UNIVERSITÀ DI NAPOLI L'ORIENTALE
Dipartimento Asia, Africa e Mediterraneo

Studi Africanistici
Serie Egittologica 6

# Ancient Egypt
# New Technology

*Edited by*
Stefania Mainieri & Rosanna Pirelli

UniorPress

On the cover: digital reproduction of the south wall
of the King's Chamber in the temple of Ramesses III at Medinet Habu, Luxor.
Image from the article in this volume, *The King's Chamber: A Digital Publication Prototype*,
by A. Singer, O. Murray, and A. Pantos.
Photos: Epigraphic Survey Photo Archive;
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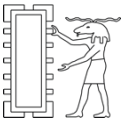

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# Preface

In recent years, the world of Egyptology has opened its doors to new technologies, giving rise to fruitful collaborations between specialists in the humanities and digital technologies and propelling the Ancient World into the future. Laser scanning, photogrammetry and 3D modelling allow archaeologists to document the entire excavation process and reconstruct contexts even after they have been physically removed, reproduce small objects with sub-millimetre precision and reassemble ancient papyri or fragments of statues scattered across different museums. At the same time, non-invasive imaging diagnostics, X-rays and CT scans enable us to peek inside a sealed vase, analyse the chemical composition of ancient pigments and virtually unwrap mummies. These are just a few of the advantages that new technologies offer in helping humanists to reconstruct history, preserve the past and disseminate it beyond the confines of museums, universities and research centres. Looking towards these new research horizons, the Conference *Ancient Egypt - New Technology* aims to enable the growing community of Humanists and Digital Technologists to meet, discuss and update each other on projects related to Egyptology.

Conceived in the United States from an idea by Rita Lucarelli (University of California, Berkeley), Joshua Roberson (University of Memphis) and Stephen Vinson (Indiana University, Bloomington), the conference was inaugurated in Bloomington in 2019 (29-31 March 2019), with the hope of being the first in a continuing series of international conferences on this globally 'hot topic'. That same year, the University of Naples 'L'Orientale' carried forward the initiative of its American colleagues by hosting the second edition in Italy, encouraged by Stefania Mainieri's participation in the inaugural conference in the United States. Her involvement, driven by a project on ancient Egyptian coffins and photogrammetry (which culminated in the award of a Marie Skłodowska-Curie Global Fellowship - Faces Revealed Project: 895130), served as a link between the institutions.

Interest in the intersection between humanities and digital technologies has deep roots at the University of Naples. The Department of Asia, Africa and the Mediterranean (DAAM), which houses Oriental Studies and Egyptology, is also home to the CISA (Interdepartmental Centre for Archaeological Services) research centre. Since 1992, CISA has provided support to archaeological activities and developed specific expertise in the field of IT methodologies and 3D surveying, growing in line with broader global developments in digital innovation. Furthermore, the importance of CISA and the continuing interest in the subject have recently led to the creation of an inter-university and interdepartmental initiative: the Digital Humanities and Technologies programme (LMDH). The programme, developed in collaboration with the Department of Science and Technology at the University of Naples Parthenope, integrates rigorous humanities training with cutting-edge computational methods, with the aim of cultivating a diverse set of interdisciplinary skills in line with ongoing social transformations. In these transformations, digital processes are increasingly shaping not only the economic and entrepreneurial landscape, but also the cultural and academic spheres. In this regard, therefore, DAAM UniOr is the ideal venue for this type of international event.

The event in Naples (5-7 July 2023) was attended by 35 speakers from various parts of the world, including scholars, researchers and specialists in Egyptology, as well as in

many other fields of research and disciplines related to Egyptology. The event proved to be a fruitful opportunity to present ongoing projects and establish contacts between physical and cultural anthropologists, conservators, archaeologists, cultural and digital heritage scientists, and museum curators, with a view to future collaborations. The event also provided an important educational opportunity, as demonstrated by the extensive involvement of students in the conference.

This volume, edited by Stefania Mainieri and Rosanna Pirelli, brings together a selection of the contributions presented during the three-day conference and offers a concise overview of the digital initiatives and innovative methodologies employed nowadays in the field of Egyptology. Alongside these the scientific committee also decided to include imaging techniques for restoration and anthropology, as well as forensic and radiological sciences. Whilst tools such as non-invasive diagnostic imaging, X-rays and CT scans are now well established and not 'new', they offer exemplars of the concept of fundamental and instrumental technologies in specific areas of research.

*Stefania Mainieri & Rosanna Pirelli*

## Acknowledgements

The editors would like to express their sincere gratitude to Prof. Roberto Tottoli, Dean of the University of Naples 'L'Orientale' (UniOr), and Prof. Andrea Manzo, Director of the Department of Asian, African and Mediterranean Studies (DAAM), for their support in hosting the second edition of the International Conference *Ancient Egypt – New Technology* at our Department. We would also like to express our gratitude to Professors Roberta Giunta, President of the Interdepartmental Services Centre for Archaeology (CISA), Michele Bernardini, Coordinator of the PhD Programme in Asian, African and Mediterranean Studies, and Matteo D'Acunto, Coordinator of the Centre for the Study of Interactions and Exchanges in the Ancient and Medieval Worlds (CEISMA), for their institutional involvement.

We would also like to thank Prof. Giancarlo Lacerenza and Dr. Mariano Cinque, Scientific and Technical Directors of UniOr Press, the official academic press of the University of Naples 'L'Orientale' for their support in bringing this publication to fruition. One of the editors' primary objectives was to publish within our University and to ensure that the volume be freely available, so, we are deeply grateful for their support to include the volume in the *Serie Egittologica*, a high-quality, peer-reviewed Egyptological series of DAAM-UniOr available in both traditional print and digital formats via the Open Journal System (OJS) and accessible on the SHARE Riviste portal.

Special thanks to the conference Scientific Committee and keynote speakers, whose contributions greatly enriched the conference: Prof. Andrea D'Andrea (DAAM, UniOr), Dr. Enrico Ferraris (Museo Egizio, Turin), Prof. Bernard Frischer (Indiana University, Bloomington), Prof. Gabriele Guidi (Indiana University, Bloomington), Dr. Stefania Mainieri (Museo Egizio, Turin/ University of California, Los Angeles), Prof. Patrizia Piacentini (University of Milan), Prof. Corinna Rossi (Politecnico di Milano) and Prof. Stephen Vinson (Indiana University, Bloomington). Moreover, we would like to express our deepest appreciation to the anonymous peer reviewers and the Scientific Committee of the *Serie Egittologica*, for their valuable insights and constructive feedback on a wide range of topics, all of which are united by the common theme of integrating new and emerging technologies into Egyptological research. We would also like to thank all the authors and contributors for their exceptional patience, collegiality and scholarly dedication throughout the editorial process.

Lastly, we would like to thank the Director of the National Archaeological Museum of Naples (MANN), Dr. Paolo Giulierini, the Directors of the Archaeological Parks of Pompeii (Dr. Gabriel Zuchtriegel) and Herculaneum (Dr. Francesco Sirano) for generously offering access to our international guests during the conference; our M.A. and B.A. students (DAAM, UniOr) Gaia Longobardi and Tiziana Castaldi; the entire Organising Committee (Dr. Maria Diletta Pubblico, DAAM UniOr; Dr. Ilaria Incordino, White-Levy Programme for Archaeological Publications, Cambridge, MA; Dr. Carlo Rindi Nuzzolo ISPC - National Research Council of Italy- and Dr. Anna Clelia Salsano, Independent Researcher) for their tireless efforts and consistent support before and during the conference, as well as the numerous speakers, students and participants whose presence and engagement ensured the success of the second edition of the International Conference *Ancient Egypt – New Technology*.

*Stefania Mainieri & Rosanna Pirelli*

# List of Abbreviations

| | |
|---|---|
| ***ACalc*** | *ArchCalc. Archeologia e Calcolatori* |
| ***Acta IMEKO*** | *Journal of International Measurement Confederation* |
| **ADS** | Archaeology Data Service |
| ***Aegyptiaca*** | *Aegyptiaca. Journal of the History of Reception of Ancient Egypt* |
| ***AeUL*** | *Ägypten und Levante. Internationale Zeitschrift für ägyptische Archäologie und deren Nachbargebiete* |
| ***AIOO*** | *Annali Sezione Orientale* |
| ***Am. J. Phys. Anthropol.*** | *American Journal of Physical Anthropology* |
| **ANEM** | Ancient Near East Monographs |
| **ANVUR** | Agenzia Nazionale di Valutazione del Sistema Universitario e della Ricerca |
| **ARKs** | Archival Resource Keys |
| **ASCBo** | Archivio Strico Comune di Bologna |
| ***ASOR*** | *American Society of Overseas Research* |
| **AWMC** | Ancient World Mapping Center |
| **BÄBA** | Beitrage zur Ägyptischen Bauforschung und Altertumskunde |
| ***BCH*** | *Bulletin de Correspondance Hellénique* |
| ***BHA*** | *Bulletin of the History of Archaeology* |
| ***BHR*** | *Belgrade Historical Review* |
| ***BJR\|Case Reports*** | *The British Journal of Radiology Case Reports* |
| ***BMSAES*** | *British Museum Studies in Ancient Egypt and Sudan* |
| ***BSAA*** | *Bulletin Société Archéologique d'Alexandrie - Revue Archéologique* |
| ***CADMO*** | *Revista de História Antiga- Journal for Ancient History* |
| ***CCE*** | *Cahiers de la Céramique Égyptienne* |
| ***CdÉ*** | *Chronique d'Égypte* |
| **CHI** | Cultural Heritage Imaging |
| **CIDOC** | Conceptual Reference Model |
| **CIPEG** | ICOM International Committee for Egyptology |
| **CHANE** | Culture and History of the Ancient Near East |
| ***EDAL*** | *Egyptological Documents, Archives, Libraries* |
| ***ENiM*** | *Égypte Nilotique et Méditerranéenne* |
| **Getty AAT** | Art & Architecture Thesaurus |
| **GHPE** | Golden House Publications Egyptology |
| ***GM*** | *Göttinger Miszellen* |
| **HÄB** | Hildesheimer Ägyptologische Beiträge |
| **HES** | Harvard Egyptological Studies |
| ***Hieroglyphs*** | *Hieroglyphs. Studies in Ancient hieroglyphic writing* |

| | |
|---|---|
| **HSO** | Hieratic Studies Online |
| **IBAES** | Internet-Beiträge zur Ägyptologie und Sudanarchäologie |
| **ICOM** | International Council of Museums |
| **IIF** | International Image Interoperability Framework |
| ***ImagAeg*** | *Imago Aegypti. Intern. Magazin für ägyptol. und koptol. Kunstforschung, Bildtheorie und Kulturwissenschaft* |
| **IMEKO** | International Measurement Confederation |
| ***IJNA*** | *International Journal of Nautical Archaeology* |
| ***J. Archaeol. Sci.*** | *Journal of Archaeological Science* |
| ***J. Med. Microbiol.*** | *Journal of Medical Microbiology* |
| ***J. Raman Spectrosc.*** | *Journal of Raman Spectroscopy* |
| ***JAES*** | *Journal of African Earth Sciences* |
| ***JAS*** | *Journal of Archaeological Sciences* |
| ***JCH*** | *Journal of Cultural Heritage* |
| ***JCS*** | *Journal of Cuneiform Studies* |
| ***JEA*** | *Journal of Egyptian Archaeology* |
| ***JFA*** | *Journal of Field Archaeology* |
| ***JFS*** | *Journal of Forensic Sciences* |
| ***JGS*** | *Journal of the Geological Society* |
| ***JLM*** | *Journal of Language Modelling* |
| ***JMB*** | *Journal of Molecular Biology* |
| ***JMLR*** | *Journal of Machine Learning Research* |
| ***LÄ*** | *Lexikon der Ägyptologie,* |
| ***LANX*** | *Rivista della Scuola di Specializzazione in Archeologia -Università degli Studi di Milano.* |
| ***LingAeg*** | *Lingua Aegyptia* |
| **LingAeg – StudMon** | Lingua Aegyptia–Studia Monographica |
| **LNCS** | Lecture Notes in Computer Science |
| **MÄS** | Münchner Ägyptologische Studien |
| ***Maarav*** | *Maarav. A Journal for the Study of the Northwest Semitic Languages and Literatures* |
| ***MDAIK*** | *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* |
| **MOA** | Monografías de Oriente Antiguo |
| ***MTA*** | *Multimedia Tools and Applications* |
| **NeHeT** | *Revue Numérique d'Égyptologie* |
| **OIP** | Oriental Institute Publications |
| **OLA** | Orientalia Lovaniensia Analecta |
| **ORACC** | The Open Richly Annotated Cuneiform Corpus |

| | |
|---|---|
| ***ORE*** | *Open Research Europe* |
| ***PeAPA*** | *Publicación Electrónica de la Asociación Paleontológica Argentina* |
| **PdÄ** | Probleme der Ägyptologie |
| ***PES*** | *Prague Egyptological Studies,* |
| **Ponda** | Predynastic online database |
| ***RdÉ*** | *Revue d'Égyptologie* |
| ***RevEthnSoc*** | *Revue d'ethnographie et de sociologie* |
| ***RiME*** | *Rivista del Museo Egizio* |
| ***RISE*** | *Ricerche Italiane e Scavi in Egitto* |
| ***SAK*** | *Studien zur Altägyptischen Kultur* |
| ***SAK***B | Studien zur Altägyptischen Kultur Beihefte |
| ***ScAnt*** | *Scienze dell'Antichità* |
| ***Sci Rep*** | *Scientific Reports* |
| ***SEAP*** | *Studi di Egittologia e Antichità Puniche* |
| ***SEP*** | *Studi di Egittologia e di Papirologia* |
| **tDAR** | The Digital Archaeological Record |
| ***TLA*** | *Thesaurus Linguae Aegyptiae* |
| **VIAF** | Virtual International Authority File |
| **W3C** | World Wide Web Consortium |

# Discovering the concealed.
# Photogrammetry as a 'key tool' for studying ancient Egyptian objects

Stefania Mainieri

Abstract

In the last few years, digital technologies and 3D models have been brought into frequent use within the fields of Archaeology and Egyptology, as well as in Museography. At first, digital models were used as tools for designing, documenting and monitoring objects or for valorisation and dissemination tasks; now their role in scientific research is emerging. The possibility of creating high-resolution and sub-millimetric reproductions of objects and the opportunity to then measure them, detect surfaces and easily compare forms, volumes and geometry allow us to add more elements to the 'traditional' study of the objects and analyse 'undervalued' peculiarities and/or concealed elements, such as the geometry of objects.

This paper will demonstrate that digital technologies and photogrammetric 3D models are 'key tools' for studying ancient Egyptian artefacts. Starting from the main results on yellow coffins within the *Faces Revealed Project*, we go on to explain how these results will inform future perspectives of research where digital technologies and 'human-machine' interactions can be fundamental to reconstructing the history of ancient societies.

Keywords: *Photogrammetry; 'Hidden' features; Production; Egyptian Coffins; Material culture.*

## 1. Introduction

In 2019, the inaugural edition of the International Conference 'Ancient Egypt - New Technologies' in Bloomington provided an invaluable opportunity to present the inception of a project on ancient Egyptian yellow coffins from the Third Intermediate Period (11th-10th century BCE), that was subsequently awarded funding in 2020.[1]

The contribution emphasised the efficacy of photogrammetry in the examination of coffins and the potential outcomes that a study founded on three-dimensional models could have yielded for this class of materials.[2] However, the applicability of the study on yellow coffins demonstrated the significant potential of photogrammetry not only for these objects, but also for the broader prospects of this application and methodology, especially for comparisons on a geometric basis to identify styles and productions.

The first main utility of photogrammetry is linked to its ability to observe the same object in colour (model with texture) and without colour (model without texture). While this capability is well known to most professionals in the field, its scope is underestimated in Egyptology, having only recently been accepted as adding value to the analysis of

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[1] Mainieri 2023a. The project, named *Faces Revealed* (2021-2024), has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No. 895130. https://facesrevealed.museoegizio.it/

[2] For the specific methodology and technical details regarding the process of photogrammetry used for the study, refer to Mainieri 2024a.

artefacts. Its importance is due to the fact that this technology is capable of making 'invisible' features 'visible', enabling elements that were disguised by decoration, previously overlooked or considered unimportant to be analysed fully. The second main utility is the ability to create a digital twin of an object, including its form and measurements with sub-millimetre accuracy. This allows more precise classifications to be made based on the canons of proportion. Making precise comparisons between different objects based on photographs is risky as different light, position, orientation, as well as lens position and framing can distort the visual evidence.[3] These limitations are overcome through rigorously standardised 3D acquisition methods that guarantee measurable visual consistency across diverse objects.[4]

**2. Make 'visible' the 'invisible': the coffins**

Yellow coffins are perhaps the best example to highlight the importance of using 3D models for the study of production and the material culture of ancient Egypt. The technical characteristics of these objects blend carpentry and pictorial decoration; the objects themselves lie between statuary and decorated surfaces.[5] The yellow coffins are in fact anthropoid, with a lid that represents the human body of the deceased in which the main features of a human body and face are crafted or modelled. Furthermore, the coffins are decorated, both the inner and outer walls being used as a base for rich textual and figurative programmes. Symbols, vignettes and texts magically embrace and envelop the deceased, helping them on their journey to the afterlife. This rich and polychrome decoration made it impossible to capture the forms and geometry in an objective way or to gain a comprehensive view of the sculpted or modelled features under the decoration.

Although the artistic or aesthetic quality of the coffins differs from one object to another, yellow coffins have a precise scheme of production and decoration techniques now reconstructed thanks to numerous international projects devoted to illuminating the technical aspects of the production during the Third Intermediate Period to give a comprehensive idea of how these objects were produced and how the pigments were applied onto the surfaces.[6] Today, for example, we know the painting procedure on coffins was based on working the entire surface with one colour at a time, starting from preparation drawings in red or black until the details in black such as pupils, eyebrows, other features of the faces and beards (Fig. 1A-B).[7]

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[3] Sourouzian 2020, XXXIV.

[4] Mainieri 2024a.

[5] For yellow coffins see e.g. Niwiński 1988; Sousa 2018; Sousa 2020; Niwiński, Rigault 2024; Sousa 2024; Vilaró-Fabregat 2024; Vilaró-Fabregat 2025.

[6] Such as the *Vatican Coffin Project* [https://www.museivaticani.va/vatican-coffin-project.html], see Amenta 2014; Amenta, Guichard 2017; Amenta, Iob 2025; and the *Fitzwilliam Museum's Ancient Egyptian Coffins Project* [https://egyptiancoffins.org/], see Dawson *et al.* 2016; Dawson 2018; Dawson, Strudwick 2019.

[7] Amenta 2024.

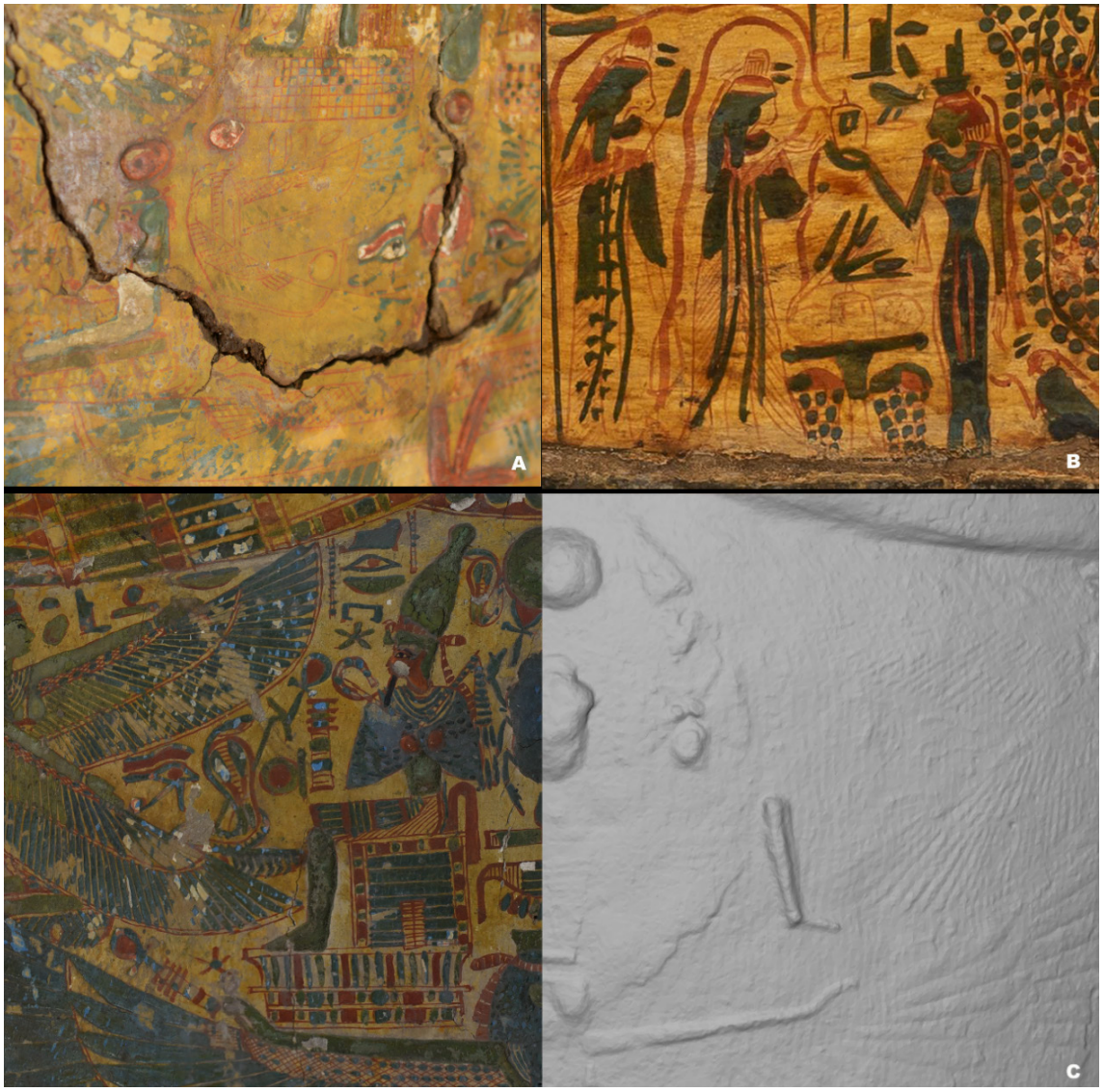


Fig. 1: (A) Detail of the lid of the coffin of Nesra, early 22nd Dynasty (MANN, IG 2348); (B) Detail of the box of the coffin of Tamutmutef, 21st Dynasty (Museo Egizio di Torino, Cat. 2228/01); (C) Detail of the mummy board of Nesypanebawib, 21st Dynasty (RMO, AH1a). 3D Models by Stefania Mainieri within *Faces Revealed Project*.

Limiting our analysis to the most external surfaces, the yellow coffins generally show smooth surfaces sometimes with the addition of a few elements made with the *pastiglia* technique to reproduce low relief.[8] This technique, added to the use of yellow colour

[8] The *pastiglia* is a low-relief decoration technique in a white paste, which can be gilded or painted, used on coffin lids for making scarabs, sun discs, and deities in a low relief. See Geldhof 2018; Amenta 2024.

for the background,[9] was part of a preference to use inexpensive materials to suggest precious ones, such as gold or even precious stones, by highlighting specific iconographic elements such as a crown, bodies of deities, sun disks (Fig. 1C). Moreover, to achieve an effect similar to gold, sometimes a yellow pigment – such as orpiment – was also added to the already yellow paint.[10]

Fig. 2: Detail of the outer (A) and inner (B) lid of Khonsu, 19th Dynasty, Deir el-Medina (TT 1), Metropolitan Museum of Art, 86.1.1a and 86.1.2a. (C) Detail of the inner box (outer right side) of Kha and (D) of the inner box (outer left side) of Merit, 18th Dynasty, Deir el-Medina (TT8), Museo Egizio, Torino, Suppl. 08429 and 08470 (for the 3D model: https://sketchfab.com/3d-models/inner-coffin-of-merit-65e7a6810a58416a86a0b3142422bce9).

However, it is interesting to note that among the set of coffins analysed in *Faces Revealed*, the coffins of Khonsu[11] display a divergent production technique observable in the model without texture. Found in the family tomb of Sennedjem in Deir el-Medina

[9] The pigments used for yellow colour were yellow ochre and orpiment, the last much more vivid, with a lamellar structure and can reflect the light, creating a gold effect. See Amenta 2024; Brunel-Duverger 2020, 42-43.
[10] On the positon of orpiment in the stratigraphy see Brunel-Duverger 2020, 177-255.
[11] Metropolitan Museum of Art, 86.1.1a-b and 86.1.2a-b. Cooney 2007; Bettum 2013, 248-255, 3a, d-g.

(TT1) and categorised as a 'proto-yellow' coffin of the 19th Dynasty (ca. 1292–1191 BCE),[12] it employs a distinct technique that seems to more closely align it to the methods used for the black coffins of the New Kingdom and the decoration of gold leaf (Fig. 2B).[13]

The delineation of the figures' forms on the outer surfaces of the Khonsu lids is not merely in red; the figures are finely incised into the wooden surface while hieroglyphic bands and iconographic motifs are modelled in a very low relief (without using the *pastiglia* technique – Fig. 2A-B).[14] The contour lines of the collar bands, the body of the goddess Nut, her plumage, and her dress are finely engraved, thereby rendering their outlines clearer. This technique is of particular interest, given its uniqueness; although it is not already a 'full' yellow coffin, it is the only 'proto-yellow'/ yellow coffin in the *Faces Revealed* dataset[15] to date that features this method of carving. The delicate engravings resemble a technique previously employed with gold leaf, where the object is chiselled or modelled in plaster and is then overlaid with gold leaf (Fig. 2C-D). The technical elegance may be attributed to the preferences of the deceased. It is noteworthy that Khonsu belonged to a sub-elite group. Despite the absence of costly materials in his coffins – such as gold leaf – they exhibit a level of craftsmanship that in many ways eclipses that of contemporary elite burials. It is as if he sought to compensate for the paucity of valuable resources by showcasing his expertise.[16] The use of yellow instead of gold leaf, in addition to the aforementioned technique, suggests the possibility of a deliberate decision on the part of the deceased to create a high-level coffin using ancient techniques, albeit with more economical materials.[17]

In addition to a different technique of production, the inner coffin shows two other important features which may be evidence of the passage between two different styles of coffin as well as the autonomy that owners and artists had in their production. The inner lid represents a perfect mix of two different styles: the 'festive dress' type coffin, which appeared after the Amarna Period,[18] and the mummiform coffin with the deceased as a *sah* image, the typical form of anthropoid coffins since the Middle Kingdom.[19] The inner coffin of Khonsu represents the deceased as a *sah* image with shroud and forearms crossed over the chest, while maintaining some features of the previous type – the 'festive dress' coffins – visible mainly in the duplex wig rather than the striped Osirian head-cloth and the short beard instead of the long and curved one.

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[12] Bruyère 1959; Mahmoud Abd el-Qader 2011; Sousa 2018, 37-42; Sousa 2019, 96-127; Gabler, Salmas 2022. Regarding the first known examples of yellow coffins, see Sartini 2024.

[13] An example is the coffin of Merit (Museo Egizio di Torino, Suppl. 08470), see Sousa 2019, 80-83. For black coffins see: Niwiński 1984; Niwiński 1988, 11-12; Dodson 1998; Taylor 2001; Sousa 2018, 28-32; Sartini 2019; Sousa 2020a.

[14] This technique is visible also on the outer surfaces of the boxes.

[15] For the dataset (ca. 100 coffins) see Mainieri 2024a, Table 1.

[16] Cooney 2007.

[17] Cooney 2007.

[18] Niwiński 1988, type Ia-b; Grajetzki 1996; Bettum 2013, 120, 126-127; Sousa 2018, 32-36.

[19] Sousa 2018, 19-43.

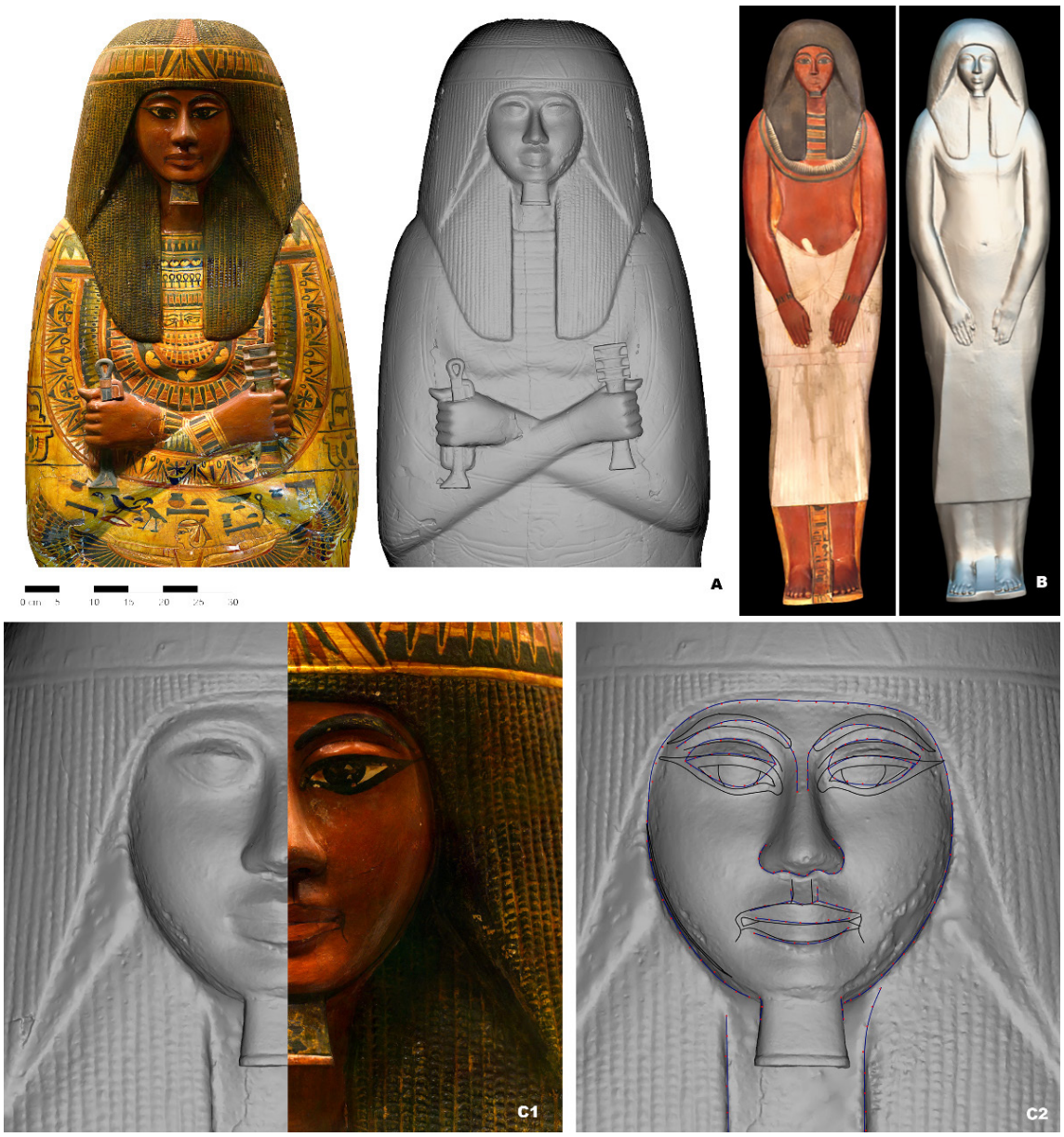


Fig. 3: (A) 3D model of the inner lid of Khonsu (by Stefania Mainieri from *Faces Revealed Project*). (B) 3D model with and without texture of the inner lid of Sennedjem, NMEC JE 27308 (by © danderson4, https://sketchfab.com/3d-models/mummy-board-of-sennedjem-egyptian-museum-cairo-f42f4c9087804759a15839fb1b625eab). (C) Detail of the face of Khonsu's inner lid with and without texture (C1) and model without texture with an overlay of the design reproducing the black-decorated features (C2).

Another very interesting feature highlighted by the model without texture is the modelling of the chest muscles under the collar (Fig. 3A). The chest was commonly represented on the male 'festive dress' type coffins, as for example, the one of Sennedjem – the father of Khonsu – testifies to (Fig. 3B). In other 'proto-yellow' coffins, however, this anatomical detail is not realised; a style seemingly disappearing as fast

as it appeared.[20] On the lid of Khonsu the mummy-like appearance as *sah* seem to includes also the image of the deceased as a living being in a kind of conciliation of both types on the same object before the appearance of 'full' yellow coffins.[21]

The presence of these features on the inner lid of Khonsu may suggests not only the autonomy in the artistic or aesthetic quality of the woodwork by single artists but also a kind of autonomy in the creation of new 'solutions' during the passage from one style to another one, creating intermediate, hybrid and 'peculiar' forms which merge old and new features on the same object.[22] Although this aspect has already been considered by researchers,[23] it is important to keep it in mind, as hybrid and 'peculiar' forms which overlap periods continue in 'full' yellow coffins, as precisely confirmed by the *Faces Revealed Project* and the use of 3D models.[24] These peculiarities on coffins have always been considered an indication of reuse.[25] However, they may rather bear witness to a change in form between two periods, resulting in a mixture of ancient and new traditions in a single coffin, as, for example, the yellow coffins set of Tanethereret testifies.[26]

The last feature we observe by deactivating the decoration is how the face and features are carved into the wood and how the decorative layer was applied to it (Fig. 3C1-2). This informs us on its production as the application of decoration can follow the sculpted/modelled traits or can partially or totally modify the original lines to correct errors, adjust asymmetries or, in occasional cases, readapt coffins for reuse.[27] On the face of the inner lid of Khonsu, for example, we note that the shape of the carved eye differs from the painted one. It is thinner and more elongated both internally and externally to reproduce the type of eye shape commonly found in Deir el-Medina. Furthermore, we note that the arched eyebrows were initially painted close to the rounded line before continuing upwards to form an arch (Fig. 3C2). However, what needs to be considered is mainly that the modelling of the masks and human parts is executed with a high level of detail, comparable to the ones of the stone statuary. Also, the shape, size, position and proportions of the facial features are consistent with the standard, canon and style of the statues of the period.[28] The face on the coffin is oval (ca. 13.8x13.9 cm) with a low forehead, high cheekbones, full cheeks and an oval chin; the eyebrows are rounded and frame two elongated but opened eyes (ca. 2.2x4.1 cm),

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[20] This conclusion is based on visual observation. However, a more systematic study of 'proto-yellow' coffins would be necessary to analyse this data, using a 3D model to facilitate observation.

[21] A sort of combination between *sah* iconography and details of everyday clothing is also attested on Katebet's coffin (British Museum, EA6665). Betrò, Miniaci 2018, specifically 179.

[22] This aspect, combined with the innovations in decoration on the box - such as the figure of the deceased and the incrementing of scenes generally represented in the tomb – evidence that the change of the style of coffins was performed within a generation and persisted thereafter, evolving into a pervasive trend associated with the socio-economic and political conditions of the era. Cooney 2007.

[23] Bettum 2013, 129; Betrò, Miniaci 2018, specifically 179.

[24] For further details on reconsideration of 'peculiar' coffin using the set of Tanethereret, refer to Mainieri 2024b; Mainieri forthcoming b.

[25] Cooney 2024.

[26] Musée du Louvre, Cat. E13027, E13034, E13035. For the coffin set see Niwiński, Rigault 2024, 250-297, Cat. 6a-e. See also Mainieri 2024b.

[27] For further details, refer to Mainieri 2024a; Mainieri forthcoming b; Cooney 2024 and relative bibliography.

[28] For canons see Robins 1994.

close to each other (ca. 2.4 cm) and located on the upper part of the face; the nose is large (ca. 5.1x3.9 cm), thin at the root and large at the base with visible nostrils; the mouth, naturalistic, has philtrum and upper arch; it is wider than the base of the nose (ca. 4.5 cm) and has full lips. The facial features carved on the coffins, therefore, although 'concealed' cannot be considered secondary elements especially if, enlarging the analysis to the entire dataset,[29] we see that the care for detail regards all the coffins, including those from the subsequent period.


Fig. 4**:** (A) Detail of the mummy board of Panebmonthu (Musée du Louvre, E13046). (B) Statue of the High Priest of Amun Ramessesnakht, reigns of Ramesses IV-IX (Egyptian Museum, CG 42163; Wikimedia CC BY-SA 2.0); (C) Statue of Horemheb and one of his wives, late 18th-early 19th Dynasty (British Museum, EA36, The Trustees of the British Museum - CC BY-NC-SA 4.0); Standard-bearing statue of (D) Pashed and (E) Penbuy, 19th Dynasty, Deir el-Medina (Museo Egizio, Torino Cat. 3047 and 3048, CC 01.0).

[29] Mainieri 2024a, Table 1.

A close link with the style of the statues of the period is evident not only in the Ramesside 'proto-yellow' coffins, but also continues in the early 21st Dynasty (Fig. 4A-E), though there is a gradual but continued modification of them due to a change of style (and/or the socio-economic level of the owner/craftsman). Moreover some coffins of the early 21st Dynasty, show facial features that recall the portraiture style of the Ramesside period (ca. 1292-1077 BCE), a physiognomy style reminiscent, therefore, of the previous statuary style with the surviving of some features over time. An example is the mummy board of Panebmonthu[30] whose face shows strong stylistic parallels with the Ramesside sculpture (Fig. 4A-E) particularly in features such as the long, straight nose; the concavity separating the nose from the sloping, low forehead; and the small, almost flat eyes positioned just beneath this depression. The face itself is square-shaped with prominent jaws and high cheekbones, while the mouth displays corner holes along with a clearly defined philtrum and upper lip arch.

**2.1 Coffins as Statues: from *Faces Revealed* to *RecoGnISe*, from Photogrammetry to A.I.**

Beyond the wealth of information on production revealed by the *Faces Revealed Project*, I would like to draw attention to this close stylistic link between the wooden faces sculpted on coffins and the ones on statuary. This link, together with the evolution of forms over time and the re-evaluation of all 'peculiar' coffins as reused,[31] represents one of the research questions of a new project named *RecoGnISe*. [32]

The study of statues and 'portraiture' has a long history, and their stylistic forms are important elements in typology and classification.[33] However, when it comes to coffins, such aspects have never been taken into consideration, or at most seen as secondary. Scattered comparisons have been made between stone coffins and statues, but only in a limited context, for example, in the identification of kings, and never between the wooden coffins or between them and the statues.

Russmann[34], Bryan[35] and Sourouzian were the first to make observations in this area, with the latter identifying the characteristics of the transition between the 18th and 19th Dynasties on the basis of the statues and stone coffins of the vizier Paramessu (later King Ramesses I, ca. 1292-1291 BCE).[36] Bryan also reviewed the relationship between statues and coffins, viewing them as the result of a recourse to "available artisans from Western Thebes to work on a broad range of monuments, perhaps crossing artistic forms as a result".[37]

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[30] Musée du Louvre, E13046. For the coffin see Niwiński, Rigault 2024, 60-87, Cat. 1a-c.; for 3D Model: https://doi.org/10.5281/zenodo.11063613 (CC-BY 4.0).

[31] Mainieri 2023b; Mainieri 2024a; Mainieri 2024b; Mainieri forthcoming a.

[32] *Reconstructing physioGnomy In Sculpture: a comparative analysis of 'yellow coffin' faces and the faces of statues* (MSCA2024_0000023 - CUP: C63C25000430001). The Project was awarded by funding in May 2025 and has been running since June 2025 at the University of Naples 'L'Orientale' (UniOr), Department of Asia, Africa and Mediterranean (DAAM).

[33] For studies on statues see for example: Bryan 1987; Sourouzian 1991; Bryan 2010; Laboury 2010; Perdu 2012; Bryan 2015; Connor 2018; Sourouzian 2020; Connor 2022; Brügger 2023.

[34] Russmann 2001, 210.

[35] Bryan 2010.

[36] Sourouzian 2020, 2, fig. 230 a-d (statues P1-2, coffins P 3-4).

[37] Bryan 2010.

Despite these considerations and sporadic studies, there is still a lack of in-depth research on these relationships, particularly with regard to the strict link and the "cross of artistic forms" between the faces on the coffins and the statues. Moreover, as contemporary studies on yellow coffins are introducing the possibility of the existence of some kind of pre-established model/ training for iconography and texts,[38] and *Faces Revealed* identified connection between faces of different coffins regarding physiognomy (Fig. 5), some questions became imperative: could this idea of pre-established models also be applied to the sculptural elements of coffins? Could there be reference models also for the sculpted parts? If so, could they be used indiscriminately for coffins and statues, as well as for sculptures in wood and stone?

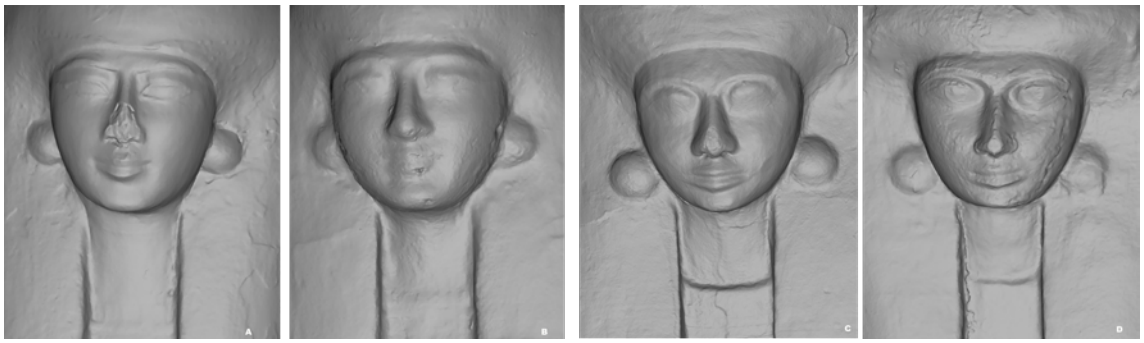

Fig. 5: Example of strict similarities between faces on different coffins which suggests the existence of some kind of model/ training: (A) the face on the mummy board of Tanethereret (Louvre, E13035) with the ones of the (B) mummy board of Henuttawy (MET, 25.3.184); (C) the face on the outer lid of Ikhy (MV, 25035.3.1) with the one on the (D) outer lid of Djedmutiuesankh (ME Firenze, 8524).

To try to answer these questions, to the coffins already analysed between 2021-2024 within *Faces Revealed,*[39] a new dataset will be added enlarging the study on coffins from the 19th Dynasty to the first half of the Late Period (ca. 1292- 525 BCE). The increase in the number of objects is crucial for statistical purposes, as an expansion of the dataset will make the outcomes of the analysis more scientifically reliable. At the same time, a group of statues from Thebes and dated to the same chronological range will be selected. The extension of the chronology is due, on the one hand, to the scarcity of evidence relating to statues dating back to the Third Intermediate Period; on the other hand, as already pointed out, the faces on the coffins of the early 21st Dynasty seems to be close to the 'portrait' style of older statues, while those of the late 21st and early 22nd Dynasties have characteristics more in line with later objects.[40] For this reason, become essential to have a larger data set, not only in numerical terms but also in chronological ones.

[38] Vilaró-Fabregat 2024, specifically § 2.2.
[39] Mainieri 2024a, Table 1.
[40] The features on *stola* coffins, for example, are completely different from previous productions. See Mainieri 2023b, Mainieri forthcoming a.

The first and second parts of the project will be devoted to the application of the *Faces Revealed* methodology on the selected materials, using the same instruments, the same software and following the same photogrammetric process.[41] An important step will be dedicated to clustering, comparing and cross-checking faces. This step will use the Compare Spreadsheet, the system developed during the previous project, which allows types to be grouped.[42] Although the Compare Spreadsheet is functional, it is quite complex and difficult to manage and 'read' for a larger amount of data, so, during *RecoGnISe* a facial recognition algorithm, capable of automatically identifying the pre-established markers and variables on 3D models, will be developed.[43] The aim is to make the grouping more easier, more precise and quick, and to cross-reference and compare the morphometric data of coffins and statues on several levels (Fig. 6).

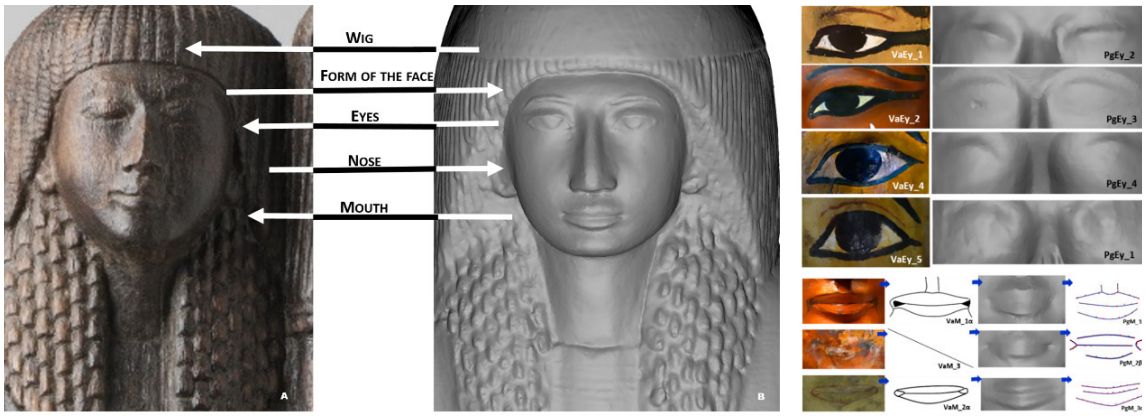


Fig. 6: Comparison of facial features between wooden standard-bearing statue of Pashed (A), Museo Egizio, Torino Cat. 3047, and the mask without texture of the mummy board of Panebmonthu (B), Musée du Louvre, E13046. On the right: types based on the morphometric approach for a vocabulary on facial features (*Faces Revealed Project* – DOI:10.5281zenodo.11002935).

An initial test of automatic landmarks recognition on bi-dimensional orthophotos was carried out in collaboration with Alessandro Mandelli[44] at the start of the *Faces Revealed Project* using the Dlib library, an open-source software library module.[45] Despite very promising preliminary results, it was concluded that to obtain more credible results the algorithm needed to be modified and trained on a large set of similar 'images'. Now, with the corpus already available and the new datasets, it will be possible to train the

[41] Mainieri 2024a.
[42] The Compare Spreadsheet is open and free and to use on the project public page: https://facesrevealed.museoegizio.it/en/section/Compare/Compare-Spreadsheet/
[43] The algorithm will be developed in collaboration with the School of Informatics, Computing, and Engineering and the Virtual World Heritage Lab at Indiana University, Bloomington (USA) in the persons of Gabriele Guidi, Professor in Informatics Virtual Heritage Track Director Studies in Digital Heritage, and Fairman Risch, a PhD student in Computer Science who will devote part of his project to this case-study.
[44] Specialist senior technician at the Politecnico di Milano (Department ABC).
[45] Mainieri *et al.* 2022; King 2009. For the software: https://github.com/davisking/dlib/blob/master/python_examples/face_landmark_detection.py. King 2009.

algorithm based on the project's needs and work directly on 3D models (point-cloud) instead of bi-dimensional images.

In this sense, the project will go beyond the state of the art not only in Egyptology but generally for Digital Technologies applied to Cultural Heritage, especially regarding the use of Artificial Intelligence (A.I.) algorithms. The second edition of the 'Ancient Egypt – New Technologies' conference in Naples attests the increasing openness of the Humanities disciplines to Digital Technologies and A.I., particularly for its advantages in simplifying and speeding up the processes of analysis and documentation (in terms of saving time in research) and in supporting the scholar in research and typological classification. Among numerous international projects based on A.I. models,[46] facial recognition methods represent a more recent, interesting and promising frontier. Experiments in this field are being carried out, for instance, by Alessia Amenta and the Vatican Museums within the *Progetto Sekhmet* for the analysis of the production of lion-headed statues,[47] and by the University of Twente and Radboud University in the Netherlands, which are developing software able to automatically identify portraits of Roman emperors through physiognomic traits.[48] Both projects have important and positive potential and demonstrate the international interest in the development of new tools based on 'human-machine' collaboration to facilitate the research by quickly processing enormous amounts of data, which is often difficult to manage with a traditional database. The ultimate aim will be to create a clearly defined evolutionary framework of facial features from the Ramesside period to the Late Period (c. 1292–525 BC) for both coffins and statues.

A comparative analysis of the characteristics of wooden masks and statues will enable an in-depth examination of the relationships between facial features, the identification of any "cross-pollination between artistic forms", and the potential identification of a shared production and/or common models used for different materials.

**2.2 Not just coffins**

The usefulness of such data for the study of the production of yellow coffins will have major implications for other classes of objects. The importance of observing finds with and without colour is also useful for inscribed or impressed objects. Cases in point are the fragmentary statue of the royal scribe Neferhotep from the now lost Imperial Iseum of Benevento and currently exhibited in the Arcos Museum of Benevento (inv. 1920), and the *cretulae* coming from the archaeological excavation in the Sun Temple of Niuserre at Abu Ghurab.

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[46] Among the interesting projects see in the present volume Gracia Zamacona *et al.* 2026, Avano *et al.* 2026 and Jauhiainen 2026. See also https://cleo.aincient.org/pages/en/; https://datascience.uchicago.edu/research/deciphering-cuneiform-with-artificial-intelligence/

[47] Amenta 2023.

[48] Ramesh *et al.* 2022.

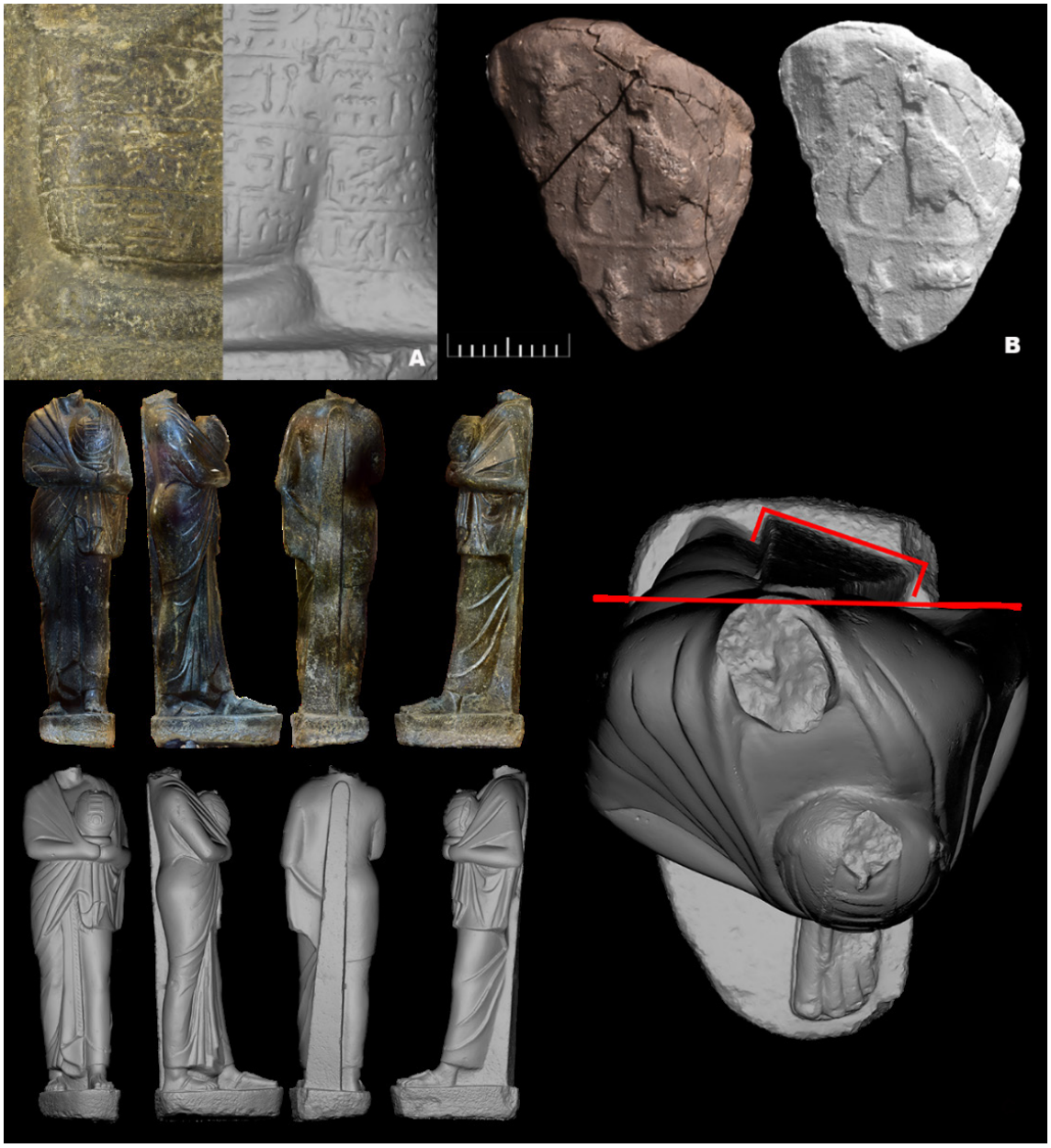


Fig. 6: (A) Orthophoto of the statue of Neferhotep, with and without texture (Arcos Museum of Benevento, inv. 1920). (B) Orthophotos with and without texture of the seal-impression of the king Shepseskara (Abu Ghurab, ST_C1094_4_21). (C) Orthophoto of the Priest carrying 'Osiris-Canopus/Hydreios' (Arcos Museum of Benevento, inv. 1926). 3D models by Stefania Mainieri.

The statue of Neferhotep is a typical block statue characteristic of the Pharaonic period, initially dated to the 22nd Dynasty.[49] However, a recent re-examination of the

[49] Müller 1971, 86; cat. 282.

artefact by Elisabeth Frood has led to a re-evaluation of its chronology, suggesting instead a connection with the 19th Dynasty statuary.[50] During the new study, the scholar faced considerable difficulties when re-reading the text that completely covers the statue. These difficulties were related to the state of conservation of the object, which was fragmentary and corroded. This was aggravated by the characteristic grey-yellow colour of the stone with which it was produced. Although the inscription had been almost entirely deciphered, the observation of the model without textures (Fig. 7A) allowed the scholar to swiftly verify the accuracy of the transcription and, where necessary, integrate signs or parts that she had been unable to decipher with the naked eye or with the aid of grazing lights and photographs.[51]

Another interesting example is that of the cretulae discovered in the solar temple of Niuserra at Abu Ghurab, objects that vary greatly in terms of size and material. During the latest archaeological mission, a photogrammetric survey of the small artefacts was carried out with the aim of creating a digital archive of all the materials from the temple for conservation and research purposes.[52] Within the material were dozens of fragments of clay *cretulae*, with associated seal impressions, bearing the names of rulers of the 5th and 6th Dynasty, such as Shepseskara (Abu Ghurab, ST_C1094_4_21, Fig. 7B).[53] The photogrammetry of these objects represented the most challenging task of the survey due to their small scale.[54] However, the photogrammetry confirmed the names and the signs impressed on the *cretulae* and, as in other cases like the Neferhotep statue, allowed a complete reading and, by digitally moving the light source, and decoding hieroglyphs which were difficult to understand due to the colour of the objects and/or the very shallow impression.[55]

Finally, the study of stone sculptures with the support of 3D models is the basis of a new research promoted by Rosanna Pirelli on statues of priests carrying 'Osiris-Canopus'. Comparing five examples – two from Benevento (Fig. 7C),[56] two similar ones found in Alexandria[57] and one from Cagliari[58] – Pirelli noticed significant stylistic differences, which led her to seek more rigorous criteria to better define their chronology

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[50] I would like to thank Elisabeth Frood for our discussion about this statue and for sharing with me the findings of her study, which is due to be published in RiMe, Frood (forthcoming).

[51] On the enhancement of the legibility of inscribed objects through digital models added to other instruments, see Abdelaziz and Elsayed 2025 (in the present volume) and related bibliography.

[52] The archaeological investigation of the site of Abu Ghurab has been carried out since 2010 by an international research team currently headed by Massimiliano Nuzzolo and Rosanna Pirelli, Universities of Turin and Naples 'L'Orientale', in cooperation with the Uninettuno University of Rome and the Polish Academy of Sciences in Warsaw. For the Sun Temple see Nuzzolo 2018 and the public page of the project https://www.suntemplesproject.org/the-sun-temples-of-niuserra/

[53] Nuzzolo 2024.

[54] For the photographic survey a full-frame Nikon D750 camera coupled with a Nikkor 105 mm lens (f/1.16; 1/6 sec., ISO-400) was used. The object was located in a light box on a rotating base equipped with circular markers and using a scale bar for references.

[55] A comprehensive work on this aspect and photogrammetry applied to objects from Abu Ghurab is in progress.

[56] Museo Arcos Benevento, inv. nos. 1922 and 1926.

[57] One statue in Greco-Roman Museum in Alexandria, inv. no. 4309 (Müller, inv. no. 20274), one in National Museum of Alexandria, inv.no. SCA 449.

[58] Museo del Tesoro di Sant'Eulalia in Cagliari, inv. no. 18004 (probably to be corrected as 18064).

and context of production.[59] From a comparative autoptic analysis of all the finds, the scholar identified a new type of canopic jar, the one held by the priest of Cagliari, which would be chronologically placed between Weber's type A and type B;[60] and noted some details relating to the presence/absence, shape and position of the back pillar, which led her to formulate new chronological hypotheses and attribute the three statues found in Italy to local production rather than Alexandrian (as previously believed).[61] Here, the photogrammetry and digital model are valuable in calculating the inclination of the back pillar on which the statues rest, the asymmetrical arrangement of the hips at the back of the figure or to better observe the presence/absence of clavicles and a tunic beneath the cloak.[62] These enable us to define in a more scientific way the differences between objects, with precisely observed mathematical data. Although the researcher identified these differences with the naked eye, there is no doubt that the observation of these statues with colour turned off, and the possibility to have accurate measurements and then compare the models provide valuable, and sometimes crucial, additional data. This raises important questions about how these objects should be interpreted, particularly concerning the contexts in which the sculptures were produced and used.

**3. Conclusions**

In conclusion, these examples demonstrate that digital technologies such as photogrammetry and 3D modelling enable researchers to investigate more deeply and explore aspects that were previously overlooked because of the limits of human observation. In this sense, these tools enhance our understanding of the material culture of ancient societies and help to reconstruct the histories of the people behind the objects. In the case of coffins and statues, for example, such technologies help to identify the style and production of artefacts, thereby bringing to 'life' the artisans who created or commissioned them across different periods.

Previously, the *Faces Revealed* project highlighted the importance of 3D models as research tools for their ability to make the invisible visible — an ability undervalued until the project's submission in 2019 — and for enabling morphometric comparisons to reveal connections among objects. Now, the *RecoGnISe* project aims to advance the field of facial feature recognition by developing free, open, and reusable software capable of automatically identifying facial landmarks on 3D models and grouping objects accordingly.

The inclusion of Artificial Intelligence in Egyptological research has the potential to enhance the reliability of results and expand the scope of datasets, thanks to its capacity to process large volumes of information. It remains essential, however, to acknowledge the primacy of human observation and validation. Technology is a means to enrich the research process, not a substitute for intellectual capacity. Human involvement remains the fundamental element at every stage — from initial training to development and application — ensuring that the collaborative interaction between humans and machines always guarantees data quality.

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[59] Pirelli 2024.
[60] Weber 1911, 32.
[61] Pirelli 2024.
[62] Pirelli 2024.

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**Online Resources**

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|---|---|
| *Faces Revealed Project* | https://facesrevealed.museoegizio.it/ |
| Compare Spreadsheet | https://facesrevealed.museoegizio.it/en/section/Compare/Compare-Spreadsheet/ |
| Dlib library | https://github.com/davisking/dlib/blob/master/python_examples/face_landmark_detection.py King 2009 |
| Cleo | https://cleo.aincient.org/pages/en/ |
| Deciphering Cuneiform with Artificial Intelligence | https://datascience.uchicago.edu/research/deciphering-cuneiform-with-artificial-intelligence/ |
| Fitzwilliam Museum's Ancient Egyptian Coffins Project | https://egyptiancoffins.org/ |
| Sun Temple Project | https://www.suntemplesproject.org/the-sun-temples-of-niuserra/ |
| The *Vatican Coffin Project* | https://www.museivaticani.va/content/museivaticani/en/collezioni/musei/museo-gregoriano-egizio/museo-gregoriano-egizio/progetti-scientifici/vatican-coffin-project.html |

# Appendix

## Programme of the International Conference *Ancient Egypt – New Technology* (2nd Edition) DAAM UniOr Naples, 5-7 July 2023

**Keynote lectures**

- *Archaeologycal data and digital society*. Andrea D'Andrea
- *TT8 Project: Decoding the materiality of the intact grave goods of Kha and Merit (Egypt, ca. 1400 BC).* Enrico Ferraris
- *Faces Revealed Project (MSCA: 895130). Discovering the concealed. Photogrammetry as a 'key tool' for studying anthropoid coffins.* Stefania Mainieri
- *A multidisciplinary and innovative approach: the case of the Aga Khan Necropolis at Aswan*. Patrizia Piacentini
- *The contribution of the immaterial realm to the study of the material culture*. Corinna Rossi
- *Digital trends in the study of Egyptology*. Stephen Vinson & Gabriele Guidi

**Wednesday 5th July 2023**

**Session 1/ Texts** (Chairman: Stephen Vinson)

- *A glossary of ancient zodiacal terms*. Christian Casey
- *OCR-PT-CT: proof-of-concept project on OCR applied to hieroglyphs from the earlier Egyptian mortuary texts*. Carlos Gracia Zamacona
- *Aligning encoded hieroglyphic and translated words with Needleman-Wunch Algorithm*. Heidi Jauhiainen

**Session 2/ 3D modelling** (Chairman: Gabriele Guidi)

- *Digital and cultural study of terracotta figurines in Egyptian Collections. The Project SUR. VI.V.E. – Phases 1-2*. Clementina Caputo, Alessandro Mandelli
- *Underwater archaeology in Alexandria-Egypt: New methods for documentation through the use of three-dimensional technology*. Mohammed Abdelaziz, Mohamed Elsayed
- *Imag(in)ing Egyptology: the Bologna Coffin Project*. Andrea Pasqui, Daniela Picchi

**Session 3 / Fieldwork** (Chairman: Corinna Rossi)

- *The Abu Ghurab landscape: from total Station to GIS and GPR*. Marco Anzalone, Emanuele Brienza
- *Database and burial containers from the Old Kingdom and First Intermediate Period*. Marie Peterková Hlouchová, Věra Nováková
- *Reconstructing ancient monuments: from excavations to BIM. The study case of the Sun Temple of Niuserra at Abu Ghurab*. Patrizia Zanfagna, Massimiliano Nuzzolo

**Thursday 6th July 2023**

**Session 1/ Chemical and Imaging Techniques** (Chairman: Patrizia Piacentini & Maria Diletta Pubblico)

- *A Ptolemaic mummy from Akhmim: the first case of fatal mastoiditis and the ancient physician's treatment.* Dina Faltings, Roman Sokiranski
- *Chemical investigation on organic and inorganic materials present on the five cat mummies of the Società Africana d'Italia*. Maria Diletta Pubblico, Leila Birolo, Alessandro Vergara
- *From macro to micro: pottery production in Predynastic Heliopolis*. Federica Ugliano, Silvia Amicone, Jade Bajeot, Vanessa Forte, Giulio Lucarini
- *An Egyptian mummy of the Roman Period with a painted shroud: a multy-analytical study of its technical features*. Daniela Picchi, Paola Buscaglia, Anna Piccirillo, Roberta Genta, Federica Pozzi, Michela Cardinali, Marco Samadelli, Alice Paladin, Claudia Caliri, Francesco Paolo Romano, Claudia Conti, Costanza Miliani
- *Analysis and comparison of two Middle Kingdom wooden statuettes from the tomb of Minhotep, Asyut*. Nicole Manfredda, Luisa Vigorelli , Paola Buscaglia, Paolo Del Vesco, Tiziana Cavaleri, Marco Nervo, Sabrina Grassini, Laura Guidorzi, Alessandro Re, Alessandro Lo Giudice.

**Session 2/ Artificial Intelligence & Virtual Reality** (Chairman: Andrea D'Andrea)

- *Artificial Intelligence for Egyptology*. Heleen Wilbrink
- *A digital archive for religious texts from the Nile Valley and beyond*. Federico Maria Avano, Angela Bosco, Andrea D'Andrea, Gilda Ferrandino, Zied Mnasri
- *"Sekhmet Project". Research and development of innovative investigative methods*. Alessia Amenta
- *Integrating virtual heritage projects in educational curriculum: the case of Reviving Karanis in 3D*. Eiman Elgewely
- *Virtual reality as "Virtual Traveling": re-imaging the sarcophagi of Psametek and Padinese in their 26th Dynasty tombs in Saqqara*. Elaine Sullivan, Rita Lucarelli, Matthias Lang, Eiman Elgewely

**Friday 7th July 2023**

**Session 1/Museum and Public Engagement** (Chairman: Enrico Ferraris)

- *Predynastic lithic production at Heliopolis, Egypt: new light on a forgotten Museum Collection*. Adelaide Marsilio, Francesca Manclossi, Donatella Barca, Mohamed Hamdan, Federica Ugliano, Giulio Lucarini
- *An Online-Only publishing experience: the Rivista del Museo Egizio*. Federico Poole
- *The Palermo Stone and its associated fragments. New technological approaches to old data*. Massimiliano Nuzzolo, Celestino Grifa, Vincenzo Morra, Salvatore Schiavone, Maria Francesca Alberghina, Chiara Germinario, Mohamed Osman
- *Digital heritage and community-engaged research.* Willeke Wendrich

**Session 2/ 3D modelling** (Chairman: Stefania Mainieri)

- *The role of laser scanning and photogrammetry in investigating geographical provenience and regional craftsmanship: graeco-roman cartonnage from the Egyptian Western Desert*. Carlo Rindi Nuzzolo
- *3D visualization of fourth-century Christian monuments and archaeological sites of Egypt.* Victor Ghica, Mohamed Abdelaziz
- *Breathing new life into ancient fragments: 3D models and automated reconstructions of private statuary from Qau el-Kebir*. Tommaso Montonati, Federico Taverni

**Session 3/ Documentation & Digital Publications** (Chairman: Stefania Mainieri)

- *The King's Chamber: a digital publication prototype.* Ariel Singer, Murray Owen, Pantos Alexis
- *Insights of the Egyptian artists: documenting Theban funerary painting in situ. A new approach*. Vivas Sainz Immaculada, Gema Menendez
- *Documenting stone structures in the west bank of Aswan (Egypt): from mobile 3D recording to GIS spatial analyses*. Facciani Sara, Alessia Brucato, Alberto Urcia, Antonio Curci, Maria Carmela Gatto

**Poster Session**

- *Anthropological and radiological results from the Aswan Necropolis near the Aga Khan III Mausoleum: the Eimawa experience*. Carmelo Messina, Patrizia Piacentini, Alice Tomaino, lucie Biehler-Gomez.
- *Bringing colour back to the page: publishing polychrome palaeographies of Egyptian Manuscripts*. Marina Sartori
- *The Nag El- Hamdulab interactive hyperbook: a new way of comunicating egyptologycal research*. Alberto Urcia, Alessia Brucato, Antonio Curci & Maria C. Gatto.


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