 1450 BC or later. Hood has now suggested that each of them was discovered in sealed early Neopalatial deposits (MM III) within the palace, returning the production dates to Evans' early proposal. The result of Hood's contribution is to shift the date of the floruit of Knossian relief painting back by 150 to 200 years from Kaiser's dates.

13 Hood 2005, no. 2 (North Entrance Passage), no. 18 (Lily Prince), nos. 28 and 30 (east wing reliefs), contains the full previous bibliography on the main groups. For the isolated fragments, see below.

14 The trajectory of previous scholarship on the dating of relief wall paintings is neatly summarised by Hood 2005, 55–56.

The chronology of the Knossian reliefs is essential to our entire understanding of the development of relief wall paintings in the Aegean. If we follow the Hood-Evans dates the Knossian group becomes the earliest anchor of the relief style anywhere. Relief wall paintings would be a mark of Knossian distinctiveness that appears early and stretches throughout the Neopalatial period, the floruit of Minoan civilisation. If, however, the arguments that some of these Knossian reliefs came from secure early Neopalatial (MM III) deposits is wrong, then there can be no early Neoplatial chronological anchor for the style at the site. If that is the case, a reassessment is needed of the date of the Knossian reliefs in comparison to the corpus elsewhere in the Aegean.

2. Bull Relief from the North Entrance Passage

I begin with the bull relief from the North Entrance Passage. Hood divides the bull fragments into two main groups.[15] One group consisting of foliage and leg fragments, he argues, was found in a walled space alongside the North Entrance Passage and to the north of the Room of the Spiral Cornice (for the general area see Fig. 1 no. 1, for the precise find spot see Fig. 3 no. 2). He argued that this group must have been sealed under a palace floor that is mentioned in the area in the excavation notebooks. The second group, consisting of bull head and body fragments, he places further north, within the North Entrance Passage itself – where they were surrounded by and sometimes overlying Linear B tablets from the final destruction horizon of the palace. On the basis of this, he proposes that all the bull reliefs were originally in an early Neopalatial fill, sealed under the later floors of the palace. After the palace's destruction the walls retaining this fill collapsed, spilling some of its contents out onto the layer containing the Linear B – thus making reliefs that had fallen from the walls and been sealed away at least as early as 1600 BC end up stratigrafically above material from 1350 BC.

Fortunately, the notebooks for the excavation of this area are extremely good and the course of the excavations can be closely followed from the accompanying sketch plans. Evans' teams approached the North Entrance Passage from the south. Initially attempting to follow out a floor level that was preserved where the crosses labelled miniature fresco are on the excavation plan (Fig. 2 no. 1) equivalent to number 1 on the modern state plan (Fig. 3 no. 1). On 2nd May 1900 fragments of wall painting depicting an olive branch were found where the circled cross is on the notebook plan and the number 2 is on the modern plan.[16] On 3rd May Linear B tablets were found immediately underneath it and below them the notebook records "similar fresco with plant decoration came into view".[17] On 4th May relief leg and hoof fragments were found a little further north and at a greater depth (Fig. 2 no. 2 which is equivalent to Fig. 3 no .3 in the modern plan).[18] At this point the notebooks provide the important information that the floor level they had initially been following disappeared as they progressed north and the notebook later refers to that floor saying "it exists further south and is best preserved in the room with the miniature frescoes".[19] A little further

15 Hood 2005, 56–58.
16 Mackenzie 1900, 50.
17 Mackenzie 1900, 51.
18 Mackenzie 1900, 53.
19 Mackenzie 1900, 55.

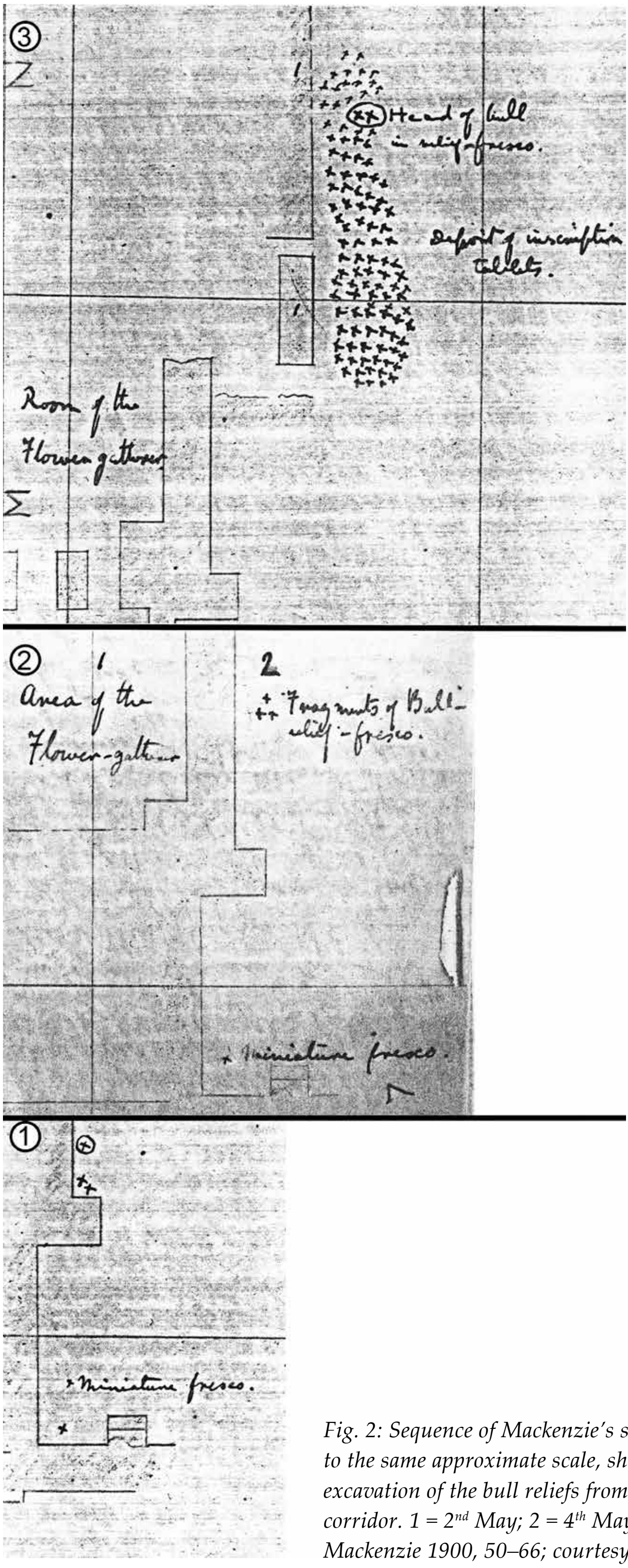

Fig. 2: Sequence of Mackenzie's sketch plans, reproduced to the same approximate scale, showing the progress of the excavation of the bull reliefs from around the north entrance corridor. 1 = 2nd May; 2 = 4th May; 3 = 15th May (after Mackenzie 1900, 50–66; courtesy of the Ashmolean Museum).

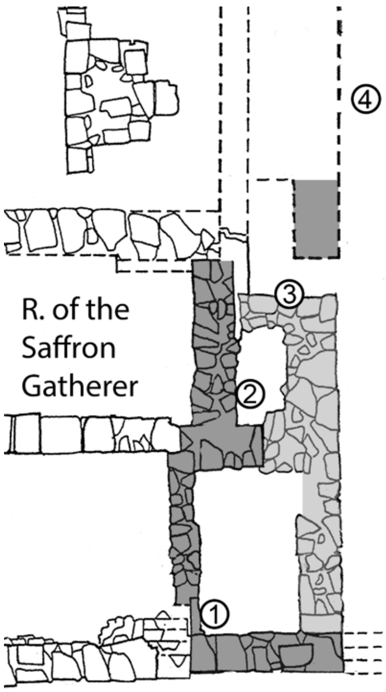

Fig. 3: State plan of the area where the bull reliefs were found showing the approximate find spots. 1 = the miniature frescoes in the room of the spiral cornice; 2 = the foliage fragments; 3 = bull relief hoof and leg fragments; 4 = bull relief head and body fragments (adapted from Hood – Taylor 1981).

north from these hoof and leg fragments and at a greater depth, a large deposit of Linear B tablets started to appear. Following this deposit along the west side of the North Entrance Passage, the team found, several days later, the relief head and body fragments of the bull (Fig. 2 no. 3 which is equivalent to modern Fig. 3 no. 4).

Hood's interpretation of the notebooks depended on dividing the various relief fragments into two discrete groups: one group consisting of the foliage and leg fragments found on the 3rd and 4th, which he suggested were enclosed by walls and overlain by the floor that the excavators had been following on the 2nd; and a second, consisting of the head and body fragments, which he suggested were in a secondary deposition having spilled out of an enclosed fill at a much later date. This interpretation is radically different than that of Evans, who ultimately published the reliefs as a single deposit distributed along the length of the North Entrance Passage and intermingled with final destruction debris throughout.[20] Hood's interpretation overlooks the reported disappearance of the floor level as the excavation progressed, which undermines his idea that some of the fragments were in a sealed deposit.[21] He also gives the false impression that the hoof fragments were found immediately underneath the foliage fragments, thus again giving the impression of a sealed fill, when they were clearly indicated as being found some distance to the north, both in Mackenzie's notebooks and in a sketch plan of Evans.[22] Overall the evidence from the notebooks strongly supports Evans' view that they were gradually revealing a single scattered deposit. Using the measurements given in the notebooks alongside the modern state plans we can draw up a three-dimensional view of this area and plot the reported positions of the wall painting fragments. It

20 Evans 1930, 170–171, fig. 114.

21 A major problem for Hood's idea is that the notebooks describe the original foliage fragments as being intermingled with Linear B just as they describe the body fragments as being intermingled with Linear B. To get around this problem he pays a great deal of attention to the fact that the final account assigns two styles of foliage to the overall area of the North Entrance Passage, only one of which was in relief: Evans 1930, figs. 109b; 113. He suggests that the non-relief fragments were stratified above the Linear B and the supposed floor level, whereas the relief fragments were immediately beneath. This idea is incompatible with the description in the notebooks, which just speaks of "similar fresco". It is even incompatible with Evans' final 1930 account, which in fact says that the two styles were found far from one another, at opposite ends of the North Entrance Passage.

22 Two photographs taken later in the excavation show a deep overburden of soil remaining in the space where the olive and foliage fragments were found which cannot have been dug much deeper, and then a deep section descending into the stairwell to the north, where Evans' sketch plan places the relief hoof and leg fragments (the photographs are reproduced in Raison 1988, pls. LVI, LVII). A closely dated body of pottery from the area comes from the bottom of this stairwell and dates to the Final Palatial destruction horizon, Popham 1970, 41–42.

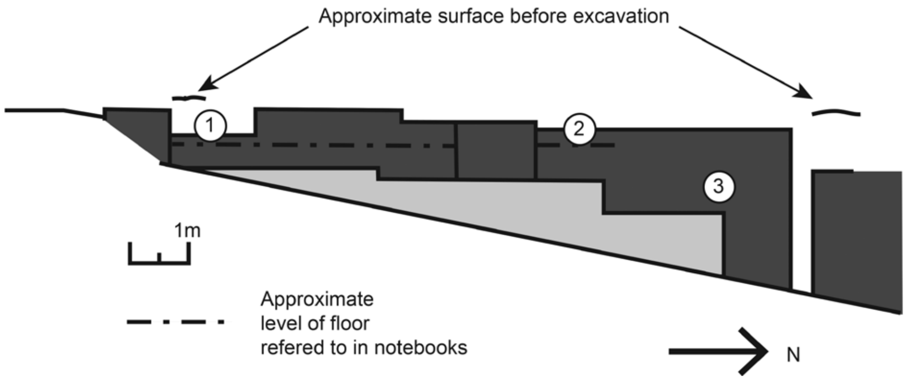

Fig. 4: Reconstructed section of area where the bull reliefs were found showing approximate levels and find spots. Pale and dark grey walls equate to those in figure 3. 1 = the miniature frescoes in the room of the spiral cornice; 2 = the foliage fragments; 3 = bull relief hoof and leg fragments (modified from Raison 1988, coupe c).

looks very much like the olive at 2, the feet at 3 and the head at 4 are part of the same deposit which follows the slope of the hill down as it progresses north (see Fig. 3 and Fig. 4). This result from the raw notebook information entirely confirms Evans' diagram depicting the reliefs as a single deposit scattered all along the entrance passage.[23] The notebooks also clearly indicate that the fragments were intermingled with Final Palatial Linear B tablets at both southern and northern ends of the scatter.

In short, there is no evidence for the reliefs being sealed in an early Neopalatial fill and strong evidence they were intermingled with material from the final destruction of the palace. The high degree of preservation of some of the fragments – especially the bull's head – suggests we should not imagine the varied lifespan of secondary deposition envisioned by Hood between the point they fell from the walls and the point they came to their final resting place.

3. Figurative Reliefs from the East Wing

Two groups of wall paintings from the central portion of the east wing – the so-called High Reliefs (Fig. 1 no. 3) and a group of relief bulls and athletes (Fig. 1 no. 2) – are of pivotal importance to the argument for an early (*i.e.* a 17th rather than 15th to 14th century) date for Knossian relief wall paintings. According to Evans' understanding a large portion of this part of the palace, which he referred to as the Royal Magazines, had been blocked off and filled in already in the earliest phase of the Neopalatial.[24] This area is key to Evans' dates for relief wall paintings because it provides a safe pocket of early Neopalatial material for the largest groups of reliefs, which were either found within this area (the bulls and athletes) or immediately down slope to the east (the high reliefs).

Reassessment of this area, however, has largely debunked the idea of an early infilling and has proven these rooms remained open and in use until the final destruction

23 Evans 1930, fig. 114.
24 Evans 1921, 562–568.

of the palace. Evans' idea was primarily based upon the date of a set of medallion pithoi that were found in situ in the area. These do belong to the early phases of the Neopalatial period, but storage jars can have very long use-lives and a comparable set of pithoi in the west wing of the palace was in use right up until the destruction of the palace at the end of the Final Palatial period.[25] Christakis has now shown that the best parallels for a group of unusual cooking pottery from the westernmost portion of this area are dated to the Late Minoan III period – that is to say the final phase of the palace – and not the early Neopalatial as Evans thought.[26] He has also pointed out that the excavation notebooks give no indication that the doors to the area were ever completely blocked – a prerequisite for them being filled with debris for hundreds of years. Finally, excavations under the flagstone floor of the central portion of this area also revealed pottery dating to the palace's final phase – proving that not only was the area still in use but was even maintained and repaired right down to the palace's destruction.[27] These insights effectively remove this area as an early Neopalatial context in which the reliefs could have initially been sealed before eroding downslope to the west.

This reassessment is particularly decisive for the High Reliefs as they were found very high in the fill, only a meter below the surface and two or three meters above the highest Final Palatial floors in the area immediately to the west of the Royal Magazines.[28] With no early fills upslope to the east, out of which they could have eroded, the only remaining option for them is that they are within the Final Palatial destruction horizon. Moreover, as with the bull relief in the North Entrance Corridor, their state of preservation must make any idea that they had a complex life of secondary deposition between falling from the walls and reaching their final resting place unlikely.

There is one added complexity when it comes to the bull and athlete fragments. These were found high in the fill of the easternmost portion of the Royal Magazines. They were partially overlain by a patch of earth floor, which should provide a terminus ante-quem for their dating. Sitting on this patch of floor were a group of pots described as 'rustic' and as tripod cooking pots.[29] Unfortunately, these types were not dateable by Evans' team – even today it can be difficult or impossible – and were thrown away immediately after excavation.[30] There are good reasons to think that the patch of floor might have been from the reoccupation of the site following the final destruction of the palace. Immediately to the north Evans excavated a portion of a substantial post-palatial building and post-palatial pottery has been identified in the preserved Stratigraphic Museum lots from this area of the palace.[31] Most indicative, however, is that the floor was at a higher level than the preserved palatial era floors in the neighbouring areas and it was even 80cm higher than the palatial floor in the room immediately up-slope from it, something that the excavation notebooks highlighted as particularly odd.[32]

25 Hallager 1977, 30.
26 Christakis 2004, 302; Christakis 2005, 7–8.
27 Niemeier 1994, 82.
28 Mackenzie 1901, Vol. 2, 41, 45. Their find spot above the southern end on the North-South Corridor can be precisely gauged by comparing Mackenzie's plan opposite page 41 with that opposite page 48.
29 Evans 1900/1901, 87–88.
30 On the dating of cooking pots, see Betancourt 1980.
31 Mackenzie 1901, Vol. 2, 48; Boardman 1963, 51; Popham 1970, 36–37; Hatzaki 2007, 235.
32 Mackenzie 1901, Vol. 2, 1.

4. Figurative Reliefs from the South Wing

The final substantial group of relief wall painting fragments is that making up the so-called Lily Prince or Priest King from the southern wing of the palace (Fig. 1 no. 4). Hood argues that this was found in an enclosed basement space walled around on all sides.[33] He envisages that the fresco had fallen from the walls early in the Neopalatial, and the basement holding its remains had been floored over and long forgotten by the time of the final destruction of the palace. The basis of Hood's argument is a plan that accompanied the 1901 preliminary report in the British School Annual, which does indeed seem to show a walled-in basement in the area where the reliefs were found.[34] Hood's argument is, however, directly contradicted by the primary excavation records themselves.

On Saturday 11th May 1901, large fragments of thigh and of the headdress were uncovered at a depth of only 30cm from the surface. When work resumed on the following Monday more fragments of leg and headdress were found.[35] On the Tuesday the torso, arm and ear were uncovered.[36] At this point, Mackenzie drew a plan of the region showing a wall to the east and to the north and a couple of spaces to the south.[37] If we follow his normal practice, this should mean that when earlier fragments were found the architecture was not emerging clearly enough for him to have drawn a sketch of it. At this point, when the majority of the fresco had been discovered, he explicitly says that no wall had been revealed in the area west of where the fresco had been discovered.[38] In other words, at this point, there is little reason to believe that the fresco was in a region that was enclosed on all sides: Hood's putative Neopalatial basement. Indeed, even three days later, by which point they had dug down over two and a half meters from the original find spots of the fresco, Mackenzie repeats the statement that there was no west wall.[39] In short, Hood's sealed Neopalatial basement cannot have existed.

A number of factors indicate that the Lily Prince fragments were in the Final Palatial destruction horizon. The fragments of the relief are surrounded by Final Palatial material. Linear B tablets were discovered at the same level as the relief fragments in the two rooms immediately to the east.[40] In the rooms immediately downslope to the south the Final Palatial layer immediately overlies the natural soil of the hillside.[41] A box of pottery in the Stratigraphic Museum, which seems to come from the larger area that included the relief frescoes, is principally made up of pottery from the last phase of the palace.[42] Most decisively however, the portion of the palace in which the fragments were found was extensively rebuilt in the Final Palatial period. A wall immediately to the south of the place where the reliefs were found can be demonstrated to have been

33 Hood 2005, no. 18. See also the most detailed version of his argument in Hood *et al.* 1994, 142–146.
34 Hood *et al.* 1994, 145, referring to Evans 1900/1901, pl. 1.
35 Mackenzie 1901, Vol. 2, 23.
36 Mackenzie 1901, Vol. 2, 24.
37 Mackenzie 1901, Vol. 2, 26, plan on the facing page.
38 "The N & E walls of the space are intact to a considerable depth from the surface down. There does not seem to be a W wall at all", Mackenzie 1901, Vol. 2, 26.
39 "there was no W wall", Mackenzie 1901, Vol. 2, 32.
40 Hood *et al.* 1994, 133–134.
41 Hood *et al.* 1994, 129–132.
42 Popham 1964, 13, 19; Hood *et al.* 1994, 144–145.

first built in the Final Palatial period.[43] This is a long axial foundation wall interconnected immediately or secondarily to many of the other walls in the area, so there is no way this could have happened without the entire southern wing being extensively rebuilt in the Final Palatial period. Without Hood's sheltering Neopalatial basement there is nothing to isolate the Lily Prince from the radical architectural changes that must have happened in the Final Palatial south wing. Moreover, the wall painting was found in the uppermost level, above most of the surviving walls, so these Final Palatial architectural changes should provide a terminus post quem for the deposit. As with the other examples we have looked at, the high degree of preservation of the reliefs suggests that they did not have too complex a history between the time they were on the walls and the time they reached their final resting place.

5. Isolated Fragments of Figurative Relief Wall Painting from Knossos

A number of isolated fragments of figurative relief wall paintings also come from the palace. The hand of an athlete in relief is said to have come from the North-East Insula, where Evans describes it as deriving from the 'superficial stratum' (topsoil).[44] A relief hand holding jewellery from the west wing was found face up and still adhering to a fallen block on the earth floor of the eponymous Gallery of the Jewell Fresco, and higher in the same fill were Linear B tablets, sealings and burnt wood.[45] Fragments of a relief bull are reported from the clearing of the destruction debris that choked the Service Stairway in the east wing.[46] Kaiser found more, including human and animal limbs with signs of burning, in trays of material labelled as from the Area of the Demon Seals.[47] The destruction debris in this area is one of the most discussed Final Palatial deposits consisting of the eponymous sealings, Linear B tablets and clearly dated LM IIIA pottery.[48] Very little can be said about a variety of other fragments of figurative reliefs, first identified in the Heraklion museum trays, that are not mentioned in the primary excavation records but that come from prima facie Final Palatial contexts.[49] It is important, however, that several of these seem to come from the dumps of wall painting that are found at various spots around the palace and that represent material stripped off the ruin's walls after the palace's final destruction.

A number of additional figurative relief fragments come from the wider town. Several fragments of a relief bull have been reported from a context in Hood's Royal

43 The wall is built over pits containing LM II pottery, Hood *et al.* 1994, 112–128.
44 Evans 1921, 571.
45 Hood 2005, no. 10.
46 Mackenzie 1901, Vol. 2, 46.
47 Kaiser 1976, 260, 283, 293. The Passage of the Demon Seals and the Service Stairs are immediately adjacent to one another and the term Area of the Demon Seals is sometimes used to denote the final destruction fill (containing the eponymous seals) that choked both spaces.
48 Popham 1970, 22–26.
49 See the following (plate numbers refer to Cameron 1976a, Vol. II and Vol. III, which contains previous bibliography): a miniature bull hoof from school room, pl. 79A6; a hoof from the hall of the double axes (not the same as the flat painting of a bull which was found adhering to the wall in the room above), pl. 80A; a thigh from the hall of the double axes lightwell, pl. 42E; an arm from the south house fresco dump, pl. 42A; kilt fragments from the north-west fresco dump, pls. 17C; 42B; 42D.

Road North excavations. The context has, unfortunately, not been published but is reported as being securely dated to the end of the Neopalatial period (LM IB).[50] Cameron identified the fragment of a relief griffin wing from the Little Palace in one of the pottery lots preserved in the stratigraphic museum.[51] The pottery dates to the Final Palatial period.[52]

A fragment of a relief bull comes from the South-East Polychrome Deposit. This area had a deep Final/Post Palatial (LM III) deposit immediately overlying an important well-preserved and recorded MM III deposit. It is first mentioned in the second volume of *The Palace of Minos at Knossos* where Evans initially includes it amongst material that he believed had drifted to the area from the palace; only later in his account, in a footnote in which he defended a MM III date for bull reliefs, did he cite this as an example from an MM III context.[53] There are two grounds not to take this second statement at face value. Firstly, in Mackenzie's notebook the piece is never mentioned, in spite of a very detailed discussion of the area and its finds that takes up most of the first volume for that year and which mentions far less striking pieces of plaster.[54] Mackenzie by this point had seen lots of pieces of relief bulls and would surely have recognised it. The second problem is that in spite of repeated claims that the MM III layer was pure, the boxes in the Stratigraphic Museum actually contain notable amounts of LM III contamination.[55] This leaves two possibilities. Either the piece was noticed during excavation, in which case Mackenzie's failure to mention it should suggest it was in the LM III deposit, which he deals with in a perfunctory way, rather than in the MM III deposit, which he deals with in great detail. Or, it was discovered in among the pottery after excavation, in which case we cannot be sure it is from the MM III levels, given the quantities of LM III contamination.[56] In either case, this one example cannot, on its own, safely anchor any or all of the bull reliefs to the MM III period.

A second bull fragment comes from the same general area but a little further up the slope to the north. Here, between 1922 and 1923, a deep (6.5m) pit was excavated, which contained two fragments of relief that Evans interpreted as belonging to a lion.[57] Cameron identified the only fragment he could locate as belonging to a bull.[58] Evans' final account of the circumstances under which it was found is relatively clear. He states that the first four meters of the excavation contained LM III pottery but

50 Cameron 1976a, Vol. I, 728. Most of the pieces are said to come from the "main LM IB deposit". Unfortunately, this 'deposit' is found in two different rooms separated by 2m (Hood 1961/1962, fig. 31 spaces A and B) and without any mention of the fragments in the preliminary notices of the excavation, it is impossible to say which part of the 'deposit' the fragments came from. The pottery is discussed by Hood (2011) and is included by Hatzaki (2007, 185–196) as one of the groups that define LM IB at Knossos.

51 Cameron 1976a, Vol. I, 722–723, no. 7.3, recovered from Stratigraphic Museum Evans box 1448.

52 Hatzaki 2005, 158–159.

53 Evans 1928, 310, 355.

54 See for example at Mackenzie 1922, 49.

55 I would like to thank Iro Mathioudaki, who is currently studying the material from the South-East Polychrome Deposit, for this information.

56 Evans (1922–1926, 11) mentions it in referring to a "surfaced high relief of man's elbow" with the latter crossed out and replaced with "bull's head?", however it comes in a list of the most notable finds from the general area, probably made after the material was washed and sorted, without any indication of original context, and therefore is compatible with either of the two interpretations offered here.

57 Evans 1928, 291–296, 332–333.

58 Cameron 1976a, Vol. I, 712, no. 4.

that after that "the occurrence of LM IIIB pottery became more intermittent, and the fragments found mainly represented the closing phase of MM III."[59] He includes the fragments of relief amongst material found above the floor of a ledge on the northern side of the pit. He says the floor of the ledge was reached at 5m depth and the accompanying cross-section drawing places the relief fragments about 1m above this floor.[60] He mentions painted tripod offering tables, a gypsum double-axe stand and fragments of LM II–III palace style jars as coming from the same place.[61] The notebooks can add little. It is clear that neither Evans nor Mackenzie directly oversaw the excavation.[62] They can tell us, however, that the relief fragments were discovered in 1923 when the northern portion of the pit (overlying the ledge) was dug and that the observation that LM III pottery diminished beyond the 4th meter belongs to the previous year when the deeper southern portion was dug.[63] They also seem to add an LM III seal depicting an agrimi and lion to the finds from the area with the relief fragments.[64] In short, then, this is another instance when material from the last phases of the palace was closely associated and perhaps even intermingled with MM III material and it is impossible to definitively associate the relief fragments with either phase.[65]

6. Ramifications

The first result of the discussion above is that the earliest anchors for relief wall paintings on Crete have been removed. All the scholars that have studied them, including Kaiser, have been influenced by the supposed existence of fragments in clear early Neopalatial (MM III) deposits at Knossos to believe that relief wall paintings begin already in that earliest phase of Cretan representational wall painting. The reassessment of the east wing of the palace and the doubts about the fragment from the South-East Polychrome Deposit mean that these early secure points can no longer be accepted. Instead, the first signs of relief wall painting on Crete and the Aegean belong to the middle of the Neopalatial period (LM IA). The clearest published examples from this initial phase are abstract relief patterns, as found at Akrotiri.[66] It is not entirely certain whether there are representational reliefs on Crete in this earliest phase. One small fragment from Prasa has been interpreted as depicting a woman's

59 Evans 1928, 292.
60 Evans 1928, fig. 171.
61 Evans 1928, 334.
62 Both of their accounts are very brief summaries and Mackenzie's 1923 account falls out of chronological sequence at the end of that year's notebook. Mackenzie (1923, Vol. 2, 45) tells us Manolis Akoumianakis was in charge of the pottery and provided sketches of the work's progress.
63 The relevant pages of Evans' notebook are unnumbered but lie near the beginning and end of Evans 1922–1926. Mackenzie 1922, Vol. 1, 33–34; Mackenzie 1923, Vol. 2, 44–end. The only serious divergence is that whereas Mackenzie says the LM III pottery died out after the 4th meter, Evans says it had "near ceased" by the time they had reached the eastern descending passage at the bottom of the pit.
64 Evans (1922–1926, unnumbered page) provides a drawing and refers to it as an LM IIIB grey steatite 'galopetra'.
65 Although interestingly when Mackenzie (1923, 47) highlights the finds from the MM III layer that allow the original palatial building in the area to be characterised, he talks at length about the pieces of cement flooring suitable to a light well but makes no mention of the relief plaster fragments.
66 Doumas 1992, figs. 136–137. Shaw 1998, 68 reports being told of unpublished relief scenes with life-size animals from Thera.

skirt.[67] Prasa was dated to LM IA by the excavator but the site is very poorly understood, which makes this an unsatisfactory benchmark as the single earliest piece of representational relief in the Aegean.[68]

Securely dated Cretan representational relief wall paintings outside the palace at Knossos date to the very end of the Neopalatial period (LM IB).[69] They depict women and elements of landscape scenes such as rockwork, foliage or birds. The largest body of the Knossian palatial relief wall paintings depicts bulls and athletes. The closest parallels for the Knossian imagery come in the form of a group of relief stone vases, the earliest of which are found in terminal LM IB contexts.[70] The concentration on bulls and athletes in the Knossian reliefs makes a striking contrast with painting elsewhere on the island where these themes are completely absent and the concentration is on women and landscape scenes. Indeed, nowhere outside the palace at Knossos do we get large-scale depictions of men in Neopalatial wall painting. Whether in relief or flat painting, the concentration is always on landscapes, animals, rockwork and foliage with the occasional female figure (Tab. 2). Men only appear in miniature town scenes somewhat like those found in the contemporary Cyclades.[71] Broader patterns in Neopalatial iconography suggest that there was a general tendency to separate the genders between media.[72] The large-scale relief male athletes and the Lily Prince are a radical departure from these patterns. By the conventional chronology this would be an aspect of Knossian exceptionalism that would have been a constant throughout the Neopalatial period beginning all the way back in MM III. By the chronology argued in this paper it would be a new phenomenon developing towards the end of the Neopalatial: a Knossian departure from wider Cretan representational norms in a period of turmoil that witnessed the extinction of rival power centres on the island.

Another result of the above discussion is that the vast majority of Knossian representational relief wall paintings were found either probably or certainly in Final Palatial destruction deposits. The single exception is the relief bull from the Royal Road excavations which belongs at the end of the Neopalatial period. An inescapable ramification of the predominance of relief in Final Palatial deposits is to raise the question of whether we should follow Kaiser's suggestion that figurative relief carried on being produced at Knossos into the Final Palatial period.[73] This is a suggestion that has been largely overlooked by scholars and the current consensus is that the relief style on Crete is confined to the Neopalatial period. Nevertheless, Kaiser's suggestion has considerable merit and deserves to be resuscitated.

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67 Cameron identified the patterned relief fragment as belonging to the dress of a female figure whose face was not painted in relief, Cameron 1976a, Vol. I, 757, no. 15.

68 For doubts about the excavator's LM IA dating, see Driessen – Macdonald 1997, 137.

69 For references see Tab. 2 entries under: Archanes, Chania, Gournia, Palaikastro, Prasa and Pseira.

70 On the dating of these vases, see Warren 1969, 174–175.

71 Shaw 1972.

72 Relief stone vases, for example, only depict male figures, Logue 2004. Three-dimensional ivory sculpture also seems to be exclusively male, Lapatin 2001, 22–34, whereas three-dimensional faience sculpture is exclusively female, Foster 1979, 70–78. For a highly complicated view of the latter dichotomy, see Alberti 2001.

73 Kaiser 1976, 293.

Site	Wall painting	Bibiography
Agia Triada	Villa, room 14: women, rockwork, foliage, goats, cats, birds.	Militello 1998, 99–132, 250–282.
Amnissos	Villa, room 7: various floral tableaus in geometric settings.	For the fragments: Cameron 1976a, Vol. II, pls. 94c; 118d; Cameron 1976a, Vol. III, 87, 103–104. For the context: Schäfer 1992, 33.
Archanes	Tourkogeitonia: plants and a dolphin in miniature; flora/foliage, shells and possibly a bird in relief; a variety of flora/foliage in large scale (the large-scale woman that has been identified is doubtful).	Sakellarakis – Sakellarakis 1997, 488–502. See Cameron 1976a, Vol. I, 741 for an argument against the identification of the woman
Chania	Kastelli: relief fragment from a large scale woman (from a mixed fill dated on stylistic grounds to the Neopalatial).	Kaiser 1976, 305, fig. 471, pl. 25.
Epano Zakros	Villa, room A: numerous fragments depicting a wide variety of flora/foliage; fragment of the skirt of a large scale woman.	Cameron 1976a, Vol. I, 766.
Galatas	Palace, pillar hall: abstract or floral pattern. Building 1: fragments of foliage and a net pattern.	Rethemiotakis 2002, 57, pls. XVI, XVIIa.
Gournia	Central building: possible relief fragments, never illustrated.	See Cameron 1976a, Vol. I, 742, who expresses doubts.
Katsamba	Birds and rockwork in miniature.	Shaw 1978.
Knossos town	South House: bird, rockwork, and foliage. House of the Frescoes: birds, monkeys, goats, rockwork, foliage. Royal Road Excavations: flora/foliage (flat), bull (relief). Stratigraphic Museum Extension Excavation, North Building: foliage, floral, rockwork, and possible large-scale women. Bougada Metochi: swallow fresco. Caravanserai: birds, rockwork, foliage ('Partridge Fresco'). Hogarth's Houses (1957–61): foliage.	Cameron 1976a, Vol. I, 713–738; Mountjoy 2003, 37–39; Shaw 2005; Warren 2005; Rousaki 2012.
Kommos	Building X: floral fragments and rockwork.	Shaw and Chapin 2012.
Malia	Palace: possible people in miniature from the area of the west façade; fragments of floral decoration and spirals from Neopalatial layer below the final floor of the northern pillar hall. Quatier Nu: floral fragments.	Deshayes – Dessenne 1959, 101; Pelon 1980, 18; Hue – Pelon 1992, 24; Driessen – Farnoux 1994, 477, fig. 6.
Nirou Chani	Villa, room 17: large-scale depiction of banded textile ('Sacred Knot')	Cameron 1976a, Vol. I, 751; Vol. II, pl. 53c.
Palaikastro	Block E, room 18: large-scale woman's arm (relief), floral fragments (flat). Block M, room 19: foliage.	Cameron 1976a, Vol. I, 752–753; Westlake 2012, 308, pl. I.
Phaistos	Palace: various fragments of foliage from early Neopalatial levels under the latest floors of the palace; fragments with friezes of foliage and rosettes from room 79; a nature scene from room 81 is only known from the excavator's description. Outside the palace: fragment with vegetation and possibly rockwork from the area south of the kouloures, and several fragments with vegetation from beneath rooms AA and CC of the Geometric houses.	Militello 2001, 98–123.
Prasa	Trees (miniature); woman's head; relief skirt fragment.	Cameron 1976a, Vol. I, 757; Cameron 1976b, 7 fn. 20, pl. 3c.
Pseira	Building AC: relief fragments of large-scale women.	Shaw 1998.
Tylissos	House C: floral fragments House A, room 17: abstract or floral pattern ('Fan Fresco'). Uncertain: miniature fragments of people, a tree, and buildings.	Shaw 1972 (who interprets the 'Fan Fresco' as part of a floral tableau).
Kato Zakros	Palace, XLVI: floral fragments and perhaps part of a large-scale female figure. Palace, LVIII: architectural stonework and horns of consecration. House I: foliage.	Cameron 1976a, Vol. I, 763–764.

Tab. 2: Known Neopalatial wall paintings from Crete beyond the palace at Knossos.

As we have seen, one of the impulses behind Hood's attempt to argue that Knossian palatial reliefs came from closed Neopalatial deposits was the problem with imagining that they could have survived on the walls through the various changes the palace underwent between the Neopalatial and Final Palatial periods. I have attempted to demonstrate that his argument for these closed Neopalatial deposits is extremely weak and that all the indications point to the reliefs falling from the walls as part of the Final Palatial destructions. But the concerns about the potential longevity of palatial wall paintings stand. Scholars have increasingly come to accept that the palace at Knossos witnessed extensive architectural modifications between the Neopalatial and Final Palatial periods.[74] It seems hard to imagine that wall paintings remained fossilised on the walls while such radical alterations were being made. This is especially the case because, as we have seen in the case of the Lily Prince, some of the areas where very radical alterations were made are close to those where relief wall paintings were found.

The imagery of two of the groups of Knossian palatial reliefs may find their closest parallels in the material culture of the Final Palatial period. The most distinctive feature of the Lily Prince relief is the crown. It has been argued that the crown's lilies look like those of the Neopalatial period. But, with their stamens joined in a spray, they appear more closely paralleled by those of the Final Palatial period than the earlier examples.[75] The crown itself has no close parallel on Neopalatial Crete.[76] However, as many people have recognised, it looks exactly like the crowns commonly worn by sphinxes in the Late Bronze Age Aegean.[77] This image of a crowned sphinx first appears in the Aegean in the form of a gold applique from Grave Circle A at Mycenae.[78] It has never been found on Neopalatial Crete, in spite of the rich iconographic record of the period, but turns up multiple times in Final Palatial contexts on the island.[79] Can this sudden blossoming of the motif on Crete be a coincidence

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74 See for example: "(…) strongly suggest that they [the final palatial rebuilding in the south wing near the Lily Prince] were part of an overall plan embracing a large part, if not the whole of the palace area" (Hood *et al.* 1994, 147); "it may well prove that large sections of the palace were virtually rebuilt in LM II–IIIA1" (Hatzaki 2004, 122); "the result from all these areas are clear and consistent. They show that while most of island lay in ruins from the LM IB destructions the palace at Knossos was rebuilt from one end to the other" (McEnroe 2010, 119).

75 A useful table of the development of the lily is provided by Niemeier 1985, Abb. 18.

76 The closest parallel is the reconstructed headdress of the so-called votary figurines from the Temple Repositories, who wears a reminiscent but more beret-like hat. However the entire head of this figure was reconstructed and the surviving fragment of the hat (if that is even what it really was) is just a small sliver from the front. It does connect to the feline that now perches weirdly on the figures head but the fact that this is an unparalleled image should lead to caution about the reconstruction (Panagiotaki 1999, 98).

77 For this reason recent reconstructions of the wall painting usually deconstruct the Lily Prince into at least two figures, one of which is a sphinx, Niemeier 1987; Niemeier 1988; Preziosi – Hitchcock 1999, 98–99; Rehak – Younger 2001, 412; Fitton 2002, 151. Shaw 2004, 71 successfully highlights the problems with modern reconstructions depicting one of the figures as holding a staff in its outstretched arm, but her argument that all the fragments belong to a single figure is weak.

78 Karo 1930/1933, 51, no. 48; for the date, see Dickinson *et al.* 2012, 185.

79 E.g. CMS II.3, 118; Poursat 1977a, pls. VIII.7; X.5–6; Godart – Tzedakis 1992, pl. LVI.3–4. The closest parallel in any medium to the image imagined by many modern reconstructions of the wall painting, with a man leading a sphinx, is on an ivory pyxis from an LH II–IIIA chamber tomb at Mycenae (Poursat 1977b, pl. XXVIII; for the context, see Xenaki-Sakellariou 1985, 127–130, with the date discussed at 352–354).

or does it provide the most appropriate context for us to date the Lily Prince?[80] It has been convincingly argued, meanwhile, that the centrepiece of the high reliefs in the east wing was a female figure holding aloft a device known as a snake frame, flanked on either side by griffins.[81] This is the only instance of this motif in wall painting but it is extremely common on sealstones. Every single instance of the motif comes from deposits dating to the Final Palatial period or later.[82]

Relief wall decoration is well attested in mainland Mycenaean contexts postdating the Cretan Final Palatial period. The most famous examples of this, associated with palaces and tholos tombs, are in stone. But at least one fragment of relief wall painting has been discovered in the Argolid.[83] In some ways, the closest parallels anywhere to the relief bulls and heraldic high relief griffins of Knossos are the large scale figurative stone reliefs of Mycenae – the Lion Gate relief and the Elgin relief bulls believed to be from the Treasury of Atreus. The argument for a late Mycenaean (13th century) date for the Lion Gate relief, appropriate to its architectural context, now appears overwhelming on both technical and stylistic grounds.[84] The case of the Elgin reliefs is more problematic but a very good case has been made for them being mainland products of the LH III period (14th–13th centuries), which combine 'minoanizing' and mainland stylistic features. Carved relief stone wall decoration on Crete is confined to the palace at Knossos and has been accepted as a Final Palatial innovation.[85] Accepting that plaster relief continued into the Final Palatial period in the palace would be an appropriate companion to this stone work and would provide a developmental link between the relief wall painting of the terminal Neopalatial period and the relief wall decoration of the Mycenaean mainland.

Overall, then, Kaiser's suggestion of a continued tradition of relief wall painting into the Final Palatial period makes sense of the reported find contexts of the wall paintings within the development of the palace as it is now understood. It is a good fit for the imagery of some of the wall paintings and it provides a convincing developmental arc for Aegean relief wall decoration over the course of the Late Bronze Age. The main counter argument is that relief wall paintings have not been found in Final Palatial contexts elsewhere on Crete. But this is easily accounted for by the fact that Knossos was the only major urban conurbation in that period and Knossos was the only monumental palatial building. As Final Palatial Knossos was without peers, we should expect some elements of its material culture to be without contemporary parallels.

80 A Final Palatial sealing from the palace at Knossos is sometimes redrawn as depicting a male figure wearing a crown similar to that of the Lily Prince CMS II.8, 248. Unfortunately, the relevant portion of the sealing is not very clear. The date attributed to the seal that made the impression by the CMS team is one that straddles the divide between the Neopalatial and Final Palatial periods (LM I–II). On this type of date, see Krzyszkowska 2005, 194.

81 Hägg – Lindau 1984, with previous bibliography.

82 CMS II.3, 63 (Knossos Area of the Hospital tomb III, LM II–IIIA); CMS I, 144 (Mycenae, Kalkani necropolis, LH II–IIIC); CMS I, 145 (Mycenae, Kalkani necropolis, LH II–IIIC); CMS V, 654 (Rhodes, Makri Vounara, tomb 20, LH IIIC1); sealing: CMS I, 379 (Pylos palace, LH IIIB).

83 Kaiser 1976, 306, fig. 473. Bietak *et al.* 2012/2013, 142 report that one of the fragments is still in the Tiryns excavation storerooms.

84 Blakolmer 2013, 93–94; Blackwell 2014, 466–467.

85 Moser 1986, 19–23; Driessen – Langohr 2008, 181.

References

Alberti 2001

B. Alberti, Faience goddesses and ivory bull-leapers. The aesthetics of sexual difference at Late Bronze Age Knossos, World Archaeology 33, 2001, 189–205.

Betancourt 1980

P. Betancourt, Cooking Vessels from Minoan Kommos, UCLA Occasional Paper 7 (Los Angeles 1980).

Bietak *et al.* 2012/2013

M. Bietak – C. von Rüden – J. Becker – J. Jungfleisch – L. Morgan – E. Peintner, Preliminary report of the Tell el-Dab^ca Wall Painting Project – Season 2011/2012, Egypt and the Levant 22/23, 2012/2013, 127–147.

Blackwell 2014

N. G. Blackwell, Making the Lion Gate relief at Mycenae. Tool marks and foreign influence, American Journal of Archaeology 118, 2014, 451–488.

Blakolmer 2011

F. Blakolmer, Creto-Minoan art abroad or Mycenaean imitation? The case of the bull reliefs from the Treasury of Atreus at Mycenae, in: E. G. Kapsomenos – M. Andreadaki-Vlazaki – M. Andrianakis – E. Papadopoulou (eds.), Πεπραγμένα του Ι' Διεθνούς Κρητολογικού Συνεδρίου (Chania 2011) 461–482.

Blakolmer 2013

F. Blakolmer, Was there a 'Mycenaean art'? Or: tradition without innovation? Some examples of relief art, in: J. Weilhartner – F. Ruppenstein (eds.), Tradition and Innovation in the Mycenaean Palatial Polities (Vienna 2015), 87–112.

Blegen 1958

C. W. Blegen, A chronological problem, in: E. Grumach (ed.), Minoica. Festschrift zum 80. Geburtstag von Johannes Sundwall (Berlin 1958) 61–67.

Boardman 1963

J. Boardman, The date of the Knossos tablets, in: Palmer – Boardman 1963.

Cadogan *et al.* 2004

G. Cadogan – E. Hatzaki – A. Vasilakis (eds.), Knossos. Palace, City, State, British School at Athens Studies 12 (London 2004).

Cameron 1976a

M. A. S. Cameron, A General Study of Minoan Frescoes with Particular Reference to Unpublished Wall Paintings from Knossos (PhD Diss., Newcastle University, Newcastle upon Tyne 1976).

Cameron 1976b
M. A. S. Cameron, Savakis's bothros. A minor sounding at Knossos, The Annual of the British School at Athens 71, 1976, 1–13.

Christakis 2004
K. Christakis, Palatial economy and storage in Late Bronze Age Knossos, in: Cadogan *et al.* 2004, 299–309.

Christakis 2005
K. Christakis, Cretan Bronze Age Pithoi. Traditions and Trends in the Production and Consumption of Storage Containers in Bronze Age Crete, Prehistory Monographs 18 (Philadelphia 2005).

Deshayes – Dessenne 1959
A. Deshayes – J. Dessenne, Fouilles exécutées à Mallia. Exploration des maisons et quartiers d'habitation (1948–1954) 2, Études crétoises 11 (Paris 1959).

Dickinson *et al.* 2012
O. T. P. K. Dickinson – L. Papazoglou-Manioudaki – A. Nafplioti – A. J. N. W. Prag, Mycenae revisited 4. Assessing the new data, The Annual of the British School at Athens 107, 2012, 161–188.

Doumas 1992
Ch. Doumas, The Wall Paintings of Thera (Athens 1992).

Driessen 1990
J. Driessen, An Early Destruction in the Mycenaean Palace at Knossos. A New Interpretation of the Excavation Field-Notes of the South-East Area of the West Wing, Acta Archaeologica Lovaniensia 2 (Leuven 1990).

Driessen – Farnoux 1994
J. Driessen – A. Farnoux, Malia, Bulletin de Correspondance Hellénique 118, 1994, 471–477.

Driessen – Langohr 2008
J. Driessen – C. Langohr, Rallying 'round a 'Minoan' past. The legitimation of power at Knossos during the Late Bronze Age, in: M. L. Galaty – W. A. Parkinson (eds.), Rethinking Mycenaean Palaces II, Cotsen Institute of Archaeology Monograph 60 (Los Angeles 2008) 178–189.

Driessen – Macdonald 1997
J. Driessen – C. F. Macdonald, The Troubled Island. Minoan Crete before and after the Santorini Eruption, Aegaeum 17 (Liège 1997).

Evans 1900/1901
A. J. Evans, The palace at Knossos, The Annual of the British School at Athens 7, 1900/1901, 1–120.

Evans 1921
A. J. Evans, The Palace of Minos. A Comparative Account of the Successive Stages of the Early Cretan Civilization as Illustrated by the Discoveries at Knossos Vol. I (London 1921).

Evans 1922–1926
A. J. Evans, Evans Knossos notebook 42 (Unpublished field notebook, Oxford, Ashmolean Museum).

Evans 1928
A. J. Evans, The Palace of Minos. A Comparative Account of the Successive Stages of the Early Cretan Civilization as Illustrated by the Discoveries at Knossos Vol. II (London 1928).

Evans 1930
A. J. Evans, The Palace of Minos. A Comparative Account of the Successive Stages of the Early Cretan Civilization as Illustrated by the Discoveries at Knossos Vol. III (London 1930).

Fitton 2002
J. L. Fitton, Minoans. Peoples of the Past (London 2002).

Foster 1979
K. P. Foster, Aegean Faience of the Bronze Age (New Haven 1979).

Godart – Tzedakis 1992
L. Godart – Y. Tzedakis, Témoignages archéologiques et épigraphiques en Crète occidentale du néolithique au minoen récent IIIB, Incunabula Graeca 93 (Rome 1992).

Hägg – Lindau 1984
R. Hägg – Y. Lindau, The Minoan 'snake frame' reconsidered, Opuscula Atheniensia 15, 1984, 67–77.

Hallager 1977
E. Hallager, The Mycenaean Palace at Knossos, Medelhavsmuseet Memoir 1 (Stockholm 1977).

Hatzaki 2004
E. Hatzaki, From Final Palatial to Postpalatial Knossos. A view from the Late Minoan II to Late Minoan IIIB town, in: Cadogan *et al.* 2004, 121–126.

Hatzaki 2005
E. Hatzaki, Knossos. The Little Palace, British School at Athens Supplementary Volumes 38 (London 2005).

Hatzaki 2007
E. Hatzaki, Final Palatial (LMII–IIIA2) and Postpalatial. MUM south sector, Long Corridor cists, MUM pits (8, 10-11), Makritikhos Kitchen, MUM North Platform pits, and SEX southern half groups, in: N. Momigliano (ed.), Knossos Pottery Handbook. Neolithic and Bronze Age (Minoan), British School at Athens Studies 14 (London 2007) 197–251.

Hood 1961/1962
M. S. F. Hood, Archaeology in Greece, 1961–62, Archaeological Reports 8, 1961/1962, 3–31.

Hood 2000
M. S. F. Hood, Cretan fresco dates, in: S. Sherratt (ed.), Proceedings of the First International Symposium 'The Wall Paintings of Thera', Petros M. Nomikos Conference Centre Thera, Hellas, 30 August – 4 September 1997 (Athens 2000) 21–32.

Hood 2005
M. S. F. Hood, Dating the Knossos frescoes, in: Morgan 2005, 45–82.

Hood *et al.* 1994
M. S. F. Hood – N. Momigliano – J. Weingarten, Excavations of 1987 on the south front of the palace at Knossos, The Annual of the British School at Athens 89, 1994, 103–156.

Hood – Taylor 1981
M. S. F. Hood – W. Taylor, The Bronze Age Palace at Knossos. Plan and Sections, British School at Athens Supplement 13 (London 1981).

Hue – Pelon 1992
M. Hue – O. Pelon, La salle à piliers du palais de Malia et ses antécédents, Bulletin de Correspondance Hellénique 116, 1992, 1–36.

Immerwahr 1990
S. A. Immerwahr, Aegean Painting in the Bronze Age (University Park 1990).

Kaiser 1976
B. Kaiser, Untersuchungen zum minoischen Relief, Habelts Dissertationsdrucke. Reihe Klassische Archäologie Heft 7 (Bonn 1976).

Karo 1930/1933
G. H. Karo, Die Schachtgräber von Mykenai (Munich 1930/1933).

Krzyszkowska 2005
O. Krzyszkowska, Aegean Seals. An Introduction, Bulletin of the Institute of Classical Studies Supplement 85 (London 2005).

Lapatin 2001
K. D. Lapatin, Chryselephantine Statuary in the Ancient Mediterranean World (Oxford 2001).

Logue 2004
W. Logue, Set in stone. The role of relief-carved stone vessels in Neopalatial Minoan elite propaganda, The Annual of the British School at Athens 99, 2004, 149–172.

Macdonald 2017
C. F. Macdonald, Punctuation in palatial prehistory. Earthquakes as the stratigraphical markers of the 18th–15th centuries BC in central Crete, in: S. Jusseret – M. Sintubin (eds.), Minoan Earthquakes. Breaking the Myth through Interdisciplinarity. Studies in Archaeological Sciences (Leuven 2017) 327–358.

Mackenzie 1900
D. Mackenzie, Excavations at Knossos, 1900 revised copy (Unpublished field notebook, Oxford, Ashmolean Museum).

Mackenzie 1901
D. Mackenzie, Excavations at Knossos, 1901 revised copy (Unpublished field notebook, Oxford, Ashmolean Museum).

Mackenzie 1922
D. Mackenzie, Excavations at Knossos, 1922 revised copy (Unpublished field notebook, Oxford, Ashmolean Museum).

Mackenzie 1923
D. Mackenzie, Excavations at Knossos, 1923 revised copy (Unpublished field notebook, Oxford, Ashmolean Museum).

McEnroe 2010
J. C. McEnroe, Architecture of Minoan Crete. Constructing Identity in the Aegean Bronze Age (Austin 2010).

Militello 1998
P. Militello, Haghia Triada I. Gli Affreschi, Monografie della Scuola Archeologica di Atene e delle Missioni Italiane in Oriente 9 (Padova 1998).

Militello 2001
P. Militello, Gli affreschi minoici di Festòs, Studi di Archaeologia Cretese 2 (Padova 2001).

Morgan 2005
L. Morgan (ed.), Aegean Wall Painting. A Tribute to Mark Cameron, British School at Athens Studies 13 (London 2005).

Moser 1986
K. Moser, Der Alabasterfries von Tiryns, Archäologischer Anzeiger 1986, 1–32.

Mountjoy 2003
P. A. Mountjoy, Knossos. The South House, British School at Athens Supplementary Volume 34 (London 2003).

Niemeier 1985
W.-D. Niemeier, Die Palaststilkeramik von Knossos. Stil, Chronologie und historischer Kontext (Berlin 1985).

Niemeier 1987
W.-D. Niemeier, Das Stuckrelief des 'Prinzen mit der Federkrone' aus Knossos und minoische Götterdarstellungen, Athenische Mitteilungen 102, 1987, 65–98.

Niemeier 1988
W.-D. Niemeier, The 'Priest King' fresco from Knossos. A new reconstruction and interpretation, in: E. French – K. Wardle (eds.), Problems in Greek Prehistory (Bristol 1988) 235–244.

Niemeier 1994
W. D. Niemeier, Knossos in the New Palace period (MM III–LM IB), in: D. Evely – H. Hughes-Brock – N. Momigliano (eds.), Knossos. A Labyrinth of History. Papers Presented in Honour of Sinclair Hood (Oxford 1994) 71–88.

Palmer – Boardman 1963
L. R. Palmer – J. Boardman, On the Knossos Tablets (Oxford 1963).

Panagiotaki 1999
M. Panagiotaki, The Central Palace Sanctuary, British School at Athens Supplementary Volumes 31 (London 1999).

Pelon 1980
O. Pelon, Le palais de Malia 5, Études crétoises 25 (Paris 1980).

Popham 1964
M. Popham, The Last Days of the Palace at Knossos. Complete Vases of the Late Minoan IIIB Period, Studies in Mediterranean Archaeology 5 (Lund 1964).

Popham 1970
M. Popham, The Destruction of the Palace at Knossos. Pottery of the Late Minoan IIIA Period, Studies in Mediterranean Archaeology 12 (Göteborg 1970).

Poursat 1977a
J.-C. Poursat, Les ivoires mycéniens. Essai sur la formation d'un art mycénien. Bibliothèque des Écoles françaises d'Athènes 230 (Athens 1977).

Poursat 1977b
J.-C. Poursat, Catalogue des ivoires mycéniens du Musée National d'Athènes. Bibliothèque des Écoles françaises d'Athènes 230bis (Athens 1977).

Preston 2008
L. Preston, Late Minoan II to IIIB Crete, in: C. W. Shelmerdine (ed.), The Cambridge Companion to the Aegean Bronze Age (Cambridge 2008) 310–326.

Preziosi – Hitchcock 1999
D. Preziosi – L. A. Hitchcock, Aegean Art and Architecture (Oxford 1999).

Raison 1988
J. Raison, Le Palais du Second Millénaire à Knossos, I. Le Quatier Nord, Études crétoises 28 (Paris 1988).

Rehak – Younger 2001
P. Rehak – J. G. Younger, Review of Aegean prehistory VII. Neopalatial, Final Palatial and Postpalatial Crete, in: T. Cullen (ed.), Aegean Prehistory. A Review, American Journal of Archaeology Supplement 1 (Boston 2001) 383–473.

Rethemiotakis 2002
G. Rethemiotakis, 2002, Evidence on social and economic changes at Galatas and Pediada in the New Palace Period, in: J. Driessen – I. Schoep – R. Laffineur (eds.), Monuments of Minos. Rethinking the Minoan Palaces, Aegaeum 23 (Liège 2002) 55–69.

Roussaki 2014
M. Roussaki, New evidence in Minoan pictorial wall painting. 'The Swallows Fresco' from the Knossos area, in: G. Touchais – R. Laffineur – F. Rougemont (eds.), Physis. L'environnement naturel et la relation homme-milieu dans le monde égéen protohistorique, Actes de la 14e Rencontre égéenne internationale, Paris, Institut National d'Histoire de l'Art (INHA),11–14 décembre 2012, Aegaeum 37 (Liège 2014) 539–542.

Sakellarakis – Sakellarakis 1997
Y. Sakellarakis – E. Sakellarakis, Archanes. Minoan Crete in a New Light (Athens 1997).

Schäfer 1992
J. Schäfer, Amnisos nach den archäologischen, historischen und epigraphischen Zeugnissen des Altertums und der Neuzeit (Berlin 1992).

Shaw 1972
M. C. Shaw, The miniature frescoes of Tylissos reconsidered, Archäologischer Anzeiger 1972, 171–188.

Shaw 1978
M. C. Shaw, A Minoan fresco from Katsamba, American Journal of Archaeology 82, 1978, 27–34.

Shaw 1998
M. C. Shaw, The painted plaster reliefs, in: P. P. Betancourt – C. Davaras – E. S. Banou (eds.), Pseira II. Building AC (the "Shrine") and Other Buildings in Area A (Philadelphia 1998) 55–78.

Shaw 2004
M. C. Shaw, The 'Priest-King' fresco from Knossos. Man, woman, priest, king, or someone else?, in: A. P. Chapin (ed.), Χάρις. Essays in Honor of Sara A. Immerwahr, Hesperia Supplement 33 (Princeton 2004) 65–84.

Shaw 2005
M. C. Shaw, The painted pavilion of the 'Caravanserai' at Knossos, in: Morgan 2005, 159–172.

Shaw – Chapin 2012
M. C. Shaw – A. P. Chapin, The frescoes, in: M. C. Shaw – J. W. Shaw (eds.), House X at Kommos. A Minoan Mansion near the Sea. Part 1. Architecture, Stratigraphy, and Selected Finds (Philadelphia 2012) 53–74.

Warren 1969
P. Warren, Minoan Stone Vases (Cambridge 1969).

Warren 2005
P. Warren, Flowers for the goddess? New fragments of wall paintings from Knossos, in: Morgan 2005, 131–148.

Warren – Hankey 1989
P. Warren – V. Hankey, Aegean Bronze Age Chronology (Bristol 1989).

Westlake 2012
P. Westlake, Plaster finds from block M, in: C. Knappett – T. Cunningham (eds.), Palaikastro Block M. The Proto- and Neopalatial Town, British School at Athens Supplement 47 (London 2012) 295–316.

Xenaki-Sakellariou 1985
A. Xenaki-Sakellariou, Οι θαλαμωτοί τάφοι των Μυκηνών. Ανασκαφής Χρ. Τσούντα (1887–1898) (Paris 1985).

Bronze Age Wall Paintings from Thebes

Technical Aspects and State of Conservation

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Abstract

Bronze Age Thebes exhibits great palaces of equivalent quality with those of Tiryns, Mycenae, Pylos and Knossos, with a great collection of unique wall paintings. The main aim of this work was the examination of wall painting fragments from the three known Mycenaean centres of Boeotia: Thebes, Gla and Orchomenos. Non-destructive techniques were chosen in order to thoroughly examine the samples (optical microscopy, micro-Raman and scanning electron microscopy with EDX analysis). Moreover, in order to examine their plaster microstructure, parameters and composition, mercury porosimetry and thermal analysis were used.

In all painting samples, at least three different layers were detected. The third outer layer was the coloured painting layer; the second was a coherent white plaster with small-sized aggregates and the third inner layer was an off-white mortar with coarser aggregates. On a few fragments a fourth yellowish layer was discovered under the blue painting layer, which probably was a preparation layer.

In general, the colour pigments detected in the wall painting fragments under investigation were blue, red, black, white and yellow, in many colour shades and different thicknesses. The results showed that white pigment was identified as calcite, black as graphite, blue as Egyptian Blue, yellow as goethite or limonite, and red as hematite. The different hues and colour saturation were produced by mixing these basic pigments in different proportions and grain sizes. Colour pigments found are the same as the ones used in Mycenaean, Minoan and Cycladic civilisations in the same period.

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in: J. Becker, J. Jungfleisch and C. von Rüden (eds.) Tracing Technoscapes. The Production of Bronze Age Wall Paintings in the Eastern Mediterranean (Leiden 2018) 279-300.

Most of the pigments came from natural materials, like earths, except Egyptian Blue, which was an artificial made pigment.

Concerning the plasters, experimental results showed that they are lime-based mortars, containing calcite aggregates with a small percentage of impurities. These plasters presented high porosity values and only small differences in their manufacturing technology. In addition, all the fragments have high total specific surface area which might be attributed to the additional tiny inclusions imbedded in it, possible for increasing the available time of painting by keeping the last layer wet.

This study allowed the characterisation of plasters and colour layers of Bronze Age wall paintings and the results can scientifically support the decision making for the most compatible conservation materials and interventions of these significant pieces of Bronze Age art.

Keywords: Aegean Bronze Age; wall paintings; plaster layers; pigments; non-destructive testing.

1. Introduction

The Mycenaean site of Thebes and its material culture appears to be of equivalent quality as those of the great Mycenaean palaces of Tiryns, Mycenae, Pylos and Knossos. Especially in the field of painting Thebes holds a unique position combining significant findings from both residential and burial space, displaying a great variety of decorated materials. These materials include fixed architectural elements (walls, floors, doorframes and desks) as well as portable objects (offering tables, figurines, clay tiles, vases and urns). In addition, its strategic location within the Boeotia region makes it highly possible that Thebes was the point from which the craft of painting broadcasted to the other centres of Boeotia with palatial character. Especially in Orchomenos and Gla, excellent examples of painted decorations can be seen, either on walls or other surfaces.[3]

The wall paintings of Bronze Age Thebes were found in the early 20th century (1906) during the excavations of A. Keramopoullos at the building which is conventionally known as the 'House of Kadmos'.[4] Especially in the 1960s and 1970s, when intensive modern building activity led to numerous excavations that revealed many important Bronze Age buildings with palatial functions, further notable wall painting fragments came to light. The wall painting corpus was enriched by new findings that have emerged from the excavation of two buildings of the palace complex, whose destruction dates back to the mid-13th century BC.[5]

The main aim of this study was the characterisation of plasters and colour layers of wall painting fragments from Bronze Age Thebes and the assessment of their state of conservation. For this reason only fragments that do not match to the wall paintings

3 Aravantinos 2010, 51–72.
4 Dakouri-Hild 2008, 203–218.
5 Aravantinos – Fappas 2015, 316–353.

Fig. 1: Reconstruction of the women's frieze from the Mycenaean acropolis of Kadmeion.

Fig. 2: Reconstructions of different wall paintings from the Mycenaean acropolis of Gla.

Fig. 3: Reconstruction of wall paintings from the Mycenaean palace of Orchomenos.

(Figs. 1–3) today exhibited in the re-opened Archaeological Museum of Thebes have been selected.[6] The samples were analysed mainly with non-destructive techniques.

2. Bronze Age Wall Paintings

Wall paintings were mainly used for the decoration of architectural elements. But, they can also serve for educational or votive purposes. Like other paintings (paintings, image, etc.), wall painting comprises one or more colour layers that are placed

6 The maintenance of the wall paintings were done by Panayiotis Angelides and Mary Luka. Aesthetic representation of the reported wall paintings was performed by Nickos Sepetzoglou.

on a surface, which is called substrate. On the substrate some preparatory layers are usually placed, which form the basis of the painting. Then, the pigments are applied. The whole composition was painted while the plaster substrate was still wet, making it very durable after drying. The secco technique was mainly used for painting details.[7]

However, before the painting could have been applied the masonries were prepared. At the beginning, a clay mortar layer, in many cases reinforced with straw, has been applied on the surface of the masonry. On top of this layer a lime-based plaster with coarser aggregates of approximately 15mm depth was applied, before another lime plaster of about 5mm with comparable fine aggregates was set on top of that. At the acme of Bronze Age civilisation (LH IIB–IIIB), this layer was very well prepared, very smooth and white, perfectly serving as a painting layer substrate. When the mortar was still wet, the artist impressed by means of a string, the upper and lower lines, determining the borders of the painting. Usually, there was an outline incised with the aid of a sharp object, and that is the reason why in many cases fine engravings are visible on the surface of the wall painting. For many round objects, like for drawing chariot wheels, compasses were used. Most of the time, the sketch was done with a pale yellow pigment, and then covered with a very fine lime mortar.[8]

These painted decorations were not only on walls, but also on floors, stairs or benches of ceremonial spaces. Furthermore, a few decorative mural themes were found inside arched tombs, for example female figures inside the big arched tomb in Thebes.[9]

In the Aegean Bronze Age, wall painting colour pigments were mainly based on different earths. Craftspersons on Crete used iron oxides for yellow and red; black was a product of charcoal and bones, green was made from mixing yellow with blue, or malachite.[10] Blue colour was made by a mixture of silicon with oxides of calcium and sodium with calcium calcite (Egyptian Blue), while the grey-blue derived from riebeckite.[11] On the island of Santorini, lime was used as white, charcoal as black, hematite as red, yellow ochre (mainly limonite or goethite) as yellow and Egyptian Blue or glaucophane as blue.[12] The colour palette also included different shades and hues of the basic colours, like brown red or orange, which were derived from mixing some basic colours or adding lime water.[13] In Thebes, the pigments identified are: yellow ochre (limonite or goethite), red ochre (hematite), Egyptian Blue or riebeckite blue, charcoal for black, lime for white and a combination of black and red for purple.[14]

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7 Vasilikou 1995, 221–223. For a summarising discussion of the used painting techniques in the Bronze Age Aegean, cf. Jones – Photos-Jones 2005. For recent evidences of secco paintings in Aegean wall painting, cf. Brecoulaki *et al.* 2012.

8 Brysbaert 2008, 2766; Wardle – Wardle 2012, 129–159.

9 Papazoglou-Manioudaki 2006, 460–501.

10 Brecoulaki – Perdikatsis 2006, 179–185.

11 Sapouna-Sakellaraki 1994, 140–141; Dimopoulou 2015, 188–197.

12 Vlachopoulos – Sotiropoulou 2013.

13 Treuil *et al.* 1996, 353–354; Televantou 2007, 36–40.

14 Brysbaert 2008, 2761–2769.

Fig. 4: Examples of sampled fragments from Thebes, Gla and Orchomenos.

3. Materials and Techniques

3.1 Sampling

For the purposes of this study, fragments (Fig. 4) from the Mycenaean palace complex of Thebes (Fig. 5),[15] the Mycenaean acropolis of Gla[16] (Fig. 6) and the suspected Mycenaean palace of Orchomenos[17] (Fig. 7) were investigated. In the following part some archaeological and descriptive information about the selected sites are provided.

15 Boulotis 1988, 36–39, 185–193; Boulotis 2000, 1095–1149.
16 Iakovidis 1989; Iakovidis 1998; Boulotis 2015, 370–403.
17 Spyropoulos 1977b, 261–263; Spyropoulos 2015, 354–368.

3.1.1 The Mycenaean Palace Complex of Thebes

Samples were taken from different sites of the Mycenaean palace complex of Thebes:

1. The plots of Yannopoulou-Dimitrakopoulou (Fig. 5; location TH_G_12)[18] and Dagdelenis' brothers (Fig. 5; location TH_DG_8)[19] lay beside each other and were excavated in the north part of the Kadmeia in 1966–1970, where an impressive palatial building once existed. The excavations in the two plots yielded an enormous amount of wall painting fragments, with a great variety of colours and designs, witnessing a work of high quality. A quick examination of the material from the two plots revealed that many fragments of wall painting may be assigned to the same composition. They include large-scale representations with birds and flowers in rocky landscapes. Other fragments with the representation of the bull's skin, conventional in Aegean iconography, indicate the presence of wall paintings including bulls or eight-shaped shields, which seem to have been coated by bull hides. Moreover, the material includes parts of decorative zones with spirals and rosettes, which framed the main composition and have exact parallels in the 'Cult Centre' of Mycenae, in Tiryns, in Pylos and in Knossos.[20] Among them, there are some exceptionally large fragments with polychrome spirals of 0.45m in diameter, coming from an impressive composition, which once decorated the ground floor apartments of the building.

2. Similarly, the plots of K. Douros[21] and K. Gikas (Fig. 5; location TH_GK_9),[22] excavated in 1969–1970 on the summit of the Mycenaean acropolis, in the southern part of the Kadmeia, lay beside each other. From the remains of an impressive building excavated at the site comes a substantial amount of wall painting fragments, mainly including pictorial representations of sea and natural landscapes with fishes and birds depicted between rivers and flowers.[23] The composition may be counted among the best examples of pictorial art of Mycenaean Thebes and probably is the work of a very gifted painter.

3. The plots of N. Ioannou (Fig. 5; location TH_IO_11)[24] and D. Filis[25] lay in the centre of the Mycenaean acropolis of Thebes. As was the case with the other plots mentioned above, these excavations revealed big walls of palatial buildings, as well as many fragments of wall paintings of similar style and topics.

4. The House of Kadmos (Fig. 5; locations TH_KD_2 and TH_KD_3)[26] was built at the central street of the main hill of the Kadmeia. The excavations by

18 Symeonoglou 1968, 183–187, pl. 195.
19 Spyropoulos 1970, 180–182, pl. 190; Spyropoulos 1972, 211–212, pls. 200–201.
20 Aravantinos – Fappas 2015, 336–340.
21 Spyropoulos 1970, 180, pl. 188.
22 Spyropoulos 1977a, 307, pl. 250ε.
23 Aravantinos – Fappas 2015, 329–330.
24 Faraklas 1969, 207–208, pl. 159α.
25 Spyropoulos 1972, 220, pl. 204γ.
26 Keramopoullos 1909, 57–122; Dakouri-Hild 2001, 81–122.

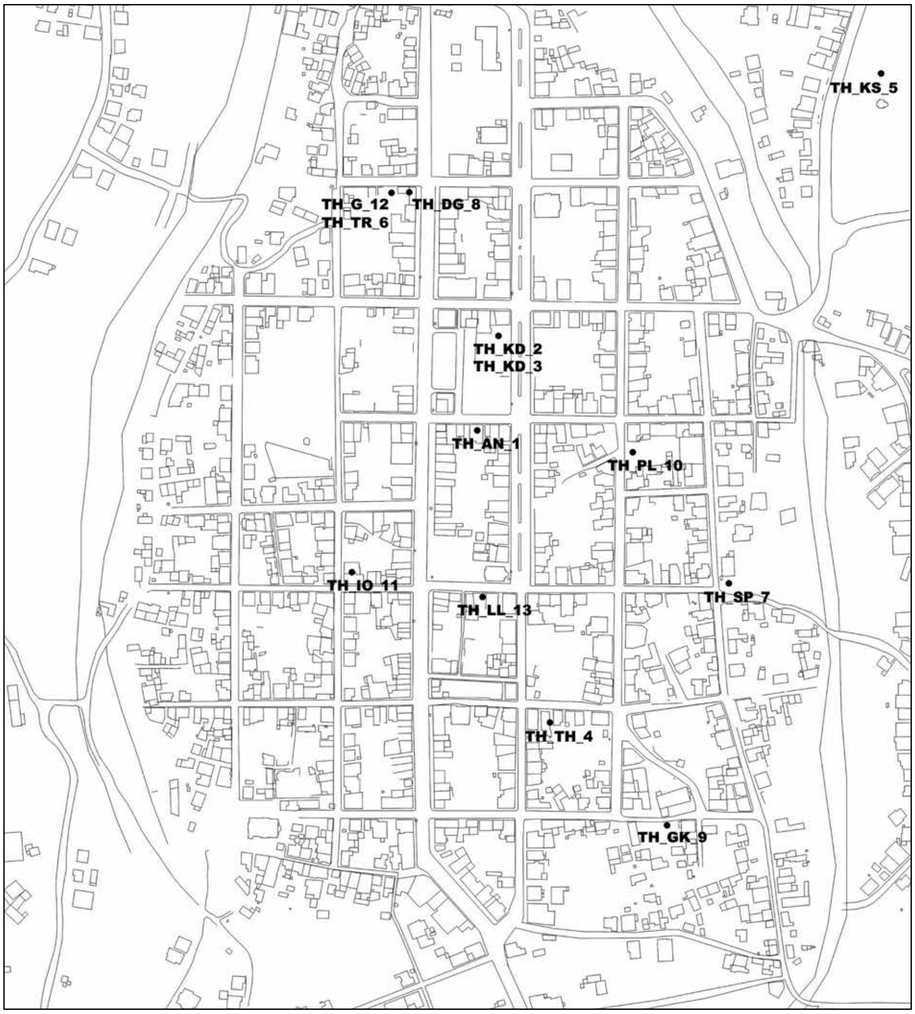

Fig. 5: Map of Thebes showing the find spots of the sampled fragments.

A. Keramopoullos during the first three decades of the 20th century showed the ruins of the biggest and best-preserved building of Thebes' Mycenaean acropolis. This building occupied approximately 720m^2 and it seems that the rooms served as both storerooms and workshops. Its ground plan shows 15 small rooms, which are only accessible through a complex system of narrow corridors. In one of these rooms the wall painting of women in procession was found.[27]

5. The impressive Mycenaean chamber tomb on the Megalo Kastelli hill was excavated in 1971,[28] just outside of the east side of Mycenaean Thebes, where one of its cemeteries once existed. It is the only known tomb of the Aegean Bronze Age, which had pictorial representations on its walls. Fragments of wall paintings

27 Reusch 1956.
28 Spyropoulos 1971, 161–164; Spyropoulos 1977a, 307–314; Keramopoullos 1917, 392.

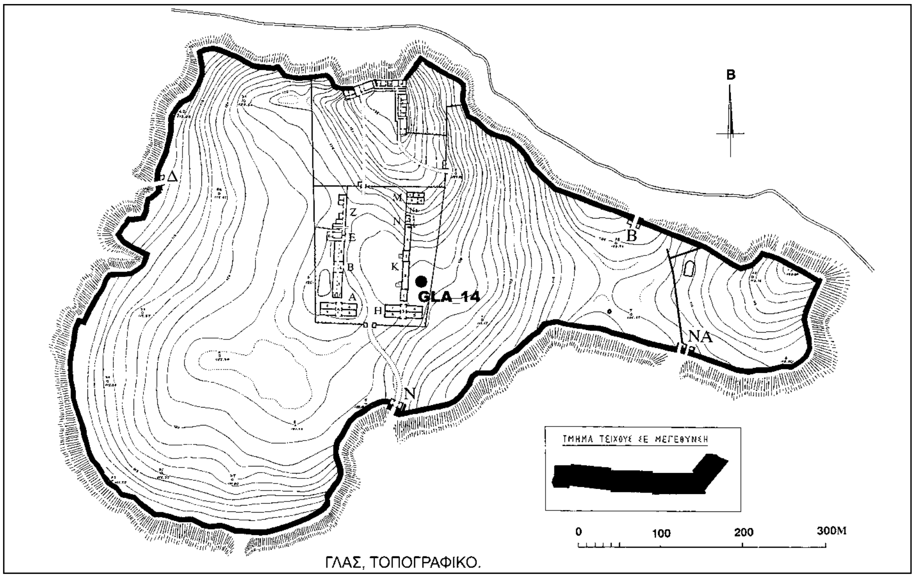

Fig. 6: Topographic plan of the Mycenaean acropolis of Gla showing the find spot of the sampled fragment.

show women with raised arms in a position of lamentation, whereas a bench running along the southern and western wall was decorated with a zone of spirals and papyrus flowers. These wall paintings were kept in the old storerooms of the Ephorate for decades and their proper conservation is an urgent need in order to prevent further damage.

3.1.2 The Acropolis of Gla

A. De Ridder started excavations at the Mycenean Acropolis of Gla (Fig. 6; location GLA_14) in 1893. His interest mainly focused on the Melathron buildings and the West Wing at the south part of the precinct. J. Threpsiadis continued the excavations from 1955–1961. In the years from 1981–1983 and 1990–1991 S. Iakovidis excavated the East Wing of the south part of the precinct.[29] During this last excavation, the frieze with the representation of dolphins was found.[30]

3.1.3 Orchomenos Palace

From the excavations conducted by the Boeotia Antiquities Ephorate in the early 1970s, Th. Spyropoulos found Mycenaean ruins of a building complex at the courtyard of the Byzantine church of Panagia Scripous.[31] This building was identified as the Orchomenos Palace (Fig. 7; location ORC_15), based on the mural fragments found in the building's backfilling. The walls were made of adobe, with foundations made of

29 Iakovidis 1989; Iakovidis 1998.
30 Boulotis 2015, 371–401
31 Spyropoulos 1974, 313–325.

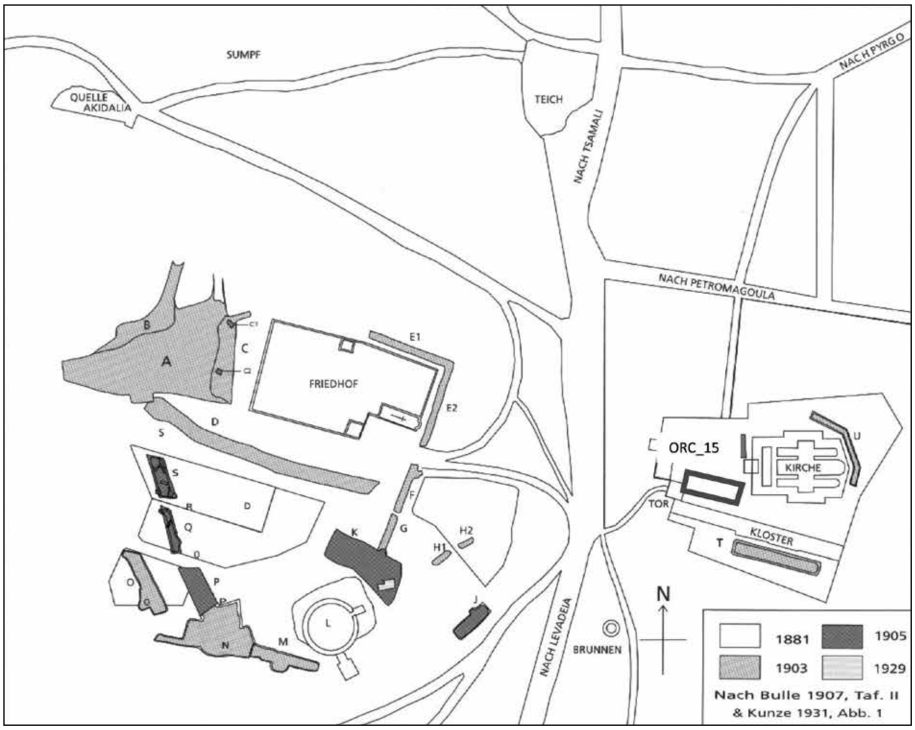

Fig. 7: Map of Orchomenos showing find spot of the sampled fragment.

stone, and the floors were covered with lime mortars. The fragments of the paintings represent for instance scenes of boar hunting, athletics, and rituals.[32]

3.2 Wall Painting Fragments' State of Conservation

The fragments' current state of conservation is a result of various intrinsic and extrinsic factors, such as the durability of the raw materials used, their production technique, their exposure to environmental loads in the course of time, the excavations' conditions, and the various treatments followed after their finding. After the excavations, wall paintings fragments were usually set on wooden trays and stored. In some cases, rescue measures have been applied for studying, representation and publication reasons. In the early 1970s, the fragments from the Kadmeion depicting women in procession were conserved at the Archaeological Museum of Thebes. These were mechanically cleaned, joined with shellac and consolidated with the use of Mowilith 50 (polyvinyl acetate homopolymer). At the end of the 1970s, fragments from Gla and Orchomenos were also partially conserved with the same technique and were published.

In 2013, in the framework of the re-exhibition of the existing wall paintings in the new Archaeological Museum, an in-depth study and conservation of all wall paintings from Boeotia – from the Acropolis of Thebes, from the Acropolis of Gla and from the Palace of Orchomenos – was conducted by P. Aggelidis, M. Louka

32 Spyropoulos 2015, 354–368.

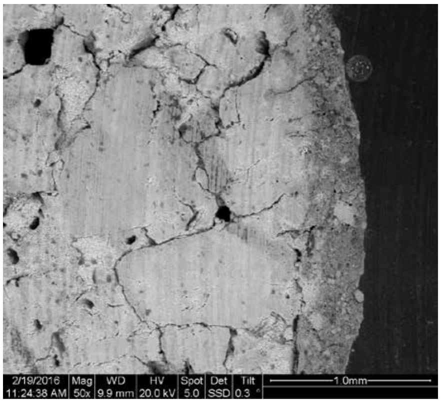

Fig. 8: SEM image of a fragment's cross section.

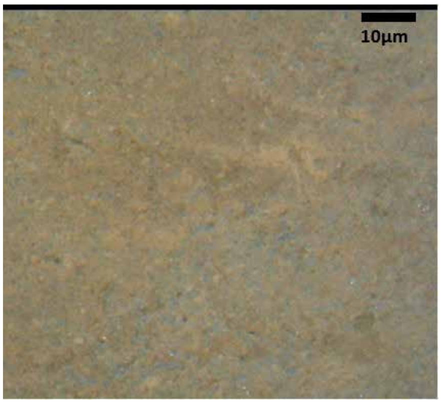

Fig. 9: Painting preparation layer (yellowish primer layer).

and N. Sepetzoglou. The various conservation stages included mechanical cleaning, consolidation with Paraloid B72 (copolymer of ethyl methachrylate and methyl acrylate), and finally fixing and setting in specific aluminium frames with the use of a plaster substrate.[33] This plaster was prepared by mixing vinavil with one part of marble powder, one part of pumice stone powder and a half part of brick powder and water.

On the surface of the fragments under investigation, a thin deposit of soil was found and the plasters were friable. Very carefully, the surfaces were mechanically cleaned, and some with ionised water, acetone and ethyl alcohol.

3.3 Examination techniques

Firstly, a detailed examination of the fragments was executed using non-destructive techniques due to the historic significance of the samples.[34] The first step of our examination included optical stereo microscopy (Leica MZ6 in combination with image analysis software Image pro plus) and micro-Raman spectroscopy (Renishaw in via Raman microscope). In the second stage, after the selection of representative samples, laboratory destructive techniques were applied only for selected substrate plasters. The method of mercury porosimetry was used for the analysis of their microstructure parameters (PASCAL 140, 440) and for the identification of their composition thermal analyses (Netzsch Simulataneous STA 409EP). In order to identify the construction technology of the wall paintings, the dimensions of the different layers of mortars and pigments as well as the aggregates of mortars, cross sections were studied using an optical stereoscopic microscope and scanning electron microscopy coupled with elemental analysis (Fei/Philips, Quanta 200).[35]

33 Horie 1987; Holland – Hay 2002.

34 Sample processing took place in the Materials Science and Engineering Laboratory at the School of Chemical Engineering of NTUA.

35 Bakolas 2002.

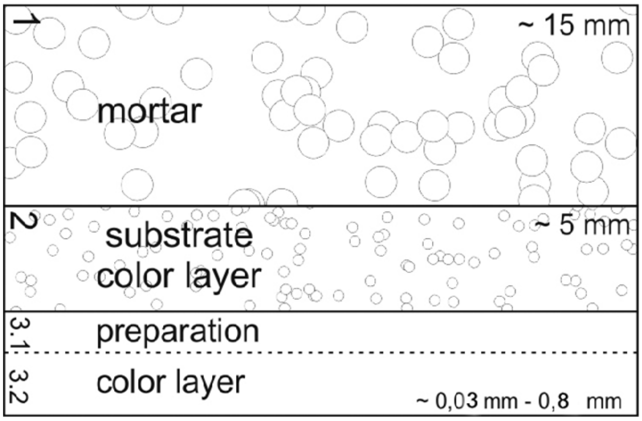

Fig. 10: Characteristic layer structure of the samples.

4. Results and Discussion

4.1 Construction Technique of Thebes' Wall Paintings

For the investigation of the different layers, optical stereo microscopy and scanning electron microscopy were used.[36] The study of cross sections, combined with image analysis measurements, gave information about the overall thickness of each plaster layer, the colour layers, size and shape of aggregates, the type and dispersion of pores, the existence of various inclusions and possible additives. Furthermore, superimposed paint layers were observed.

All samples possessed small holes and micro cracks, due to the detachment of the aggregates and as a consequence of their decay in the course of time (Fig. 8). The plasters contained aggregates of different size, of which the majority were of white hue, probably of calcite composition. The separation of the different plaster layers was not easy to conduct since in many cases the bigger layers superimposed smaller layers. In general, three different layers are distinguishable: a first plaster layer has a width of about 15mm and coarser aggregates (maximum grain size ~2.6mm), a second plaster layer a width of about 5mm and smaller aggregates (maximum grain size ~0.9mm), while the third one represents the painting layer. In almost all cases the colour layer is very thin, about 0.03–0.8mm. Its thickness varies from 90–400µm for blue, from 62–800µm for white, from 62–200µm for yellow, from 53–188µm for red and 34–59µm for black. Interestingly, in some blue samples an ochre preparation layer has also been discovered under the blue colour (Fig. 9). A. Brysbaert also identified a layer of carbon-based black or grey under most blue layers.[37]

The plasters have slight variations (layers width, aggregates sizes etc.) in their manufacturing technology from different sites in Boeotia and even more from building to building from the Mycenaean citadel of Thebes.

Figure 10 shows the characteristic layer structure of the samples:

- The 1st layer, a plaster with large aggregates, mainly white.
- The 2nd layer, plaster with smaller aggregates, mainly white.
- The 3rd layer, the painting layer: 3.1 yellowish preparation layer; 3.2 painting surface (colorant layer).

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36 Moropoulou *et al.* 2000.
37 Brysbaert 2008, 2761–2769.

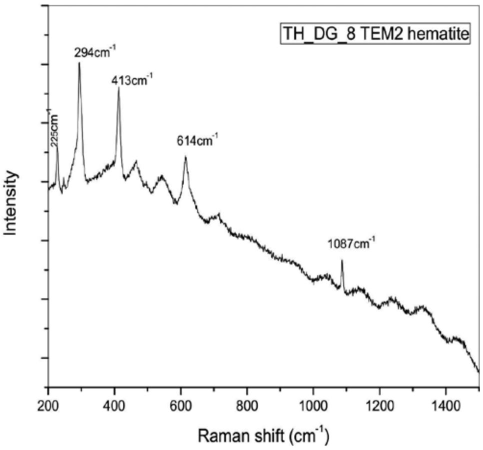

Fig. 11: Micro-Raman spectrum of red pigments.

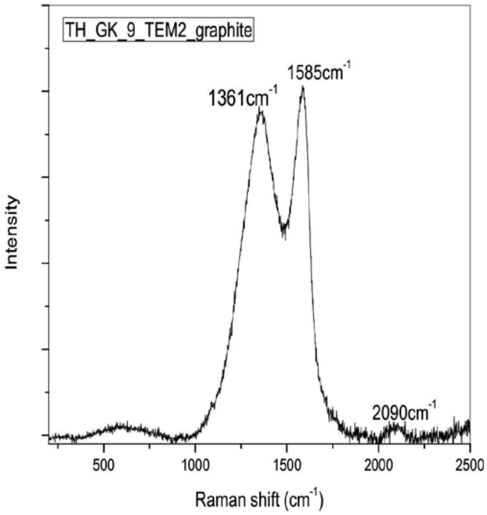

Fig. 12: Micro-Raman spectrum of black pigments.

4.2 Characterisation of the Wall Painting's Plasters

The plasters were characterised with the aid of optical microscopy, scanning electron microscopy,[38] thermal analysis[39] and mercury porosimetry. Samples were selected on the basis of their different regions of provenance.

All plaster layers were characterised as lime based mortars with calcite aggregates, with a very high percentage of calcium carbonate of over 90%. Most of the plaster layers present high total porosity values, ranging from 30–40%. For some samples, the values were over 50%, which can probably be attributed to decay phenomena of these layers. Additionally, they also presented very high values of specific surface area (5–13m^2/g), which can be attributed to the use of some calcite additives probably added to avoid the quick drying of the mortar. In this way, the painters had more time for the creation of the painting layer, also avoiding cracks in the plaster.

4.3 Characterisation of Pigments

In the Aegean Bronze Age, pigments were prepared mostly from natural materials, except Egyptian Blue. Most of the pigments were locally produced (except the Egyptian Blue). The palette was not wide, and all colours were produced by using basic colours, by mixing, diluting or concentrating and altering the grain size of their basic pigments. The raw materials were mainly coloured earths, with iron oxides and other mineral impurities, which the painter decided to keep or to subtract, based on the desired effect of the oxide.[40]

All pigments were characterised with the aid of SEM-EDX and μ-Raman spectroscopy.[41] The analyses gave the following results:

38 Goldstein *et al.* 1992.
39 Bakolas *et al.* 1995; Bakolas *et al.* 1998.
40 Perdikatsis 1997, 103–108; Jones – Photos-Jones 2005, 199–224.
41 Bell *et al.* 1997; Bouchard – Smith 2003; Scherrer *et al.* 2009.

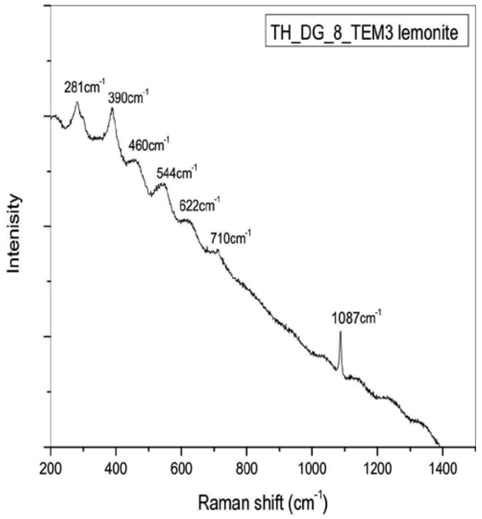

Fig. 13: Micro-Raman spectrum of yellow pigments.

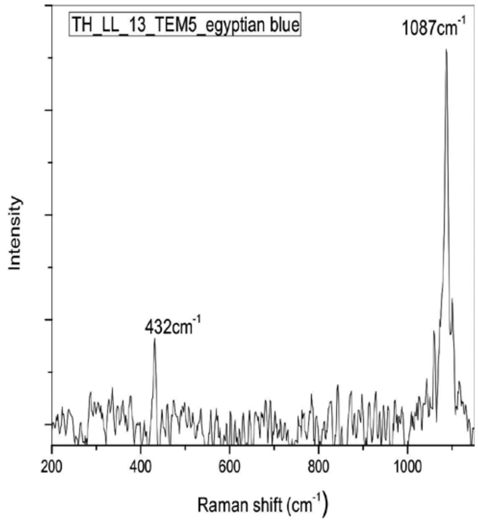

Fig. 14: Micro-Raman spectrum of Egyptian Blue.

- Red pigment
  Characteristic Raman spectrum of hematite revealed that the red dye is hematite (Fig. 11). This can be the basic colour for all tones ranging from deep to light red. The results were confirmed by the SEM-EDX.

- White pigment
  With the aid of micro-Raman spectroscopy the characteristic spectrum of the white pigment was identified as calcite (calcium carbonate). The results of the microanalysis by SEM-EDX confirmed this result.

- Black pigment
  The micro-Raman[42] spectrum identified the black pigment as graphite (Fig. 12). This can be attributed to a carbon-based material, probably charcoal.

- Yellow pigment
  The micro-Raman spectrum identified the yellow pigment as the mineral limonite (FeO(OH) · nH2O) (Fig. 13) and goethite (FeO(OH)).

- Blue pigment
  The micro-Raman spectrum identified the blue pigment as Egyptian Blue ($CaCuSi_4O_{10}$) (Fig. 14).

It should be noted that these fragments did not include a green colour. This is due to the fact that green is very rare and green fragments were not available for analysis.

42 Perez-Rodriguez *et al.* 2014, 602–609.

The only example with green colour so far from Boeotia, is in the fresco from the excavation of Orchomenos, now in the permanent exhibition of the Archaeological Museum of Thebes.

5. Conclusions

In this paper wall painting fragments from the Mycenaean palace complex of Thebes, the Mycenaean acropolis of Gla, and the suspected Mycenaean palace of Orchomenos were examined.

The study of cross sections allowed the investigation of the fragments' manufacture techniques. Most of the samples presented three different layers: a first lime-based plaster layer with coarser, white aggregates, of about 15mm, a second lime-based plaster layer with finer white aggregates of about 5mm, and a painting layer of various width (0.03–0.8mm), depending on the type of pigment and its grain size and decay degree of the outer surface. Furthermore, in some samples an ochre primer layer was detected below the colour layer.

The different plasters presented slight regional variations in their manufacturing technique. All plasters were lime-based with calcite aggregates. They presented high total porosity values. Also, they had very high values of specific surface area, that could possibly be attributed to special additives which the painters used in order to keep the plaster moist and thus to have more available time for painting.

The red colour pigment, responsible for all colour tones from light to dark red, was identified as hematite, while yellow colour was possibly related to limonite or goethite. Blue colour was identified as Egyptian Blue and black colour was carbon based, probably from charcoal and the white colour from lime. The pigments of the wall paintings of Boeotia that were identified at the laboratory are identical to the pigments that were identified in the studies of samples from other centres of the Greek mainland (Mycenae and Tiryns), Crete and the Cyclades (Thera). The natural earths indicate preference for local resources, except the artificial Egyptian Blue, which is probably an imported product.

This study allowed the characterisation of plasters and colour layers of Bronze Age wall paintings and the results can scientifically support the decision making for the most compatible conservation materials and interventions of these significant pieces of Bronze Age art.

Acknowledgments

Many thanks to Dr. Alexandra Harami for her valuable assistance and for providing us photographs that belong to EFA Viotia and to Dr. Vasilis Aravantinos and Dr. John Fappa for providing us with material and valuable information. We also would like to thank Joanna Moraitou, Peggy Vergioti, Sotiri Kazakidi, Olga Kyriazi, Evi Tsota and Spyro Samartzi for their valuable assistance.

References

Aravantinos 2010

V. Aravantinos, Mycenaean Thebes. Old questions, new answers, in: I. Boehm – S. Müller-Celka (eds.), Espace civil, espace religieux en Égée durant la période mycénienne. Approches épigraphique, linguistique et archéologique. Actes des journées d'archéologie et de philologie mycéniennes tenues à la Maison de l'Orient et de la Méditerranée – Jean Pouilloux les 1er février 2006 et 1er mars 2007, Travaux de la Maison de l'Orient et de la Méditerranée 54 (Lyon 2010) 51–72.

Aravantinos – Fappas 2015

V. Aravantinos – I. Fappas, The Mycenaean wall paintings of Thebes. From excavation to restoration, in: Brecoulaki *et al.* 2015, 316–353.

Bakolas 2002

A. Bakolas, Κριτήρια και μέθοδοι χαρακτηρισμού ιστορικών κονιαμάτων, (PhD Diss., National Technical University of Athens, Athens 2002).

Bakolas *et al.* 1995

A. Bakolas – G. Biscontin – V. Contardi – E. Franceschi – A. Moropoulou – D. Palazzi – E. Zendri, Thermoanalytical research on traditional mortars in Venice, Thermochimica Acta 269/270, 1995, 817–828.

Bakolas *et al.* 1998

A. Bakolas – G. Biscontin – A. Moropoulou – E. Zendri, Characterization of structural byzantine mortars by thermogravimetric analysis, Thermochimica Acta 321, 1998, 151–160.

Bell *et al.* 1997

I. M. Bell – R. J. H. Clark – P. J. Gibbs, Raman spectroscopic library of natural and synthetic pigments (pre- ~ 1850 AD), Spectrochimica Part A. Molecular and Biomolecular Spectroscopy 53, 1997, 2159–2179.

Bouchard – Smith 2003

M. Bouchard – D. C. Smith, Catalogue of 45 reference Raman spectra of minerals concerning research in art history or archaeology, especially on corroded metals and coloured glass, Spectrochimica Acta Part A. Molecular and Biomolecular Spectroscopy 59, 2003, 2247–2266.

Boulotis 1988

Ch. Boulotis, Οι μυκηναϊκές τοιχογραφίες, in: K. Demakopoulou (ed.), The Mycenaean World. Five Centuries of Early Greek Culture. 1600–1100 BC (Athens 1988) 36–39, 185–193.

Boulotis 2000

Χ. Μπουλωτης, Η τέχνη των τοιχογραφιών στη μυκηναϊκή Βοιωτία, in: Β. Αραβαντινος (ed.), Γ‘ Διεθνές Συνέδριο Βοιωτικών Μελετών, Θήβα 4–8 Σεπτεμβρίου 1996, Επιτηρίς της Εταιρείας Βοιωτικών Μελετών 3,1 (Athens 2000) 1095–1149.

Boulotis 2015

Ch. Boulotis, Reconstructing a dolphin frieze and argonauts from the Mycenaean citadel of Gla, in: Brecoulaki *et al.* 2015, 370–403.

Brecoulaki – Perdikatsis 2006

H. Brecoulaki – B. Perdikatsis, Το πράσινο χρώμα στην Αρχαία Ελληνική Ζωγραφική in: Γ. Καζάζη (ed.), Αρχαία ελληνική τεχνολογία. Πρακτικά 2ου Διεθνούς Συνεδρίου Αρχαίας Ελληνικής Τεχνολογίας, Οκτώβριος 2005 (Athens 2006) 179–185.

Brecoulaki *et al.* 2012

H. Brecoulaki – A. Androetti – I. Bonaduce – M. P. Colombini – A. Lluveras, 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, Journal of Archaeological Science 39, 2012, 2866–2876.

Brecoulaki *et al.* 2015

H. Brecoulaki – J. L. Davis – S. R. Stocker (eds.), Mycenaean Wall Painting in Context. New Discoveries, Old Finds Reconsidered. Proceedings of an International Workshop Held February 10–11, 2011 at the National Hellenic Research Foundation, Μελετήματα 72 (Athens 2015).

Brysbaert 2008

A. Brysbaert, Painted plaster from Bronze Age Thebes, Boeotia (Greece). A technological study, Journal of Archaeological Science 35, 2008, 2761–2769.

Dakouri-Hild 2001

A. Dakouri-Hild, The house of Kadmos in Mycenaean Thebes reconsidered. Architecture, chronology and context, Annual of the British School at Athens 96, 2001, 81–122.

Dakouri-Hild 2008

Α. Ντακουρη-Hild, Η ‘Οικία του Κάδμου’. Η μέχρι τώρα (2000) έρευνα πάνω στην αρχιτεκτονική και την χρονολόγηση, in: Β. Αραβαντινος (ed.), Δ‘ Διεθνές Συνέδριο Βοιωτικών Μελετών, Λιβαδειά 9–12 Σεπτεμβρίου 2000, Επιτηρίς της Εταιρείας Βοιωτικών Μελετών 4,1 (Athens 2008) 203–218.

Dimopoulou 2015

Ν. Διμοπούλου, Οι τέχνες, in: Σ.Μανδαλάκις – Γ. Ρεθεμιωτάκις (eds.), Μινωικός Κόσμος. Ταξίδι στις απαρχές της Ευρώπης (Heraklion 2015) 151–197.

Faraklas 1969
N. Φαράκλας, Αρχαιότητες και μνημεία Βοιωτίας, Αρχαιολογικόν Δελτίον 23,B1/1968, 1969, 207–224.

Goldstein *et al.* 1992
J. I. Goldstein – D. E. Newbury – P. Echlin – D. C. Joy – A. D. Romig – C. E. Lyman – C. Fiori – E- Lifshin, Scanning electron Microscopy and X-ray Microanalysis. A Text for Biologists, Materials Scientists, and Geologists, 2nd edition (New York 1992).

Holland – Hay 2002
B. J. Holland – J. N. Hay, The thermal degradation of poly(vinyl acetate) measured by thermal analysis–Fourier transform infrared spectroscopy, Polymer 43, 2002, 2207–2211.

Horie 1987
C. V. Horie, Materials for Conservation. Organic Consolidants, Adhesives and Coatings (Oxford 1987).

Iakovidis 1989
Σ. Ε. Ιακωβίδης, Γλάς Ι. Η ανασκαφή 1955–1961, Βιβλιοθήκη της εν Αθήναις Αρχαιολογικής Εταιρείας 107 (Athens 1989).

Iakovidis 1998
Σ. Ε. Ιακωβιδη, Γλάς ΙΙ. Η ανασκαφή 1981–1991, Βιβλιοθήκη της εν Αθήναις Αρχαιολογικής Εταιρείας 173 (Athens 1998).

Jones – Photos-Jones 2005
R. E. Jones – E. Photos-Jones, Technical studies of Aegean Bronze Age wall painting. Methods, results and future prospects, in: L. Morgan (ed.), Aegean Wall Painting. A Tribute to Mark Cameron, British School at Athens Studies 13 (London 2005) 199–228.

Keramopoullos 1909
Α. Δ. Κεραμοπουλλος, Η οικία του Κάδμου, Αρχαιολογική Εφημερίς 48, 1909, 57–122.

Keramopoullos 1917
Α. Δ. Κεραμοπουλλος, Θηβαϊκά, Αρχαιολογικον Δελτιον 3,Α, 1917, 1–508.

Moropoulou *et al.* 2000
A. Moropoulou – A. Bakolas – K. Bisbikou, Investigation of the technology of historic mortars, Journal of Cultural Heritage 1, 2000, 45–58.

Papazoglou-Manioudaki 2006
Λ. Παπάζογλου-Μανιουδακή, Μυκηναϊκή τέχνη, in: Η. Μανιατέας – Ι. Τεγόπουλος (eds.), Ιστορία των Ελλήνων. Προϊστορικοί Χρόνοι Vol. 1 (Athens 2006) 460–501.

Perdikatsis 1997
V. Perdikatsis, Analysis of Greek Bronze Age wall painting pigments, in: S. Colinart – M. Menu (eds.), La couleur dans la peinture et l'emaillage de l'Égypte. Actes de la Table Ronde, Ravello 20–22 mars 1997, Scienze e materiali del patrimonio culturale 4 (Bari 1997) 103–108.

Perez-Rodriguez *et al.* 2014
J. L. Perez-Rodriguez – M. D. Robador – M. A. Centeno – B. Siguenza – A. Duran, Wall paintings studied using Raman spectroscopy. A comparative study between various assays of cross sections and external layers, Spectrochimica Acta Part A. Molecular and Biomolecular Spectroscopy 120, 2014, 602–609.

Reusch 1956
H. Reusch, Die zeichnerische Rekonstruktion des Frauenfrieses im böotischen Theben, Abhandlung der Deutschen Akademie der Wissenschaften. Klasse für Sprache, Literatur und Kunst Jg. 1955, Nr. 1 (Berlin 1956).

Sapouna-Sakellaraki 1994
Ε. Σαπουνά-Σακελλαράκη, Μινοική τέχνη, in: Γ. Σακελλαράκης – Χ. Ντούμας – Ε. Σαπουνά-Σακελλαράκη – Σ. Ιακωβίδης, Ελληνική Τέχνη. Η αυγή της Ελληνικής τέχνης (1994 Athens) 131–217.

Scherrer *et al.* 2009
N. C. Scherrer – S. Zumbuehl – F. Delavy – A. Fritsch – R. Kuehnen, Synthetic organic pigments of the 20th and 21st century relevant to artist's paints. Raman spectra reference collection, Spectrochimica Acta Part A. Molecular and Biomolecular Spectroscopy 73, 2009, 505–524.

Spyropoulos 1970
Θ. Γ. Σπυρόπουλος, Αρχαιότητες και μνημεία Βοιωτίας, Αρχαιολογικόν Δελτίον 24,Β1/1969, 1970, 173–187.

Spyropoulos 1972
Θ. Γ. Σπυρόπουλος, Αρχαιότητες και μνημεία Βοιωτίας – φθιωτιδος, Αρχαιολογικόν Δελτίον 25,Β1/1970, 1972, 211–245.

Spyropoulos 1971
Θ. Γ. Σπυρόπουλος, Μυκηναϊκὸς Βασιλικὸς θαλαμωτὸς τάφος ἐν Θήβαις, Αρχαιολογικά Ανάλεκτα εξ Αθηνών 4,2, 1971, 161–164.

Spyropoulos 1977a
Θ. Γ. Σπυρόπουλος, Αρχαιότητες και μνημεία Βοιωτίας – φθιώτιδος, Αρχαιολογικόν Δελτίον 27,Β2/1972, 1977, 307–319.

Spyropoulos 1977b
Θ. Γ. Σπυρόπουλος, Αρχαιότητες και μνημεία Βοιωτίας – φθιώτιδος, Αρχαιολογικόν Δελτίον 28,Β1/1973, 1977, 247–273.

Spyropoulos 1974
Θ. Γ. Σπυρόπουλος, Τὸ ἀνάκτορον τοῦ Μινύου εἰς τὸν Βοιωτικὸν Ὀρχομενὸν, Αρχαιολογικά Ανάλεκτα εξ Αθηνών 7,3, 1974, 313–325.

Spyropoulos 2015
Th. Spyropoulos, Wall painting from the Mycenaean palace of Boiotian Orchomenos, in: Brecoulaki *et al.* 2015, 354–368.

S. Symeonoglou 1968
Σ. Συμεώνογλου, Αρχαιότητες και μνημεία Βοιωτίας. ΙΙ. Ανασκαφαί. 1. Θήβαι, Αρχαιολογικόν Δελτίον 21,Β1/1966, 1968, 177–194

Televantou 2007
Χ. Τελεβάντου, Τοιχογραφίες. Μια μνημειώδης Τέχνη, in: Χ. Ντούμας – Μ. Μαρθαρή – Χ. Τελεβάντου (eds.), Μουσείο Προϊστορικής Θήρας. Συνοπτικός οδηγός (Athens 2007) 36–40.

Treuil *et al.* 1996
R. Treuil – P. Darcque – J. Poursat – G. Touchais, Οι πολιτισμοί του Αιγαίου. Κατά τη νεολιθική και την εποχή του χαλκού (Athens 1996).

Vasilikou 1995
Ντ. Βασιλικού, Ο Μυκηναϊκός Πολιτισμός, Βιβλιοθήκη της εν Αθήναις Αρχαιολογικής Εταιρείας 152 (Athens 1995).

Vlachopoulos – Sotiropoulou 2013
A. Vlachopoulos – S. Sotiropoulou, The blue colour on the Akrotiri wall-paintings. From the palette of the Theran painter to the laboratory analysis, Talanta. Proceedings of the Dutch Archaeological and Historical Society 44/2012, 2013, 245–272.

Wardle – Wardle 2012
Κ. Α. Γουαρντλ – Ντ. Γουαρντλ, *Πόλεις του Μύθου. Μυκηναϊκός κόσμος* (Athens 2012).

TRACING TECHNOSCAPES

Colourful surface treatments form an integral element of vernacular and élite architecture of ancient societies. This is also true for the various regions of the Eastern Mediterranean in the 2nd millennium BCE, where elaborate wall paintings furnished temples, tombs, palatial buildings, and in general more elaborate houses. From a present-day perspective, these rich images provide invaluable insights into past realities as well as interconnections between different visual systems. However, beyond stunning images, the materiality of wall paintings implicates a whole range of specific technical choices and gestures executed during the artistic process. The bodies of knowledge immanent in the practice of plaster and pigment preparation, in the application of paint and in the conception and execution of compositions allow us to compare the wall painting corpora of the Eastern Mediterranean on a technical level and to trace differences and similarities in a cross-cultural perspective.

Evolved from an interdisciplinary workshop held at the 10th ICAANE in Vienna, this volume provides insights into the various technical approaches and underlying bodies of knowledge in the different wall painting traditions of the Eastern Mediterranean and West Asia and throws light on the way and extent of their possible interwovenness. Moreover, it seeks to overcome regional as well as disciplinary isolation of technical studies by bringing together authors of different scientific backgrounds ranging between Conservational Studies, Archaeometry, Prehistory, Egyptology, as well as Western Asiatic and Classical Archaeology. In doing so, the book permits an interdisciplinary perspective on this field of study.

This book is equally intended for archaeologists, art historians, conservators and the interested layperson and hopes to stimulate more research in this direction in future.

Sidestone Press

ISBN: 978-90-8890-687-9

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