

# Photogrammetry and Face Carvings: Exploring the ‘Face’ of the Egyptian Anthropoid Coffins by 3D Modeling

*Stefania Mainieri*

## Abstract

This paper aims to illustrate the initial results of a new methodological approach to the study of anthropoid coffins. We analyze the coffins using a new methodological approach that will support and complement traditional analytical methods used for these finds. The project is based on the analysis of “facial features” carved on the lid and the so-called “minor attributes.” 3D modeling provides us with an excellent record of surface morphology.

## Keywords

photogrammetry – coffins – sarcophagi – mummy – facial analysis – portraits

## 1 Introduction

This paper will explain a new methodological approach for studying Ancient Egyptian coffins. The new methodology is based on analyses of the facial features of the coffin lid masks and other elements using 3D models created by photogrammetry: an extremely versatile, simple and economical technique that records accurate textures based on photographic shots.<sup>1</sup>

Starting with decontextualized Late Period coffins—on the occasion of a collaboration with the Vatican Coffin Project (VCP)<sup>2</sup>—a pilot project on a new

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1 Fiorini 2012, 213–227; Remondino and Campana 2014; Russo, Remondino and Guidi 2011, 169–198.

2 Amenta 2014, 483–499; Amenta and Guichard 2017; Weiss 2018. The *Vatican Coffin Project* (VCP) is an International Team Project, set up by the Egyptian Department of the Musei Vaticani, directed by Alessia Amenta, in collaboration with the Diagnostic Laboratory for

class of artifacts was started in October 2018: the so-called “yellow coffins.” The conference in Bloomington on “Ancient Egypt and New Technology” was the occasion for the presentation of this use of photogrammetry and an explanation of interesting aspects revealed and preliminary considerations born within the *VCP*, to be analyzed in depth from February 2021. In the months following the conference, in fact, a well-defined, specific and exact methodology was established, and the project has been awarded a Marie Skłodowska-Curie (IF) Global Fellowship (within the H2020 program), with the title “Faces Revealed Project. Investigating the faces of “yellow coffins” through photogrammetry. A comparison of 3D models and digital twins for a new analysis of the manufacture, painting techniques and re-use” (H2020-MSCA-GF 2019: 895130).<sup>3</sup>

## 2 Starting Point: The Late Period Coffins

This methodology was conceived during the researcher’s Ph.D. studies at the University of Naples “L’Orientale,” (UniOr), while studying two bivalve coffins

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Conservation and Restoration of the Musei Vaticani, directed by Ulderico Santamaria, to study the ‘yellow coffins’ of the Third Intermediate Period. Other partners are: Rijksmuseum van Oudheden in Leiden, Musée du Louvre in Paris, Museo Egizio di Torino, Centre de Recherche et de Restauration des Musées de France (C2RMF) in Paris, Centro Conservazione e Restauro La Venaria Reale in Turin and Xylodata in Paris. Kathlyn M. Cooney (UCLA University, Los Angeles) is collaborating in the project for the study of the reuse of coffins of the 21st Dynasty.

- 3 This prestigious achievement will allow the researcher to lead—as Principal Investigator—the Project, through a two-year research/training path at the University of California Los Angeles, USA (Host) with a reintegration time at the Egyptian Museum of Turin (Beneficiary) during the third year. The project will be coordinated by Christian Greco, Director of the Museo Egizio di Torino, and Kathlyn Cooney, Professor of Egyptology at UCLA. Corinna Rossi, Professor of Egyptology, will host the researcher for a secondment at the Politecnico di Milano University. This research has been made possible thanks to the suggestion, support and collaboration of several scholars. I would like to thank Alessia Amenta (Curator, Ancient Egypt and Near Eastern Antiquities Dept., Musei Vaticani, Città del Vaticano), Angela Bosco (CISA—University of Naples “L’Orientale”, Italy), Kathlyn M. Cooney (Professor of Egyptian Art and Architecture and Chair of the Department of Near Eastern Languages and Cultures at UCLA, California), Andrea D’Andrea (CISA—University of Naples “L’Orientale”, Italy), Christian Greco (Director of the Museo Egizio, Turin, Italy), Hélène Guichard (Curator, Ancient Egypt Antiquities Musée du Louvre, Paris), Rita Lucarelli (Associate Professor of Egyptology, UC Berkeley) Rosanna Pirelli (Professor of Egyptology, University of Naples “L’Orientale”, Italy), Rosario Valentini (CISA—University of Naples “L’Orientale”, Italy), and Lara Weiss (Curator, Ancient Egypt Antiquities, Rijksmuseum van Oudheden, Leiden).

in the Archeological Museum of Naples (MANN),<sup>4</sup> sold by Camillo Borgia in 1814 and repainted during the 19th century.<sup>5</sup> The chronology of coffins is usually based above all on the figurative apparatus and the paleography. Therefore, the current condition of both lids did not allow us to understand and reconstruct their cultural and chronological context. For this reason, a different kind of analysis was used. At first, the structure and morphology were considered, and then other specific details were investigated, above all the face. Features such as eyes, nose and eyebrows are important elements for the typology and classification of statues,<sup>6</sup> but had never been taken into consideration for coffins, perhaps because they are secondary elements—the so called “minor attributes”<sup>7</sup>—and because it is difficult to clearly discern them under the superimposed pictorial decoration. The presence of pictorial layers, in fact, makes the correct and objective perception of the sculpture of the face—the only carved element in anthropoid coffins with hands—less clear. However, I found photogrammetry, created in 2015 in collaboration with Centro Interdipartimentale Servizi per l’Archeologia (CISA) at the UniOr for documenting the condition of the coffins in the MANN before the restoration, to be of great help for this type of analysis. Along with its value in designing, documenting and monitoring the objects, 3D models could also be useful for research and study because they give us an excellent record of surface morphology. The monochrome solid model, curvature shading and shadows—important for conveying shape—all allow us to discover the modeling of the face under the pictorial layer and can reveal fine surface details that are not always discernible in color (fig. 11.1).

This possibility of “reading” the object and analyzing in greater detail the sculpted “face” on the lids was fundamental for my research. In the case of one of the repainted Borgia coffins (the coffin of Tchahapyemiu, inv. gen. nos. 2340, 2345), for example, photogrammetric analysis made clear all the “invisible” sculpted physiognomic traits: eyes, eyebrows, the line of the nose and mouth. All these traits, especially the eyebrows, represent features commonly observed in stone specimens, dated precisely to the 25th/26th Dynasty (Perdu 2012). This chronology was later confirmed by the reconstruction of the original texts and

4 Anonymous coffin, inv. gen. nos. 2342, 2346, and coffin of Tchahapyimu, inv. gen. nos. 2340, 2345.

5 Mainieri 2016, I, 338–347, cat. nos. 15.3–4, 423–469; AA.VV. 2016, 120–121, n. 7; Mainieri 2019, 63–71.

6 Bryan, 1987, 3–20; id. 2010, 913–943; id. 2015, 375–396; Laboury 2010, 1–18; Perdu 2012; Sorou-zian 1999, 55–74.

7 Taylor 2003, 102.



FIGURE 11.1 Comparison of the model textured (above) and model solid (below) of the coffins at the MANN. From the right: anonymous inner coffin lid, inv. no. 2346 (Saqqara (?), 24th–30th Dyn.); inner coffin lid of Tchahapyemiu, inv. no. 2345, (Menfi (?), 25th–26th Dyn.); Coffin of Ankhapy, inv. no. 114.113 (Akhmim, early Ptolemaic Period)

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decoration, thanks to the accurate descriptions and the “photographic” copy of the hieroglyphs made by Zoëga in 1789 (NKS 357b fol. III, I), which allowed me to combine the morphological data with the paleographic and stylistic ones, thus corroborating the proposed chronological identification and linking the coffin to a specific typology from the north.<sup>8</sup>

### 3 The Pilot Project: “Yellow Coffins” and 3D Models—First Results

The collaboration with the *Vatican Coffin Project* at the end of 2018 led to the shifting of the project to a new class of artifacts: the “yellow coffins” appearing in Thebes at the end of the New Kingdom and used for more than a millennium,

<sup>8</sup> Mainieri *in press*.

peaking during the 21st Dynasty (ca. 1069–945 BCE).<sup>9</sup> These coffins are characterized by a marked sense of *horror vacui*. In the Third Intermediate Period (ca. 1069–664 BCE), the pictorial and textual tradition of the tomb walls found its way onto the coffins. We are therefore witnessing what van Walsem calls the “architectonization” of the coffin, which becomes a small universe, at the center of which is the deceased themselves, who becomes the source of their own regeneration and rebirth.<sup>10</sup> The development of these artifacts has been extensively studied,<sup>11</sup> thanks to the coffins found in the 19th century in the two Theban cachettes,<sup>12</sup> now stored in diverse museums around the world.<sup>13</sup> In 1988, Niwiński identified different typologies with a precise chronology based on layout, style and images.<sup>14</sup> Nevertheless, the numerous stylistic and iconographic variables, as well as the various techniques of execution and the widespread reuse of coffins during the Third Intermediate Period, continue to place these artifacts at the center of a lively debate. While earlier scholars focused almost exclusively on layout, iconography and texts,<sup>15</sup> recent years have seen a shift of attention towards production, materials and painting techniques.<sup>16</sup> The Pilot Project seeks to close the existing gap in our knowledge by focusing specifically

9 Niwiński 1988; Taylor 1989; van Walsem R. 1997.

10 Van Walsem 2015, 390–397.

11 Aston 2009; Niwiński 1988; Sousa, 2018b; Taylor 1989; id. 2001, 164–181; id. 2006, 263–291; van Walsem 1997.

12 In 1881 at Deir el-Bahari the first *cachette* (TT 320) was found, with royal coffins and mummies and 14 ‘yellow coffins’ of the Priests of Amun during the 21st Dynasty (ca. 1069–945 BCE). Ten years later (1891), an inviolate burial chamber was found in the northeast corner of the Hatshepsut’s temple (ca. 1473–1458 BCE), with 250 coffins dating back to the 21st Dynasty, later called Bab el-Gasus.

13 Part of the Bab el-Gasus coffins was retained for the Giza Museum and another part was divided into XVII lots and sent in 1893 to countries involved in political and diplomatic operations in Egypt: Lot I (France), Lot II (Austria), Lot III (Turkey), Lot IV (United Kingdom), Lot V (Italy), Lot VI (Russia), Lot VII (Germany), Lot VIII (Portugal), Lot IX (Switzerland), Lot X (USA), Lot XI (Netherlands), Lot XII (Greece), Lot XIII (Spain), Lot XIV (Sweden-Norway), Lot XV (Belgium), Lot XVI (Denmark), Lot XVII (Città del Vaticano). Originally 17 museums profited from Khedive’s gift, but subsequently the coffins were reallocated and today at least 35 museums are known to house objects from Bab el-Gasus. ‘The gate of the Priests Project’, directed by Rogério Sousa (University of Lisbon) and involving the Egyptian Dept. of the Musei Vaticani, the University of Leiden and the University of California, Los Angeles, has as its main purpose recreated/reconstructed the original integrity of the Egyptian tomb of the priests of Amun (Bab el-Gasus) dating from the 21st Dynasty and found undisturbed since antiquity, see Sousa et al. (eds) 2021.

14 Niwiński 1988.

15 E.g., Niwiński 1988.

16 Amenta 2014, 483–499; Amenta and Guichard 2017; Dawson and Strudwick 2016; Dawson and Strudwick 2018; Weiss 2018.

on the material aspects of the Egyptian coffins together with their symbolic and cultural value. The reason for this is to understand whether the construction and painting/decorative techniques can also be functional elements in creating a typology.<sup>17</sup> An important development in burial practices was the subsequent reuse of “yellow coffins” during the 21st Dynasty which had economic and social implications during what was a period of scarcity.<sup>18</sup> In recent years, the question of the identity of ateliers and the reuse of the objects have been the subject of specific projects characterized by a combination of different but interconnected skills and competences from diverse disciplines: Egyptology, Diagnostic and Conservation.<sup>19</sup> Thanks to such collaborations, a protocol of scientific analyses and a specific methodology have been devised that aim at studying the composition of the various materials and deepening our understanding of the practices lying behind ancient reuse, through the use of the latest technologies available in our cultural heritage.

The Pilot Project fits into this new line of research and started from a small group of 13 artifacts coming from the Bab el-Gasus Cache, a coherent *corpus* for dating, provenance and commissioning:

- 1) Lot XVII at the Musei Vaticani (MV) donated by the Egyptian Government to Pope Leo XIII: outer coffin and mummy board of Ikhy, MV 250353.1-3;<sup>20</sup> inner coffin of Takhybiat, MV 25015.2.1-2;<sup>21</sup> two anonymous inner coffins, MV 25016.2.1-2<sup>22</sup> and MV 51515;<sup>23</sup> and two anonymous mummy boards, MV 25020<sup>24</sup> and MV 25022.<sup>25</sup>
- 2) Lot XI at Rijksmuseum van Oudheden in Leiden (RMO): anonymous inner coffin (RMO F 93/10.4); coffin set of Nesytanebtawy, outer and inner coffin and mummy board (RMO F 93/10.2a-c); coffin set of Tjenetpenherunefer, inner coffin and mummy board (RMO F 93/10.3a-b).<sup>26</sup>

The first step was to create a 3D model of the upper part of each coffin lid. The photos were taken with Nikon D5200 that allowed the acquisition of photos with very high resolution, in order to produce a final result with many accu-

17 Amenta 2014, 483–499.

18 Cooney 2007; id. 2011, 3–44; id. 2014, 45–66; id. 2017, 101–112. id. 2018a, 295–322; id. 2018b, 96–108.

19 Amenta and Guichard 2017; Dawson and Strudwick 2018; Weiss 2018.

20 Cooney 2014, 48, fig. 11; id. 2017, 101–112; Gasse 1996, 81–97.

21 Du Quesne 1998, 615–617; Gasse 1996, 98–109.

22 Gasse 1996, 13–23; Grenier 1993, 23.

23 Gasse 1996, 129–130.

24 Gasse 1996, 132–134.

25 Gasse 1996, 135–137.

26 Weiss 2018.

rate details, using Color Checker (for the color) and a metric reference (for the size). The settings of the shots were calibrated in relation to the features of the objects but, above all, to the light and shadows. The coffins, in fact, are stored in both the exhibition rooms and storerooms, so the light conditions changed in relation to this; moreover, some of them are exhibited in a vertical position, others in very dark rooms or in non-optimal light conditions and often they cannot be moved.<sup>27</sup>

Once the 3D model had been created and the monochrome solid processed with Agisoft Metashape program (1.4.0.5076 version), in order to compare the facial geometry and the underlying features with the decoration, the model solid of each coffin was compared with its 3D model textured. Unexpected information emerged, different from previous data obtained for Late Period coffins, but equally important because more details can be added to the information that we already have on these coffins. We have to consider this information differently from the Late Period coffins, where the paint was directly applied onto the wood or a very thin layer of plaster—so the 3D model “reflects” the sculpted wooden facial features. In the “yellow coffins,” the painted layer is applied over generally two layers of plaster (differing in composition and granulometry). Moreover, the plaster does not lie on the carved wooden surface in a uniform manner. Often, we can find a large amount of plaster used to help create a curved surface and to give a better shape to the head, face and upper part of the trunk. So we have to emphasize that the 3D model reveals more of the surface level of plaster modeling in the “yellow coffins.”

The first result was to observe that the faces seemed to be different from each other. This might suggest that there is no “standardization” (fig. 11.2): they can be rounded or square, sometimes not symmetrical or well proportioned (MV 51515; MV 25020); in some cases the eyes are at different levels (RMO F 93/10.2c), the mouth is out of position regarding the central axis, which can create a distortion of the two halves of the face (RMO F 93/10.4; MV 51515), or individual features are not placed in the correct relationship to each other (MV 25015.2.1); in one case, the jaw seems to display prognathism (MV 25022); with all the specimens, the eyebrows follow the extension of the line of the nose that continues from the curve of the eyebrows: this curve, however, can be straight and slightly tilted at the ends, rounded or arched; the nose can be thin and proportionate, large at the base or very big; the mouth can be narrow and fleshy, or thin and straight.

27 In general, a value ISO 800 was preferred, with an aperture between  $f/7$  and  $f/10$  and lens of 24 mm in order to guarantee a good compromise between depth of field and brightness. The distance from the object was 1 meter maximum.

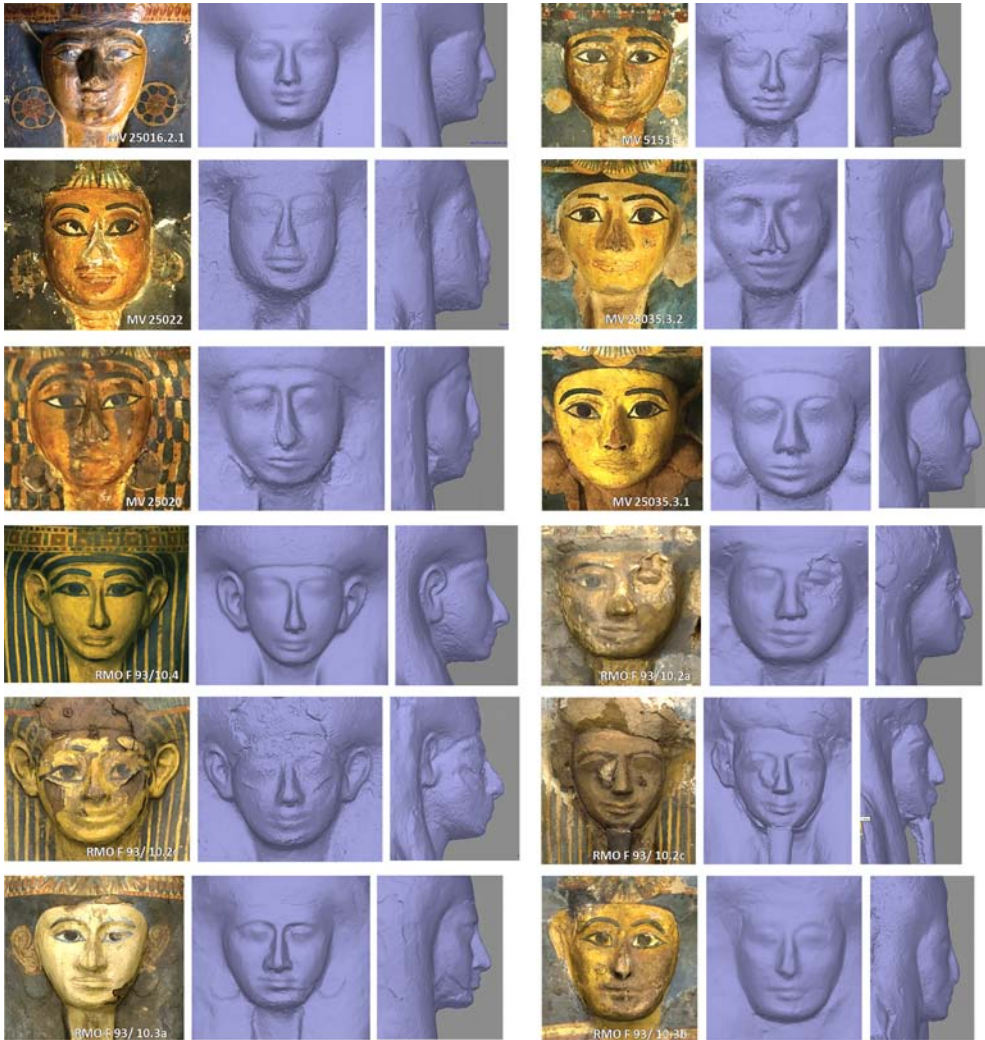


FIGURE 11.2 The 'yellow coffins' (Lot XVII and Lot XI) from the Bab el-Gasus cache  
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Nevertheless, starting from a simple autoptical observation of the form of the face, it is possible to arrange the finds into four groups:

- Group I** round face (full cheeks; small, round chin; narrow, wide forehead)
- Group II** square face (wide forehead; square, protruding jaw)
- Group III** triangular face (high cheekbones; wide forehead; pointed chin)
- Group IV** oval face (wide forehead; shallower jaw; protruding chin).



Owner	Inv. n.	Date	Group				
			I	II	III	IV	
Takhybiat	IC	MV 25015.2.1–2	Late 21st Dyn.				X
Anonymous	IC	MV 25016.2.1–2	Late 21st Dyn.	X			
Anonymous	IC	MV 51515	Late 21st Dyn.	X			
Anonymous	MB	MV 25022	Late 21st Dyn.		X		
Anonymous	MB	MV 25020	Late 21st Dyn.			X	
Ikhy	MB	MV 25035.3.2	Late 21st Dyn.			X	
Ikhy	OC	MV 25035.3.1–3	Late 21st Dyn.	X			
Nesytabebtawy	OC	RMO F 93/10.2a	Late 21st Dyn.	X			
Nesytabebtawy (?)	IC	RMO F 93/10.2b	Late 21st Dyn.	X			
Nesytabebtawy (?)	MB	RMO F 93/10.2c	Late 21st Dyn.				X
Tjenetpenherunefer	IC	RMO F 93/10.3a	Early 21st Dyn.			X	
Tjenetpenherunefer	MB	RMO F 93/10.3b	Early 21st Dyn.			X	
Anonymous	IC	RMO F 93/10.4	Late 21st Dyn.			X	

Certainly other elements could be different or could be linked to another group: in some cases, there may be some minute details which certain masks belonging to different groups have in common (e.g. mummy boards MV 25035.3.2 and MV 25020), as well as masks in the same group but belonging to a different set having strong correspondence in other facial features (e.g. the inner coffin of Takhybiat, MV 25015.2.1 and the mummy board of Nesytabebtawy, RMO F 93/10.2c having the same rendering of lips and mouth).

Another element emerged during this preliminary observation regarding the eyes. In most cases the eyes appeared as a rounded shape where the upper part seems to define the eyelids, while the lower part is the area for the iris and cosmetic lines; sometimes they were painted on without following the sculpted line (e.g. MV 25020 and MV 51515), a characteristic often found on objects dating from a successive period (Sousa 2018a, 48). Moreover, in some cases the eyes were not sculpted in detail on the wood but were modelled with plaster in order to create more or less three-dimensionality. Good examples come from the inner coffin lid of a Takhybiat (MV 25015.2.1) and the anonymous mummy board MV 25022, both in the Musei Vaticani.

Maybe the wooden mask of Takhybiat was adapted at a later date or at a different stage of production, to make the face smaller (fig. 11.3). The wooden mask is 15.3 cm long, and the new one (modelled with plaster on wood) is 2.2 cm smaller. The poor condition of the coffin allowed us also to observe the wooden

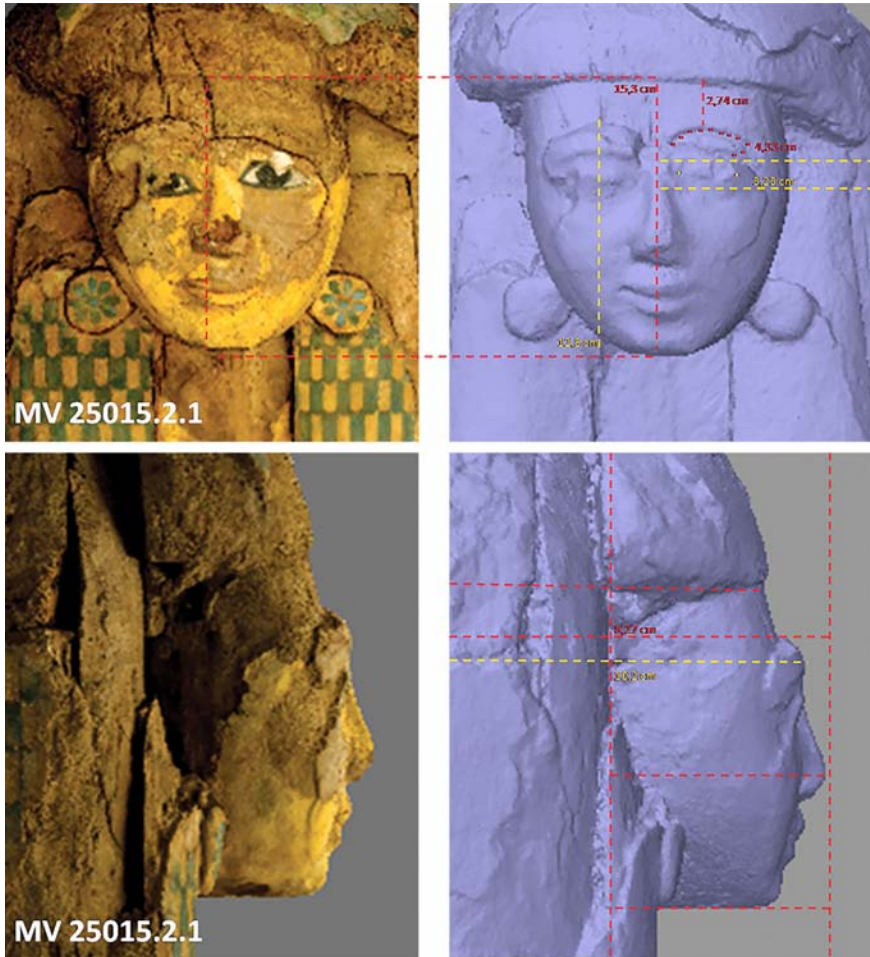


FIGURE 11.3 Particular of the inner coffin lid of Takhybiat in the Musei Vaticani  
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base and see one of the carved eyes on it. The eye starts 2.74 cm under the hair-line. It is a very basic eye, narrow and long (around 4.33 cm between outer and inner corner of the eye fissure), simply carved onto the wood without any detail and three-dimensionality, but possibly only carved to indicate the position where the eye was supposed to be placed. The “new” eye, instead, was created by modeling the plaster (1.93 cm thick). It is aligned with the carved eye, but smaller and painted on a crudely made, slight bulge for three-dimensionality.

Conversely, in the anonymous mummy board (MV 25022), the model solid made it clear that the eyes are almost flat. The lines of the eyes and eyebrows

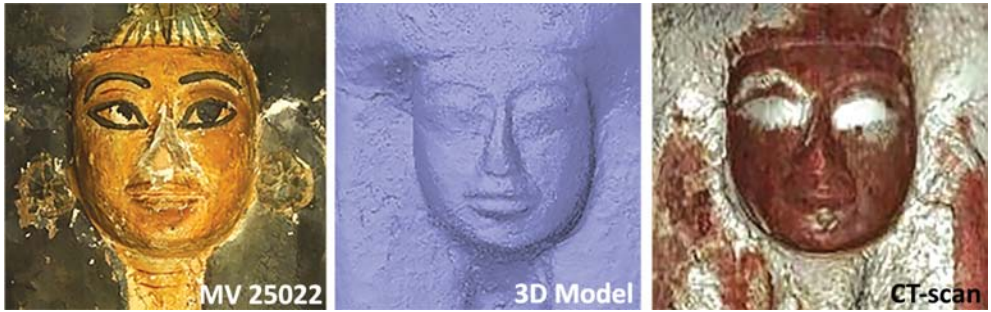


FIGURE 11.4 Comparison of the model textured, model solid and CT-scan (cardiovascular filter) of the anonymous mummy board in the Musei Vaticani  
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are distinguishable under the paint but different from the forms observed in the other artifacts. The eyes are narrow and elongated and seem to have the form of an almond; both eyelids have the same curvature but are extended upward. Moreover, the face is crudely carved, and the paint is not refined, as if the painting was applied in a hurry. The observation of the Computer Tomography (CT) scan images in Volume Rendering Technique (VRT) carried out on the artefact within the VCP<sup>28</sup> shows that much plaster was used to shape the eyes, and we can observe the same form in the photogrammetry (fig. 11.4).

One of the most important results of these preliminary findings regards the coffin set belonging to the Chantress of Amun, Ikhy (MV. 2035.3.1-3), in particular her mummy board. Studied for a long time, both iconographically and textually, its physiognomic traits had never been taken into consideration. The face could be part of group III but its square-shaped, striking features are very different from the features on the other Bab el-Gasus coffins in the Musei Vaticani and even from the features on its own outer coffin.

If we observe in detail the painted faces of both artifacts, we can recognize the same painting style and the same colors, which might be indicative of the same workshop or craftsman, or that they were painted at the same time. Both faces are painted yellow; the eyes, with a black iris painted on a white background, are large with cosmetic lines painted in black, as well as the eyebrows, which are slightly tilted at the ends; the lips are outlined in red with a shadowy effect created by small circles painted in the corners of the mouth. However, this uniformity in the painted features cannot be observed in the sculpted ones. The 3D monochrome solid, in fact, immediately reveals that the sculpted face

28 Amenta 2018, 323-335.

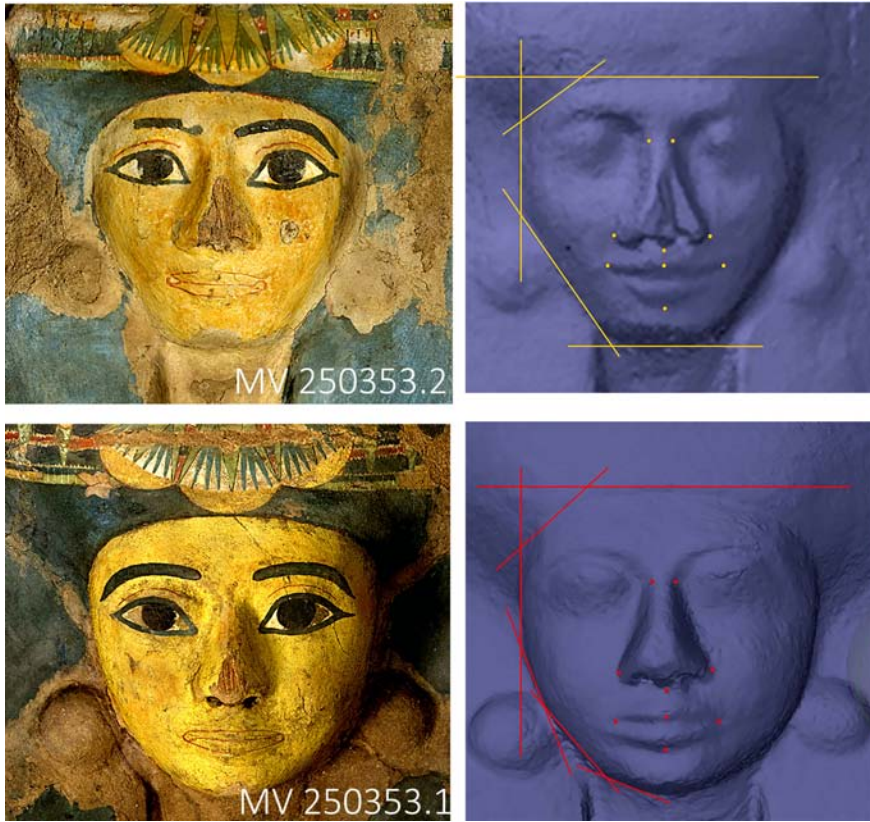


FIGURE 11.5 Comparison of model textured and model solid of the mummy board of Ikhy (above) and its outer coffin (below)  
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and physiognomic features of the mask on the mummy board are totally different from the face on the outer coffin (fig. 11.5). The mummy board has a more square-shaped face with striking features, such as high cheekbones and a square chin; the nose is long, very large in the lower part, with flared nostrils; the mouth is closed, forming a hint of a smile with well-defined, large, fleshy lips. Conversely, the face of the outer coffin presents fine features with rounded cheekbones, chubby cheeks and a slightly pointed chin; the nose is small and well-proportioned with “regular” nostrils, and the mouth, closed too, is linear and fleshy but less so than the mummy board. Why they are so different in form? Moreover, along with these so different facial features, we note that the mummy board presents a modification of some sculpted elements with paint, possibly made to unify the style of decoration both in the mummy board and the outer coffin. This is evident in the mouth: the paint does not reflect the

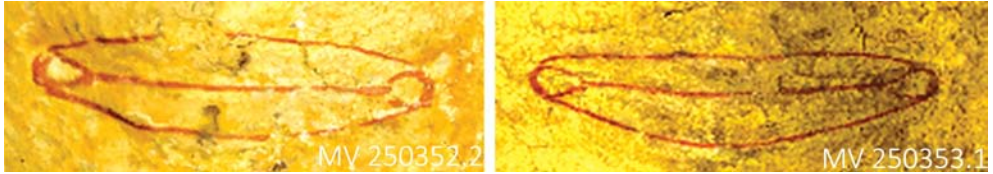


FIGURE 11.6 Particular of the painted lips on the mummy board of Ikhy (on the left) and on its outer coffin  
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underlying features, but changes them, from a hint of a smile and a mouth with well-defined, large, fleshy lips to a smaller, closed, unsmiling mouth (fig. 11.6).

#### 4 *Faces Revealed Project and the New Methodology*

To sum up, the investigation of this small group of artifacts and the comparison of the 3D models solid with their models textured show us that sometimes the faces seem to be painted without following the underlying sculpted/ modelled traits. Moreover, in some cases we have a large layer of plaster that completely changes the carved wooden traits, thus remodeling some facial features. This evidence has never been considered before and therefore has much potential to add to both the recent projects concerning the “yellow coffins” and the more traditional analytical approaches to these objects. In any case, these results consequently pose a series of interesting questions that are also the main focus of the “Faces Revealed” project, in other words to understand:

- a) How important the paint is when compared with the modelled/sculpted masks, alongside how faithfully it reproduces them
- b) Whether the different physiognomic modelled/sculpted traits and proportions of the faces can be linked to different workshops and/or can reflect the stylistic features of a certain period (as also proposed for the statues)
- c) How important the plaster is in the modeling of the original sculpted traits in creating forms and three-dimensionality, and whether its thickness can be linked to the economy of the workshop or different location or linked to the reuse of the masks/coffins. We have to consider, in fact, that around 53.82% of coffins dated to this period provide circumstantial evidence of reuse.<sup>29</sup> The presence of excess plaster on the coffin arms,

29 Cooney 2014, 48; id. 2017, 101–112; Prestipino 2017, 397–406.



FIGURE 11.7 Example of marks and polylines to individuate the correspondence between paint and modelled traits on the outer coffin of Ikhy  
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for example, is suggestive of reuse, because plaster was a common way to cover over the older style of modelled forearms and elbows. Could the same be the case for the faces?

In order to attempt to answer the questions that emerged during this pilot project, the analysis was extended to all “yellow coffin” (included “stola coffins”) from the 19th to the beginning of the 22nd Dynasty and coming from other archaeological sites for a broader investigation, and a project with a well-defined, specific and exact methodology was developed in three main steps:

- 1) Analysis of the faces (fig. 11.7). After the creation of the 3D model, for each coffin the following processes will be carried out: a) conducting an autoptic comparison of the 3D models solid and their models textured to understand whether or not the pictorial layers correspond to the underlayer; facial features will be drawn with polylines on the Metashape program and then inspected on the 3D model for resemblance; b) Virtually eliminating the paint to identify landmarks on the solid model for measurement.



FIGURE 11.8 Example of the morphometric approach to facial proportion and measurements on the outer coffin of Ikhy COURTESY OF THE VATICAN COFFIN PROJECT (© MUSEI VATICANI)

- 2) Morphometric approach to facial proportion, measurements, and grouping. The facial features will be measured in order to understand the proportions of the faces. Each face will be inserted into a grid, which divides it into symmetrical halves and where vertical and horizontal distances will be the kinds of variables mostly related to four of the major facial components (fig. 11.8). Physiognomic marks will be identified and measured. Faces will be grouped together for their similarities and the local distance along the predominant modes of variation for different facial components will be computed to understand whether there are any correlations between face carvings.<sup>30</sup> If correlations are discovered, they may

<sup>30</sup> These measurements will be done on an ad hoc basis with a pre-calibrated and fixed grid that will be adapted for each face. During the project, in collaboration with the UCLA and Dipartimento di Architettura, Ingegneria delle Costruzioni e Ambiente Costruito at the Politecnico di Milano, it is my intention also testing face recognition software for a faster and more precise investigation.

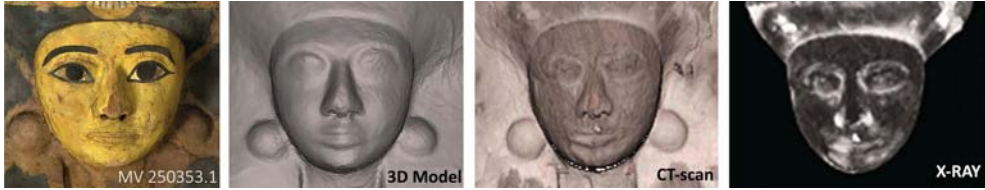


FIGURE 11.9 Comparison of the 3D model textured, 3D model solid, CT-scan and X-Ray of the outer coffin of Ikhy

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indicate how many and which workshops were used in crafting masks and whether the proportions could be linked to a specific workshop or to a precise historical period.

- 3) Database and data connection. The entire corpus of the selected coffins will be managed in a relational database including all the newly acquired data, which will be organized into different tables according to a relational structure. During this phase the Faces Revealed database will be made accessible to the Vatican Coffin Project team. The collaboration of the researcher with the VCP is a unique opportunity to combine data acquired from the most recent and ongoing research on “yellow coffins” in Europe, such as that gained from the last 10 years by the VCP, with that obtained from the *Faces Revealed Project*. Such a collaboration will allow an integration of the data with results obtained through other scientific analyses and a comparison of the photogrammetry methodology with the latest technologies that the international team have been using. Comparing 3D models textured and solid ones with CT-scans and X-rays (fig. 11.9) will allow an analysis of the thickness and density of the plaster and give us a plethora of technical information.<sup>31</sup>

In conclusion, the Faces Revealed project takes its lead from innovative research trends, which see the combination of different but interconnected skills and competences, and which seeks to contribute to the study of the coffins by developing a new and efficient methodology based on an extremely fast, simple, cost-effective and portable technique allowing the acquisition of a non-invasive partial stratigraphy. This technology will provide further insights into the manufacture, production, workshops and maybe ancient reuse of the “yellow coffins” and could also help to create a new way of classifying these coffins, considering not only their iconographic and textual *apparatus* but all the various characteristics of these artifacts. The innovative project focuses on two

<sup>31</sup> Amenta 2018, 323–335.



areas never considered before: the physiognomic traits of the coffin faces virtually removing the pictorial layer, and the impact and importance of the plaster at first in “modeled,” as well as in “remodeled” sculpted wooden masks. Moreover, combining all the data (iconography, texts, layout, morphology, and technical aspects) will allow us to isolate comparative models and outline a new, more precise classification of “yellow coffins” and their provenances. Interpretation will have an impact on our scholarly knowledge of the ancient Egyptian coffin and of the funerary religion as a whole, because coffins represent “a social hieroglyph,” “one of the enshrined material foundations for Egyptian society”<sup>32</sup> that we are trying to discover.

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32 Meskell 2004, 130; see also Cooney 2007.

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