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## EDITOR'S NOTE

The Lepidopterists' Society occasionally publishes longer, topical manuscripts in the serial publication *Memoirs of the Lepidopterists' Society*. Beginning in January 2016, I will be assuming editorial responsibilities for *Memoirs* that involve detailed treatment of ecology, evolution, or systematics of lepidopteran taxa. Kelly Richers will continue to serve as the lead editor for *Memoirs* that involve historical treatment of the Society, the study of Lepidoptera, techniques for studying Lepidoptera. Manuscripts for any submission for the *Memoirs* series should follow the standard instructions for authors used by the *Journal of the Lepidopterists' Society*. Those instructions may be found at <http://www.lepsoc.org/journal.php>. If you are considering preparing a manuscript for the *Memoirs* series, please contact me for additional information ([keith.summerville@drake.edu](mailto:keith.summerville@drake.edu)).

Keith S. Summerville, Editor  
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Detail from a wall painting in the tomb of Nebamun (British Museum). Photo by Monica Bowen (albertis-window.com), reproduced with permission. See article in this issue.

## BUTTERFLIES OF ANCIENT EGYPT

VAZRICK NAZARI

3058-C KW Neathy Building, 960 Carling Ave., Ottawa, ON K1A 0C6 Canada; email: nvazrick@yahoo.com

AND

LINDA EVANS

Ancient Cultures Research Centre, Department of Ancient History, Macquarie University, Sydney NSW 2109 Australia linda.evans@mq.edu.au

**ABSTRACT.** A review of butterflies depicted in ancient Egyptian tomb scenes and other artifacts dating from the predynastic period (c. 3000 BCE) until the end of the pharaonic era (c. 100 BCE) reveals a wide spectrum of stylistic changes over time. A cladistic analysis shows relative consistency of style during the Old Kingdom period, copying of old styles during the Middle Kingdom period, and a deviation from tradition during the New Kingdom period. The utility of a cladistic approach in assigning dates and localities to ancient Egyptian artifacts with unknown origins is demonstrated. We discuss lepidopteran symbolism in ancient Egypt, and investigate how some of these depictions may highlight historical shifts in species ranges since pharaonic times.

**Additional key words:** Egyptology, Lepidoptera, Iconography, Cladistic, Egyptian art

Butterflies have been represented in art since the Neolithic period (c. 5000 BC) (Schimitscheck 1978). Although their presence in antiquity is also significant in Minoan and Mycenaean art (Evans 1928, Brentjes 1964, Parent 1987), the use of butterflies, alongside other insects, by ancient Egyptian artists as a standard decorative element in tomb imagery over three millennia gave them a unique prominence that is unparalleled in art history. Several insects were revered by the Egyptians, represented deities, or otherwise had deep symbolic meaning (e.g. scarab beetles, locusts, honey bees, mosquitoes, mantids, fleas, etc.) (Ward 1994). However, the role of butterflies in Egyptian funerary contexts, if any, remains disputed (Fleuren 2010).

Ancient Egyptian culture, which developed over three thousand years, is usually divided into several major periods: the Predynastic era (Neolithic–3100 BCE), Early Dynastic period (3100–2686 BCE, Dynasties I–II), Old Kingdom period (2686–2181 BCE, Dynasties III–VI), Middle Kingdom period (2055–1650 BCE, Dynasties XI–XIII), and the New Kingdom period (1550–1069 BCE, Dynasties XVIII–XX). These were separated by intermediate periods marked by unrest. The Late Period (664–332 BCE, Dynasties XXV–XXXI) followed by Greek and Roman conquests marked the end of the pharaonic era (van de Mieroop 2011).

The significance of the afterlife for the ancient Egyptians is well documented (Kanawati 2002). The poor were interred in simple graves, but the country's elite, such as the king, noblemen, and high government officials, invested in elaborate tombs in which to spend eternity. Despite the development of different construction methods over time, every tomb (whether a

free-standing structure or cut into the rock face) comprised three essential elements: an offering chapel or mortuary temple, a tomb shaft, and a subterranean burial chamber (Arnold 2003). The walls of the chapel, and occasionally those of the burial chamber, were usually decorated. During the Old Kingdom, the decoration was rendered in painted bas-relief in which the background around intricately carved figures was removed to create an embossed effect; sunken relief, in which figures were chiseled into the wall surface, was also used throughout the pharaonic era. In later periods, however, tomb scenes were painted directly on to prepared plaster walls. Only six colors were used commonly: red, green, blue, yellow, white and black, each with its own symbolic meaning. These pigments were prepared from natural substances such as red and yellow ochre, powdered malachite, carbon black, and gypsum (Robins 1997).

The stability of Egyptian life and culture resulted in a form of art that was characterized by a highly conservative adherence to rules favoring order and form over creativity and artistic expression. Strict representational guidelines determined how human figures could be depicted: sizes, poses and colors were all dictated by prescribed formulae that were followed for generations. Hence ancient Egyptian sculptors and painters were not artists in the modern sense, but rather paid and trained labor, working anonymously as part of a team of skilled craftsmen who were commissioned by the elite to build and decorate their tombs. These teams normally included stonemasons, plasterers, draftsmen, sculptors, carpenters, painters and scribes. In the case of rock-cut tombs, for example, stonemasons would first





FIG. 1. Examples of marsh scenes and butterflies from the walls of Egyptian tombs. (a) Menna<sup>70</sup>, (b) Nefer/Kahay<sup>7</sup>; (c) Kaemankh<sup>34</sup>; (d) Merefnebef<sup>36</sup>; (e) Nikauisesi<sup>42</sup>; (f) Puyemre<sup>66</sup>; (g) Amenemhat (excluded); (h) Khnumhotep II<sup>63</sup>; (i) Nakht<sup>71</sup>; (j) Horemheb<sup>68</sup>. See Table 1 for publication details. Photo credits: Figs. 1a: Davies 1936: plate 54; 1b: Lashien 2013; 1c: Junker 1940: plate 11; 1d: Karol Mysliwiec, © Polish-Egyptian Archaeological Mission in Saqqara, reproduced with permission; 1e: kairinfo4u on Flickr, CC license; 1f: Metropolitan Museum of Art Gallery Images, in public domain; 1g: Davies 1936: plate 19; 1h: Australian Centre for Egyptology, reproduced with permission; 1i: Mekhitarian 1978: 71; 1j: Brack & Brack 1980: plate 22.



excavate the chapel rooms and tomb shaft. Plasterers then covered the uneven walls with a layer of gypsum and whitewash. Once the walls were smoothed and polished, they were turned over to the draftsmen who sketched out proposed designs in red. The master draftsman would then go over these designs in black ink, to ensure accuracy. Finally, the painters would add color with brushes made of a twig or reed with the fibers teased out.

Although religious imagery was introduced during the New Kingdom period, so-called “scenes of daily life” dominated the decoration throughout the pharaonic era. These images, arranged in horizontal panels (or registers), appear to show various activities on the tomb-owners’ estates, such as men and women baking and brewing, plowing, harvesting and threshing grain, herdsman at work in pastures caring for cattle, carpenters, potters and jewelers, social activities such as games, music and banqueting, and offering bearers bringing produce to the deceased owner at his funerary table. In “marsh scenes”, the tomb-owner was shown hunting waterfowl and spearing fish on the Nile River (Fig. 1). These images reliably depict dense thickets of papyrus amongst which many bird species nest and small carnivores lurk, such as common genet (*Genetta genetta*) and Egyptian mongooses (*Herpestes ichneumon*). In the waters below swim fish, hippopotami, and crocodiles, while in the skies above fly waterfowl and insects. Butterflies are frequently found in such scenes, both at rest and flying above and within the papyrus thicket.

The purpose of these scenes, which conform to specific themes that are repeated from tomb to tomb, has been much debated. The images are believed by many to have had a magical function, to help sustain the spirit of the deceased in the afterlife (e.g. Smith 1978), but other theories view the scenes as indicators of social status (e.g. Moreno-Garcia 2006) or having a mythological meaning that allowed the deceased to partake in a broader cosmic drama (e.g. Altenmüller 1999). Whatever their function, the detailed wall paintings provide valuable insights into many aspects of ancient Egyptian life, including the natural environment.

Despite the strict rules governing representation in ancient Egypt, significant diversity and variation in style of lepidopteran imagery over time is evident (Keimer 1934, Verhoeven 1975, Evans 2010, Fleuren 2010). Here we attempt to shed light on the process and direction of this art form with a cladistic analysis, using the most comprehensive compilation to date of butterfly depictions in ancient Egyptian art. We also examine the possibility of inferring dates for artifacts of unknown origin through this approach, and investigate potential

shifts in historical ranges of butterflies that no longer occur in Egypt today.

#### MATERIALS AND METHODS

A list of Old Kingdom tombs containing scenes with butterflies (Harpur 1987) was used as a starting point, and structures from earlier or later time periods with similar scenes or recent discoveries were added following examination of published tomb reports. Artifacts such as amulets, pendants, jewelry, statuettes, etc. with butterfly themes or imagery were also included (Fig. 2). The final list (Table 1) contains 82 exemplars derived from a total of 194 depictions of butterflies from 20 different locations throughout the country (Fig. 3). It is likely, however, that further investigation will bring additional examples to light.

High quality images or drawings were sought for every entry in the list, mainly from tomb excavation reports and museum catalogues, but also from other publications, books, websites, Egyptological databases, and occasionally amateur photography (e.g. Flickr). In many cases the only available images were original line drawings made by the Egyptologists who first documented the tombs. We cannot exclude inaccuracies that may have been introduced in these works due to lack of attention to entomological detail; for example, the line drawings by Mohr (1943) from the mastaba of Hetepherakhti<sup>11</sup> (now in Leiden) were found to be highly inaccurate (Prof. Dr. Maarten Raven, pers. comm.).

Composite plates of obtained butterfly images were compiled in Adobe Photoshop CS.5 and subsequently re-drawn using India ink and a Rapidograph pen with 0.25 and 0.5 mm thickness on Mylar drafting sheets (Fig. 4). Shading was accomplished using Letraset Letratone sheets in three different intensities (LT15, LT25 and LT29). Where more than one butterfly was present in a tomb scene, or multiple objects of the same kind were stored in a museum, the best preserved types (a total of 82 exemplars) were selected for illustration and inclusion in the cladistic analysis.

Each image was also assigned a date. The dating of Egyptian tombs is based largely on inscriptions, the type of architecture, and stylistic elements in the decoration. Nevertheless, the dates for many structures, especially for the Old Kingdom period, are highly contentious. For this project, tomb dates were obtained from Yvonne Harpur’s (1987, 2006) careful analysis and supplemented by re-assessments by later scholars (e.g. Swinton 2014 for Old Kingdom tombs). Standard dating terminology also follows Harpur (1987), with dynasties given in Roman numerals followed by the order of reigning king within the dynasty, and if known, approximate period



FIG. 2. Examples of butterfly artifacts: (a) Hetepheres bracelets <sup>2</sup>, (b) a hippopotamus statuette <sup>57f</sup>, (c) blue faience amulets <sup>60</sup>, (d) Senwoset amulet <sup>62</sup>, (e) Cleveland Museum inlay <sup>76</sup>. See Table 1 for publication details. **Photo Credits:** 2a: Egyptian museum in Cairo, in public domain; 2b: © Rhode Island School of Design, photo by Linda Evans; 2c: Arnold 1995; 2d: Metropolitan Museum of Art Gallery Images, in public domain; 2e: © Cleveland Museum of Art, reproduced with permission.

(Early, Middle or Late) during his reign (e.g. “XVIII.6L” indicates the later years of the reign of the 6th king of Dynasty XVIII). For tombs or artifacts where the dating is still disputed, a wider time period was considered.

During this study the first author examined a butterfly relief in the Los Angeles County Museum of Arts (LACMA #M.80.199.137) for which the provenance is unknown (Fig. 5). The artifact is part of a collection acquired by the museum from a private collector. To infer an approximate date or locality for this relief, it was also included in our analysis.

A set of 32 characters was selected for cladistic analysis, of which 16 were binary and 16 were multistate (Appendix 1). The final dataset included one outgroup and 81 ingroup taxa. Characters were scored using observed character states (Appendix 2). Dates were excluded from the analysis and subsequently plotted on the cladogram. The data matrix was then subjected to a cladistic analysis using the heuristic (add and re-arrange) modules implemented in Mesquite 2.75 (Maddison & Maddison 2011), with the NNI re-arranger (maxtrees=500) and under the Parsimony criterion with the “minimize Tree Value Using Character Matrix” option selected. A majority-rule consensus tree of 500 equally parsimonious trees with a total length of 407 steps was obtained (Fig. 10). Percent consensus frequencies for each node were calculated and plotted on the tree. An ostensible butterfly incised on a predynastic clay bowl <sup>1</sup> (see Table 1) was used to root the tree. Each branch was then colorized based on the main historical period.

**Items excluded from the analysis.** Several examples considered by past researchers to be possible lepidopterans were excluded from our analysis due to their dubious identity. These were (Fig. 6; Table 2):

- a) variants of an ideogram used in the word for “open” (s3š) (as found in surviving funerary inscriptions known as the Pyramid Texts), suggested by Keimer (1934) to have been modeled after a butterfly with open wings (Fig. 6A). However, the stylized nature of their representation and their visual conflation with bovine symbolism does not support such a notion;
- b) butterfly-like images on predynastic vases (von Bissing 1913) that have been dismissed as vegetation (Keimer 1934) (Fig. 6B);
- c) a kite-like object in the tomb of Ankhmahor: Seshi (Saqqara) (Fig. 6C);
- d) a Middle Kingdom faience plaque found at Lisht (Cairo Museum), resembling a rudimentary insect and suggested by Keimer (1934) to be a butterfly (Fig. 6D);
- e) a Dynasty XII butterfly pendant found in the tomb of Princess Khnumet at Dahshur, believed by many scholars to be of foreign origin due to the granulation method used in its construction (Lilyquist 1993) (Fig. 6E);
- f) a highly stylized insect with spiral wings on a Dynasty XVII–XVIII steatite amulet from Luxor, now in Cairo Agriculture Museum (Fig. 6F);
- g) two insects from the tomb of Amenemhat (TT82) with bifurcated forelegs, no antennae, and oddly shaped heads and abdomens that do not support their

identification as moths or butterflies (Davies 1936; Fleuren 2010), but most likely cicadas (Hemiptera) or ladybugs (Coleoptera: Coccinellidae) (Fig. 6G);

h) an unfinished image from the tomb of Menkheperreseneb (TT79) (Fig. 6H);

i) a flying insect from an anonymous Dynasty XVIII tomb in Thebes (Raven 2000) (Fig. 6I);

j) an insect from the tomb of Djehutymes (TT32), with narrow forewings and wide hind wings that suggest it is most likely a locust (Fig. 6J).

## RESULTS

**Location and frequency.** The earliest unambiguous examples of butterflies appear on jewelry dating to Dynasty IV from the site of Giza (Fig. 2a), however most of the surviving images examined in our study were located in the Old Kingdom necropolis at Saqqara and the Theban burial grounds of the New Kingdom period (Table 1). Provincial sites overall contained fewer examples.

Butterfly imagery was found predominantly in painted or carved wall decorations in royal mortuary complexes (e.g. Userkaf<sup>3</sup> and Niuserre<sup>6</sup>) and private tombs, and among these the most common context was in or near marsh scenes. A small number were depicted in other locations however (e.g. in bird-catching (Neferherenptah<sup>21</sup>), clapnet (Ankhmahor: Seshi<sup>41</sup>), and hippopotamus hunt scenes (Hemre: Isi<sup>55</sup>). In the tomb of Ankhmahor: Seshi<sup>41</sup>, a butterfly is perched on a bundle of reeds among a group of men pulling the rope of a clapnet (Kanawati & Hassan 1997), while in another rare instance, one of the butterflies in the tomb of Mehu<sup>46</sup> is hunted by an ibis (Fig. 7). The number of butterflies per tomb varied greatly, with most tombs having one or two instances, but some displaying as many as 11 (Hesi<sup>40</sup>) or 13 (Mehu<sup>46</sup>).

In the Middle Kingdom period, butterflies began to appear on a new element of funerary furniture: hippopotamus statuettes<sup>57</sup>, which were produced in blue faience and decorated with marshland motifs. Butterflies also occurred in non-funerary decoration for the first time during the New Kingdom period, painted on a ceiling in the palace of Amenhotep III<sup>73</sup> at Malqata, as well as on a floor at Tell el-Amarna<sup>74</sup>.

**Representations.** Butterflies were generally depicted in their most conventional form and showing their most characteristic features. They are thus often pictured with their wings open, although from late Dynasty V (i.e. Ptahhotep II: Thefi<sup>26</sup> and Nebet<sup>28</sup>) they also began to appear in a lateral pose and with their wings closed. Among the images examined, 11 butterflies were represented laterally, and in a few cases (e.g. Senbi<sup>61</sup>, Khnumhotep II<sup>63</sup> and Ukhhotep<sup>64</sup>), they

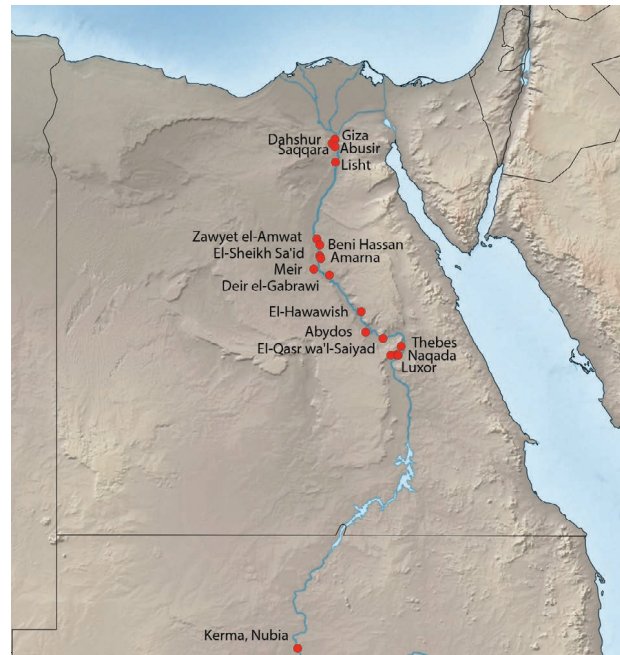


FIG. 3. Location of tombs and artifacts examined in this study.

were clearly drawn ventrally. Apart from once exception (that of Nefersehshemphah/Sekhenti<sup>15</sup>; see below), all butterflies prior to late Dynasty V were represented with just two wings, while thereafter anatomically correct details were added to indicate four wings, confirming an earlier observation made by Evans (2010: 51) and Fleuren (2010: 62-63) that a stylistic change occurred during the Dynasty V.9 reign of king Unas. In later periods (especially during the New Kingdom), butterflies were again often represented with two wings.

**Identification.** The present butterfly fauna of Egypt is well studied and to date 61 species of butterflies are known to occur (Larsen 1990, Gilbert & Zalat 2007). The vast majority of lepidopteran depictions examined in our study, however, were too stylized to be scientifically identifiable. Many images showed exaggerated morphology or unusual wing coloration, suggesting that zoological accuracy was not always of primary concern for some artists. Furthermore, often no trace of the original paint remained and the mere outline did not always provide helpful clues to identify the insects.

Among the images studied only a handful could be attributed with any certainty to modern-day butterflies (Table 1). These are spread across the Old, Middle and New Kingdom periods and were from different locations. The oldest identifiable depiction was found in the tomb of Nefer/Kahay<sup>7</sup> (Fig. 1b). Three butterflies appear in this wall scene, carved in bas-relief and painted, only one of which is well preserved. Both its



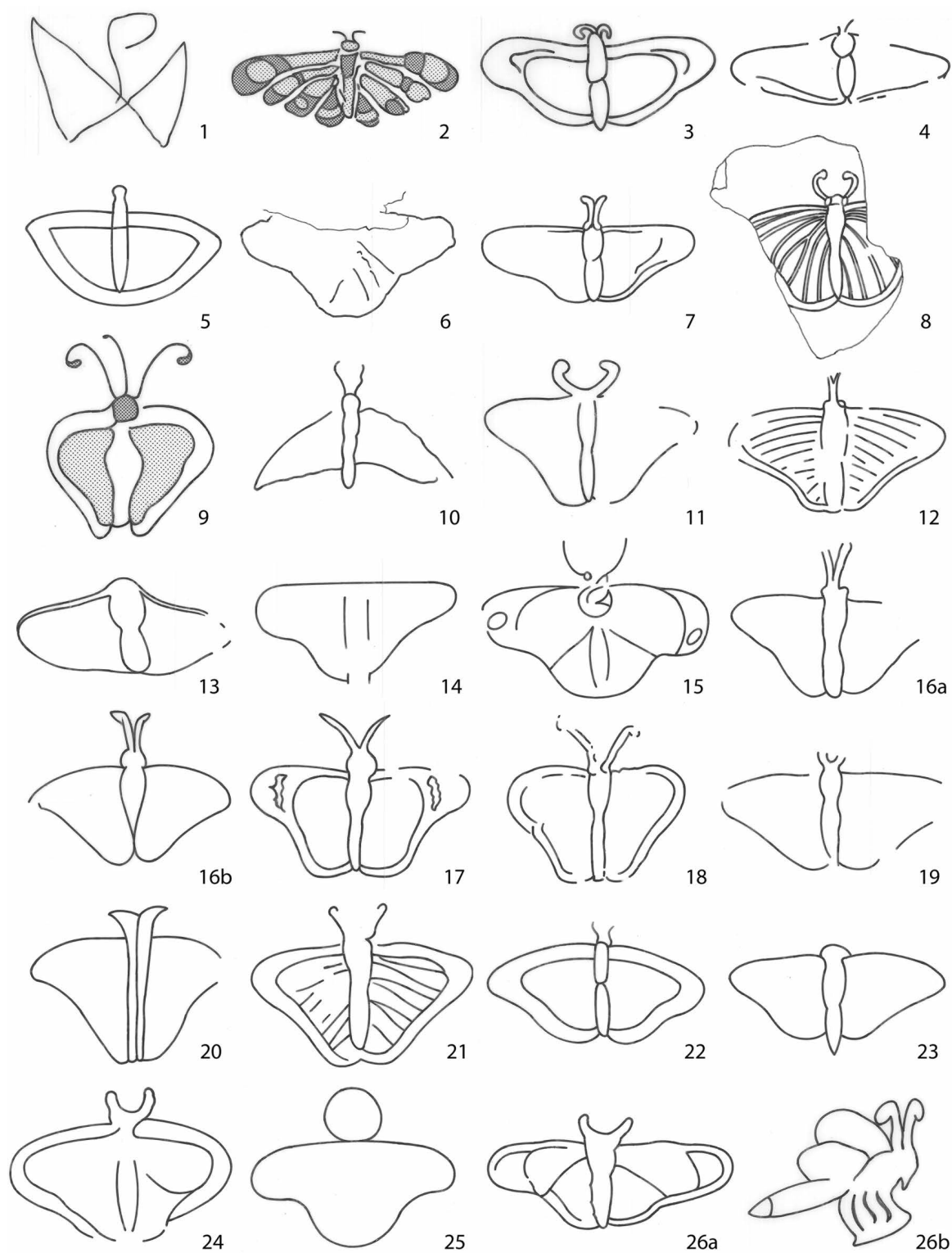


FIG. 4. Line drawings of selected butterflies from ancient Egyptian artifacts and wall scenes examined in this study. For corresponding information, see Table 1.



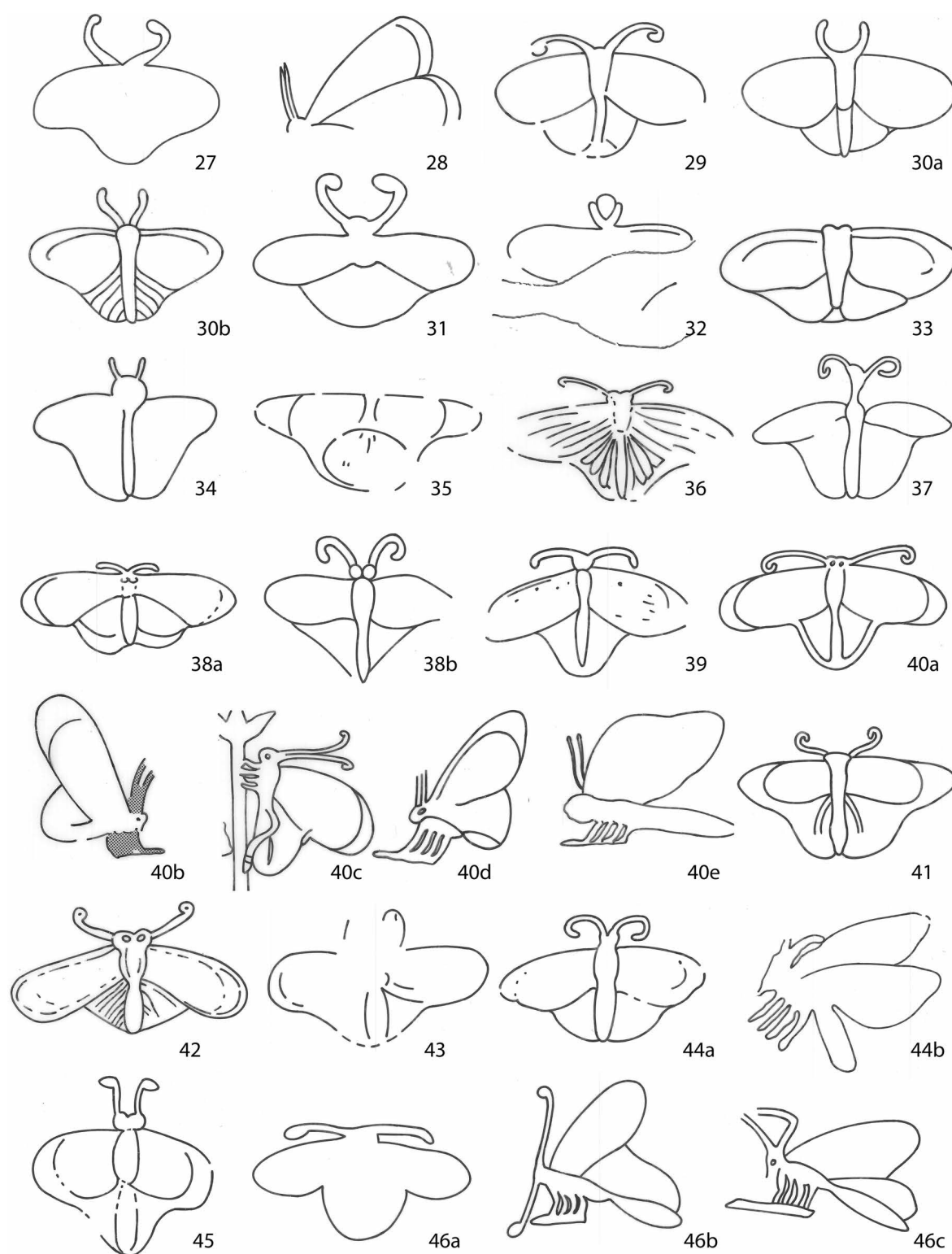


FIG. 4. Line drawings of selected butterflies from ancient Egyptian artifacts and wall scenes examined in this study. For corresponding information, see Table 1.

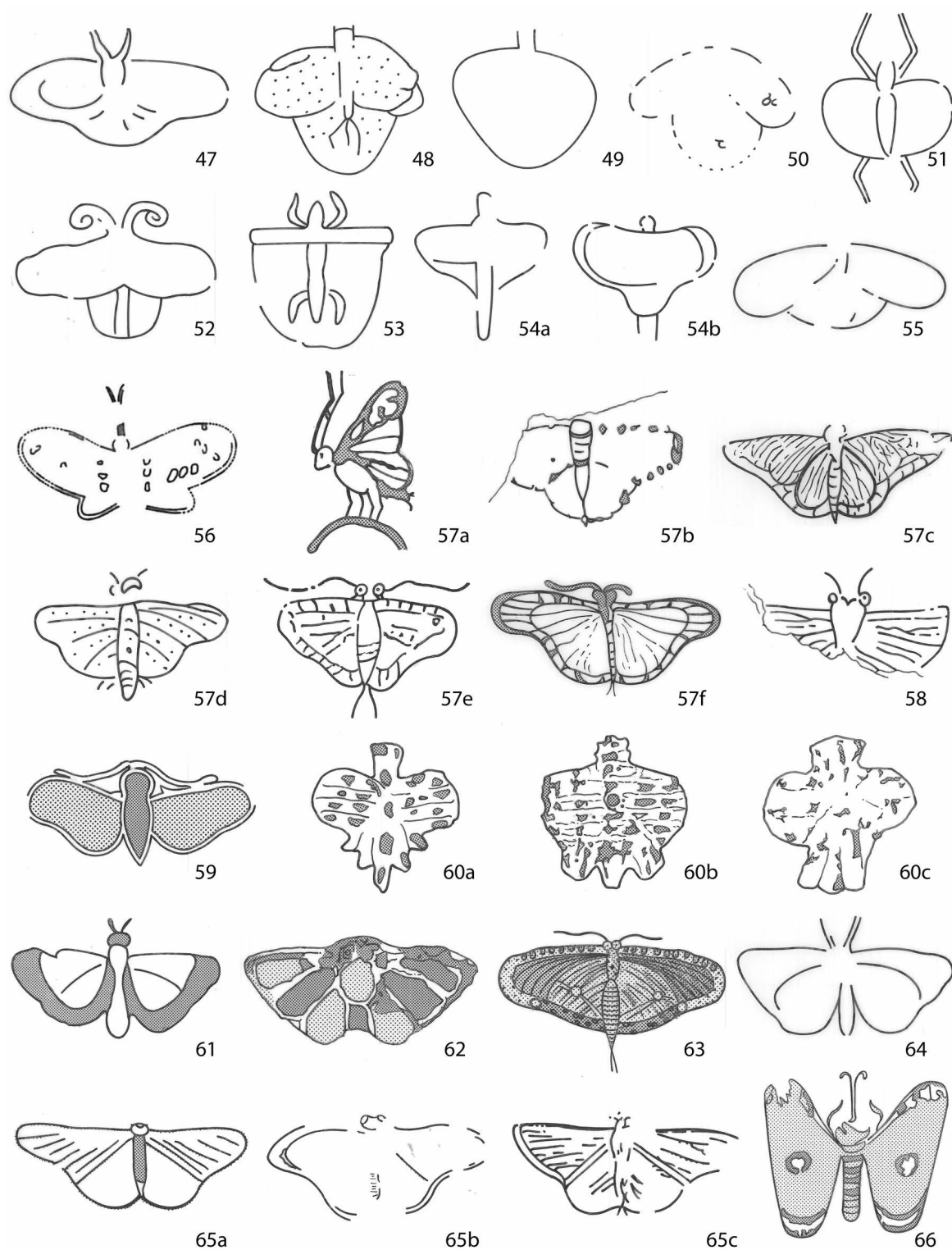


FIG. 4. Line drawings of selected butterflies from ancient Egyptian artifacts and wall scenes examined in this study. For corresponding information, see Table 1.



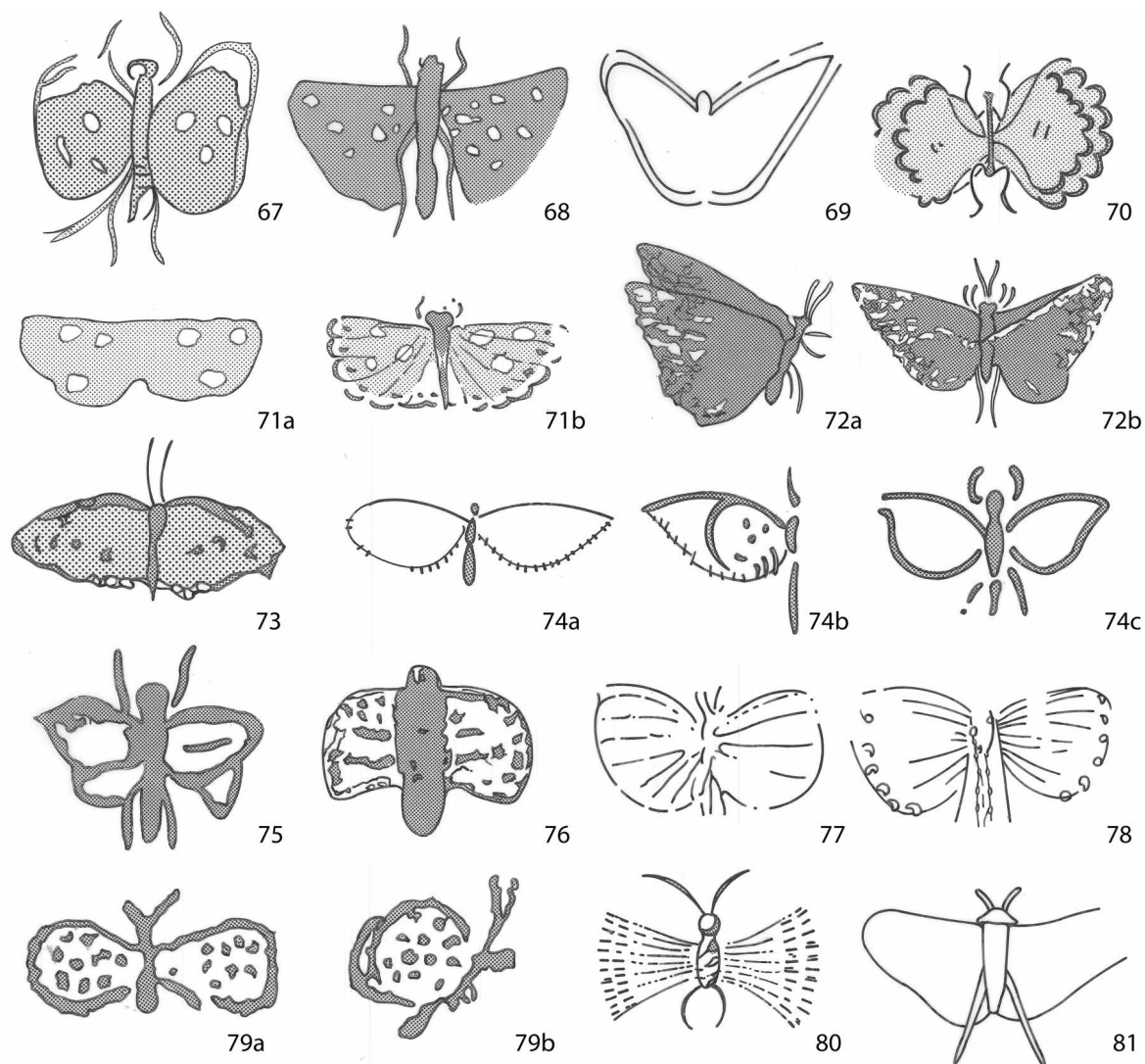


FIG. 4. Line drawings of selected butterflies from ancient Egyptian artifacts and wall scenes examined in this study. For corresponding information, see Table 1.

TABLE 1. Material examined. NBT=Number of butterflies in the tomb; NBI= Number of butterflies illustrated in this study; LV=butterfly in lateral view; DR=dragonfly-like insects present in tomb scene. NTN = no tomb number. Periods from Harpur (1987); those revised by Swinton (2014) are marked with \*. Dates are presented as dynasties in Roman numerals followed by the period of the reigning pharaoh; e.g. VI.4 indicates the sixth dynasty during the reign of the fourth king, Pepi I (E=early, M=middle, L=late). Identification sources: 1) This study, 2) Fleuren 2010, 3) Lopez-Moncet & Aufrere 1999, 4) Myśliwiec 2004, 5) Klebs 1934, 6) Keimer 1934, 7) Davies 1922, 8) Larsen 1979, 9) Keller 1913, and 10) Leith Adams 1870.

#	Period	Tomb owner / object type	Provenance	Tomb #	Image from	NBT	NBI	LV	DR	Identification
1	Naqada I-III	Clay bowl (3850-2960 BCE)	Mesaid	764	Museum of Fine Arts Boston (13.5448)	1	1			
2	IV.2	Hetepheres I Bracelet inlay ( <i>Htp-hr-s I</i> )	Giza	G7000X	O'Neill 1999: cat. no. 31 (JE 53271)	2	1			
3	V.1	Userkaf ( <i>Wsr-k3-f</i> )	Saqqara	ntn	Keimer 1934: fig. 92 (Cairo Museum, JE56601)	1	1			
4	V.1-5	Hetepet ( <i>htpt</i> )	Giza	ntn	Keimer 1934: fig. 95 (Berlin Museum, 15420)	1	1			
5	V.2	Sekhemkare ( <i>sh̄m-k3-r*</i> )	Giza	LG89	Hassan 1943: fig. 59	1	1			
6	V.6	Niuserre ( <i>N(y)-wsr-R*</i> )	Abu Ghurab	-	Edel & Wenig 1974: pl.15	1	1			
7	V.6	Nefer/Kahay ( <i>nfr/k3-h3.j</i> )	Saqqara	ntn	Lashien 2013: pls. 10 and 81	3	1			<i>D. chrysippus</i> or <i>H. misippus</i> (1,2)
8	V.6L*	Ptahshepes ( <i>Pth-šps</i> )	Abusir	ntn	Vachala 2004: 160-161 (no. 1259)	1	1			<i>D. chrysippus</i> or <i>H. misippus</i> (2)
9	V.6-8	Fetekta ( <i>ftktj</i> )	Abusir	LS1	Lepsius 1842-45 Band IV: pl. 96	1	1			<i>D. chrysippus</i> or <i>H. misippus</i> (2)
10	V.6-8?	Itisen ( <i>itj-sn</i> )	Giza	ntn	Hassan 1944: fig. 123	1	1			
11	V.6-8E	Hetepherakhti ( <i>htp-hr-šhtj</i> )	Saqqara	D60	Mohr 1943: fig. 34 (in Leiden)	1	1			
12	V.6-8E	Akhethetep ( <i>šhtj-htp</i> )	Saqqara	ntn	Ziegler 1993: 130-131 (in Louvre)	3	1			
13	V.6-9	Rudj-ka ( <i>Rwd-ka</i> )	Giza	ntn	Unpublished internet news source (2010)	1	1			Noctuidae? (1)
14	V.6E-8L*	Irenkaptah ( <i>irj-n-k3-pt̄h</i> )	Saqqara	ntn	Moussa & Junge 1975: pl. 12	4	1			
15	V.6-8E*	Neferseshemphah/Sekhenti ( <i>nfr-šsm-pt̄h/šhtjw</i> )	Saqqara	ntn	Moussa & Junge 1975: pl. 6	1	1			
16	V.6L-8E*	Niankhkhnum/Khnumhotep ( <i>nj-ṯnh-ḥnmw/ḥnmw-htp</i> )	Saqqara	ntn	Moussa & Altenmüller 1977, fig. 5	2	2			
17	V.7-8E	Ty ( <i>tj</i> )	Saqqara	D22	Wild 1953, pl. 115	1	1			<i>D. chrysippus</i> (1)
18	V.7-9E	Kaemnefert ( <i>k3.j-m-nfrt</i> )	Saqqara	D23	Simpson 1992: pl. A	1	1			
19	V.8E	Werirni ( <i>Wr-jr-n.j</i> )	El Sheikh Said	no. 25	Davies 1901a: pl. 11	2	1			
20	V.8-9	Sekhemankhptah ( <i>sh̄m-ṯnh-pt̄h</i> )	Saqqara	D41	Simpson 1976: pl. C (in Boston Museum of Arts)	3	1			
21	V.8-9	Neferherenptah ( <i>Nfr-hr-n-Pth</i> )	Saqqara	ntn	Smith 1981: fig. 121	1	1			
22	V.8-9?	Khunes ( <i>ḥw-ns</i> )	Zawyet el-Amwat	no. 2	Lepsius 1842-45 Band IV: pl. 106a	2	1			
23	V.8L-9*	Iasen ( <i>j3zn</i> )	Giza	G2196	Simpson 1980: fig. 30	1	1	1		
24	V.8L-9E	Akhethotep ( <i>šhtj-htp</i> )	Saqqara	D64	Davies 1901b: pls. 8 and 14	3	1			
25	V.9E*	Senezemib: Inti ( <i>sn̄gm-jb: jntj</i> )	Giza	G2370	Brovaski 1999: fig. 42	2	1			
26	V.9*	Ptahhotep II: Thefi ( <i>pt̄h-htp II: t̄fj</i> )	Saqqara	D64	Paget & Pirie 1896: pl. 32	2	2	1		
27	V.9	Khenut ( <i>ḥnwt</i> )	Saqqara	ntn	Munro 1993: pl. 33	2	1			
28	V.9	Nebet ( <i>nbt</i> )	Saqqara	ntn	Munro 1993: pl. 10	1	1	1		
29	V.9	Iyefret ( <i>j-j-nfrt: š3.n.f</i> )	Saqqara	ntn	Kanawati & Abder-Raziq 2003: pl. 37	1	1			
30	V.9	Unas ( <i>Wnjs</i> )	Saqqara	ntn	Labrousse & Moussa 2002: fig. 42	2	2	1		
31	V.9-VI.1*	Sesheshet: Idut ( <i>š3š3t: jdw̄t</i> )	Saqqara	ntn	Kanawati & Abder-Raziq 2003: pl. 54	1	1			
32	V.9-VI.1	Nimaetre ( <i>nj-m3ṯ-rṯ jzj-mr-ntrj</i> )	Giza	G2097	Roth 1995: pl. 185	1	1			
33	V.9-VI.2	Akhethotep ( <i>šhtj-htp</i> )	Saqqara	E17	Petrie & Murray 1952: pl. 6	1	1			
34	VI.1	Kaemankh ( <i>k3.j-m-ṯnh</i> )	Giza	G4561	Junker 1940: abb. 8 and pl. 11	6	1			
35	VI.1	Hem-min ( <i>hm-mnw</i> )	El-Hawawish	M43	Kanawati 1985: figs. 6 and 7	2	1			
36	VI.1-2L	Merefnabef ( <i>mr̄rw-n-nbw.f</i> )	Saqqara	ntn	Myśliwiec 2004: pls. XXI and LXVI (j)	2	1			<i>D. chrysippus</i> (3,4); <i>ibid.</i> or <i>H. misippus</i> (2)
37	VI.1?	unknown owner (fragments inside tomb of <i>In-sneferu-ishtef</i> )	Dahshur	-	de Morgan 1896: fig. 516 (under " <i>Mera</i> "); Porter & Moss 1981: 891-2.	2	1			
38	VI.1E-M	Kagemni: Memi ( <i>k3.j-m-nj: mmj</i> )	Saqqara	LS10	Firth and Gunn 1926: pl. 52	3	2			
39	VI.1*	Seankhuptah: Hetepniptah ( <i>sṯnh-w(j)-pt̄h</i> )	Saqqara	ntn	Kanawati & Abder-Raziq 1998: pls. 69 and 76	7	1	1		
40	VI.1L*	Hesi ( <i>ḥzj</i> )	Saqqara	ntn	Kanawati & Abder-Raziq 1999: pls. 53-55	11	5	3	1	
41	VI.1M-2E*	Ankhmahor: Seshi ( <i>ṯnh-m-ṯhr: zsj</i> )	Saqqara	ntn	Kanawati & Hassan 1997: pl. 42	1	1			
42	VI.1M*	Nikausesi ( <i>nj-k3w-jzj</i> )	Saqqara	ntn	Kanawati & Abder-Raziq 2000: pl. 50	5	1	1		<i>D. chrysippus</i> (1)
43	VI.1L*	Mereruka: Meri ( <i>mr̄rw-k3j: mrj</i> )	Saqqara	ntn	Kanawati et al 2010: pl. 67	2	1			
44	VI.1M-L	Niankhnesut ( <i>nj-ṯnh-nswt</i> )	Saqqara	ntn	Leahy & Mathieson 2001: pl. 4	2	2			
45	VI.2	Meryre-meryptahankh: Nekhebu ( <i>mr̄j-rṯ-mrj-pt̄h-ṯnh: ḥḥbw</i> )	Giza	G2381	Smith 1958, fig. 2	1	1	1		
46	VI.2M-3?	Mehu ( <i>mḥw</i> )	Saqqara	ntn	Altenmüller 1998: pl. 34b	13	3	2		
47	VI.2L-4E*	Wernu ( <i>wr-nw</i> )	Saqqara	ntn	Davies et al. 1984: pl. 25	1	1			



TABLE 1. Continued.

#	Period	Tomb owner / object type	Provenance	Tomb #	Image from	NBT	NBI	LV	DR	Identification
48	VI.3-4E*	Ibi ( <i>jbj</i> )	Deir el-Gebrawi	no. 8	Davies 1902: pl. 5	1	1			Lycaenidae? (1)
49	VI.4-5	Pepyankh: Heni-kem ( <i>ppj-j-nh-hnj-km</i> )	Meir	A2	Kanawati & Evans 2014a: pl. 84	2	1			
50	VI.4L	Zau ( <i>d'w</i> )	Deir el-Gebrawi	no. 12	Davies 1902: pl. 3	2	1			
51	VI.5-6	Kahep: Thei-iker ( <i>k3-j-tp/Tj-jqr</i> )	El-Hawawish	H26	Kanawati 1980: fig. 8	1	1			
52	VI.5-6?	Pepiankh-heri-ib: Neferka/Heny ( <i>ppj-j-nh-hnj-jb</i> )	Meir	D2	Kanawati 2012: pl. 80	2	1			
53	VI.6	Idu: Seneni ( <i>jdaw: snnj</i> )	El-Qasr wa'l-Saiyad	T66	Keimer 1934: fig. 102; Wreszinski 1927: pl. 30A	1	1			
54	VI.6	Shepsipumin: Kheni ( <i>špsj-pw-mnw: bnj</i> )	El-Hawawish	H24	Kanawati 1981: figs. 18 and 22	2	2			locust or dragonfly? (2)
55	VI.7	Hemre: Isi ( <i>hm-r': izj</i> )	Deir el-Gebrawi	N72	Davies 1902: pl. 20	1	1			
56	XI.5	Intef ( <i>Unj-jlj.f</i> )	El-Assasif	TT386	Jaros-Deckert 1984: pl.16.	1	1			
57	XI-XII	Hippopotamus statuette a	Dra Abu el-Naga	-	Keimer 1934: fig. 106 (Cairo Antiquities Museum, 877 bis)	1	1			
57	XI-XII	Hippopotamus statuette b	Abydos	-	Keimer 1934: fig. 104 (Musées Royaux d'Art et d'Histoire de Bruxelles, E.02676)	1	1			
57	XI-XII	Hippopotamus statuette c	unknown	-	Page-Gasser & Wiese 1997: fig. 56 (private collection, Switzerland)	1	1			
57	XI-XII	Hippopotamus statuette d	Dra Abu el-Naga	-	Keimer 1934: fig. 105 (Cairo Antiquities Museum, 877)	1	1	1		
57	XI-XII	Hippopotamus statuette e	unknown	-	Musées Royaux d'Art et d'Histoire de Bruxelles (E.07055)	1	1			
57	XI-XII	Hippopotamus statuette f	unknown	-	Rhode Island School of Design (29.119)	1	1			
58	XII	Vase fragment	Kerma en Nubie	-	Keimer 1934: fig. 107; Reisner 1923: pl. 45	1	1			
59	XII	Gold pendant	unknown	-	Müller 1972: abb. 45 (State Museum of Egyptian Art, AS5381)	1	1			
60	XII-XIII	Faience amulets	Lisht	-	Arnold 1995: cat. 31 (22.1.1394, 15.3.512 and 15.3.513)	5	3			
61	XII.1	Senbi ( <i>Snbj</i> )	Meir	B1	Keimer 1937: fig. 211a; Blackman 1915a, pl. 2	2	1			
62	XII.2	Faience amulet (Senworset) ( <i>S-n(y)-Wsr.t</i> )	Lisht	-	Metropolitan Museum of Art (15.3.307)	1	1			
63	XII.3	Khnumhotep II ( <i>Hnmw-htp</i> )	Beni Hassan	no. 3	Rosellini 1834: pl.14; Kanawati & Evans 2014b	3	1			<i>D. chrysippus</i> f. <i>chrysippus</i> and <i>D. chrysippus</i> f. <i>alcippus</i> (2,3,6) ; moths (5);
64	XII.3	Ukhhotep ( <i>wb-htp</i> ) (son of Ukhhotep and Mersi)	Meir	B4	Blackman 1915b: pl. 6	1	1			<i>D. chrysippus</i> f. <i>alcippus</i> (2); <i>D. chrysippus</i> (3)
65	XII.4	Ukhhotep ( <i>wb-htp</i> ) (son of Ukhhotep and Henhyeryib)	Meir	C1	Blackman & Apted 1953: pl. 13	3	1			<i>D. chrysippus</i> (2)
66	XVIII.5	Puyemre ( <i>Pwj-m-R'</i> )	El-Khokha	TT39	Metropolitan Museum of Art (30.4.12: watercolour copy by H.R. Hopgood)	2	1			<i>Agila tau</i> ? (Saturniidae)(1); <i>D. chrysippus</i> (1, 2,7); moths (5); unidentifiable (6)
67	XVIII.5-7	Neferhotep ( <i>Nfr-htp</i> )	Thebes	A5	Louvre (E 13101)	5	1			<i>H. misippus</i> (1); unidentifiable (2)
68	XVIII.5-9	Horemheb ( <i>Hr-m-hb</i> )	Sheikh Abd el-Qurna	TT78	Brack & Brack 1980: pl.22	1	1			<i>Limenitis reducta</i> (1); unidentifiable (2)
69	XVIII.6	Amenhotep(?)	Sheikh Abd el-Qurna	TT73	Säve-Söderbergh 1957: pl. 7	6	1			
70	XVIII.8	Menna ( <i>Mnn3</i> )	Sheikh Abd el-Qurna	TT69	Davies 1936: pl. 54	2	1			<i>Colotis fausta</i> (1); <i>D. chrysippus</i> or <i>H. misippus</i> (2)
71	XVIII.8	Nakht ( <i>Nbt</i> )	Sheikh Abd el-Qurna	TT52	Davies 1917: pl. 24; Mekhitarian 1978: 71	4	2			? <i>H. misippus</i> or <i>D. chrysippus</i> (2); butterflies and moths (5)
72	XVIII.8-9	Nebamun ( <i>Nb(=j)-Jmn</i> )	Luxor	ntn	Davies 1936: pls. 65 and 66	7	2	1		<i>Issoria</i> (2); <i>D. chrysippus</i> (2,8); <i>Vanessa</i> (9); <i>Euploea</i> (10)
73	XVIII.9	Amenhotep III ( <i>Jmn-htp III</i> )	Malqata	-	Curtius 1913: fig. 47.	3	1			<i>D. chrysippus</i> f. <i>dorippus</i> or <i>Precis octavia</i> (1); <i>D. chrysippus</i> (2, 3); "Pyrameis cardui" (6)
74	XVIII.10	Pavement (Amenhotep IV / Akhenaton) ( <i>3b-n-Jtn</i> )	Amarna	-	Keimer 1934: fig. 111; Petrie 1894: pls. 2 and 3	3	3	1		<i>D. chrysippus</i> or <i>H. misippus</i> (2)
75	XVIII.10	Ceramic tile	probably Amarna	-	Keimer 1934: fig. 112; Wallis 1900: fig. 10	1	1			
76	XVIII.10-15	Inlay	unknown	-	Cleveland Museum of Art (1914.789)	1	1			
77	XVIII.13	Neferhotep ( <i>Nfr-htp</i> )	El-Khokha	TT49	Germond 2008: fig. 11; Keimer 1934: fig.113; Davies 1933: p. 79/82	6	1			
78	XVIII.14-XIX.3	Neferhotep ( <i>Nfr-htp</i> )	Deir el-Medina	TT6	Wild 1979: fig.1	1	1	1		
79	XIX.3	Simut ( <i>S3-mw.t, Kjkj, Z3-mwt</i> )	El-Assasif	TT409	Wilkinson 1837: no. 336; Malek 1993: fig. 41	3	2	1		Lycaenidae? (1)
80	XIX.3	Nebwenenef ( <i>Nb-wnn.f</i> )	Dra Abu el-Naga	TT157	Wilkinson 1837: no. 341	1	1			Alucitidae? (1)
81	XXV.3-XXVI.1	Montuemhat ( <i>mnt-m-h3t</i> )	El-Assasif	TT34	Malek 1993: fig. 21 (Museo Gregoriano Ergizio, 22765)	1	1			
82	unknown	Relief fragment	unknown	-	Los Angeles County Museum of Art (M.80.199.137)	1	1			

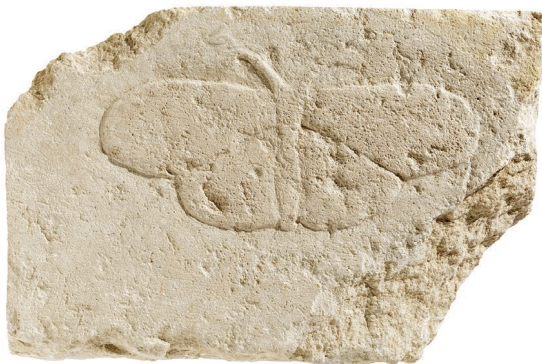


FIG. 5. Butterfly relief from Los Angeles County Museum of Art (LACMA #M.80.199.137). Photo Credit: Los Angeles County Museum of Art, reproduced with permission

coloration and patterning suggest that the latter is a Plain Tiger, *Danaus chrysippus* (Fig. 8a). This common species (or its close mimic, the female of *Hypolimnys misippus*) also appears in many other tombs, from the Old Kingdom period through to the New Kingdom, including Ty<sup>17</sup>, Merefnebef<sup>36</sup>, Nikauisesi<sup>42</sup>, Khnumhotep II<sup>63</sup>, Ukhhotep<sup>64</sup>, Nebamun<sup>72</sup>, and others (Keimer 1934, Larsen 1979, Lopez-Moncet & Aufrère 1999, Fleuren 2010). Some of these (e.g. Merefnebef<sup>36</sup>) were evidently drawn from specimens of the form *f. alcippus*, which display whitish hindwings (Fig. 8b). The butterflies on the ceiling of the New Kingdom palace of Amenhotep III<sup>73</sup> seem to belong to *D. chrysippus f. dorippus*, a form that lacks the black area on the tip of the forewings (Fig. 8c). Other possibilities in this case are *Vanessa cardui* (Keimer 1934: 210) as well as the summer form of *Precis octavia* Cramer, 1777 (Nymphalidae) (Fig. 8d), although this savannah butterfly today occurs only south of Somalia to South Africa (Larsen 1991).

If the salmon color of the two butterflies in the tomb of Menna<sup>70</sup> reflects their original coloration and is not a product of their age, it may suggest that *Colotis fausta* was the model and not *D. chrysippus* as posited by Fleuren (2010), although the painting is otherwise highly stylized (Fig. 8e). Round-winged, light-colored butterflies with black dots speckled on the upper- or undersides of the wings are found in the tombs of Ibi<sup>48</sup> and Simut<sup>79</sup>; these may have been inspired by polyommata blue butterflies (Lycaenidae).

Some of the butterflies depicted on the hippopotamus figurines<sup>57</sup> could also be interpreted as *D. chrysippus*; Germond (2008) suggested that *Polyommatus icarus* may have been another model, although this species is very rare in Egypt today. He also proposed that the butterflies in the Middle Kingdom

tombs of Senbi<sup>61</sup> and Ukhhotep<sup>64</sup> are probably *D. chrysippus*, but in our opinion these insects are too stylized to be certain.

Dark butterflies with white dots first appear in tomb paintings from Dynasty XVIII onwards (Neferhotep<sup>67</sup>, Horemheb<sup>68</sup>, Nakht<sup>71</sup>). The only butterfly matching this profile in Egypt today is the male of *Hypolimnys misippus*, with dark wings marked by six conspicuous white spots (Fig. 8f–g). This morphology closely matches butterflies in the tombs of Neferhotep<sup>67</sup> and Nakht<sup>71</sup>, where (in the latter case) the *Danaus*-mimicking female is also depicted (Fig. 1i). A dark butterfly in the tomb of Horemheb<sup>68</sup> has numerous white dots, and its pointed wings also suggest that it may have been drawn from a specimen of *Limenitis reducta*, a butterfly that is absent from Egypt but is found today in southern Europe to northern Israel, Jordan, Lebanon, Syria and Iran in the Mediterranean zone (Higgins & Riley 1970) (Fig. 8h).

In some cases, a thicker body and triangular shape of the wings suggest that the image was perhaps drawn from a moth model rather than a butterfly (e.g. Hetepet<sup>4</sup>, Rudj-Ka<sup>13</sup>). The two insects in the tomb of Puyemre<sup>66</sup> with stout bodies and large eye-spots on each wing (Fig. 1f) have been suggested to be a stylized ventral view of *D. chrysippus* (Davies 1922), although they also resemble Saturniid moths, namely the Eurasian *Agria tau* (Fig. 1f). The “butterfly” in the tomb of Nebwenenef<sup>80</sup> may have been derived from an Alucitid moth. The insect depicted in the tomb of Hesi<sup>40</sup> with three pairs of wings and long antennae resembles a pterophorid moth (Fig. 9a) (Evans 2010). Pterophorids favor humid habitats and are common in marshes. Similar insects with only two pairs of identical narrow wings (e.g. Itisen<sup>10</sup>, Iasen<sup>23</sup>, Inefret<sup>29</sup>, Nakht<sup>71</sup>, etc.) have been thought to represent dragonflies or locusts (Keimer 1932). We suggest that some of these may be Neuropterans, namely antlions (Myrmeleontidae) and owlflies (Ascalaphidae) (Fig. 9b–c). These are dragonfly-like insects with visible, often long antennae that are also common in marshes and along riverbanks. At least 70 species of antlions and six species of owlflies have been recorded in Egypt (El-Hamouly & Fadl 2011).

**Cladistic analysis.** In our inferred tree (Fig. 10), the examined images from the three main historical time periods were not monophyletic. Although Old Kingdom butterflies mostly stayed together, odd butterflies from the provincial tombs of Kahep/Theti-iker<sup>51</sup> and Idu: Seneni<sup>53</sup> were outliers. Most of the Middle Kingdom butterflies also clustered closely and emerged near to or within examples from the Old Kingdom, although a few (especially jewelry and faience amulets) diverged. Butterflies painted on hippopotamus statuettes from



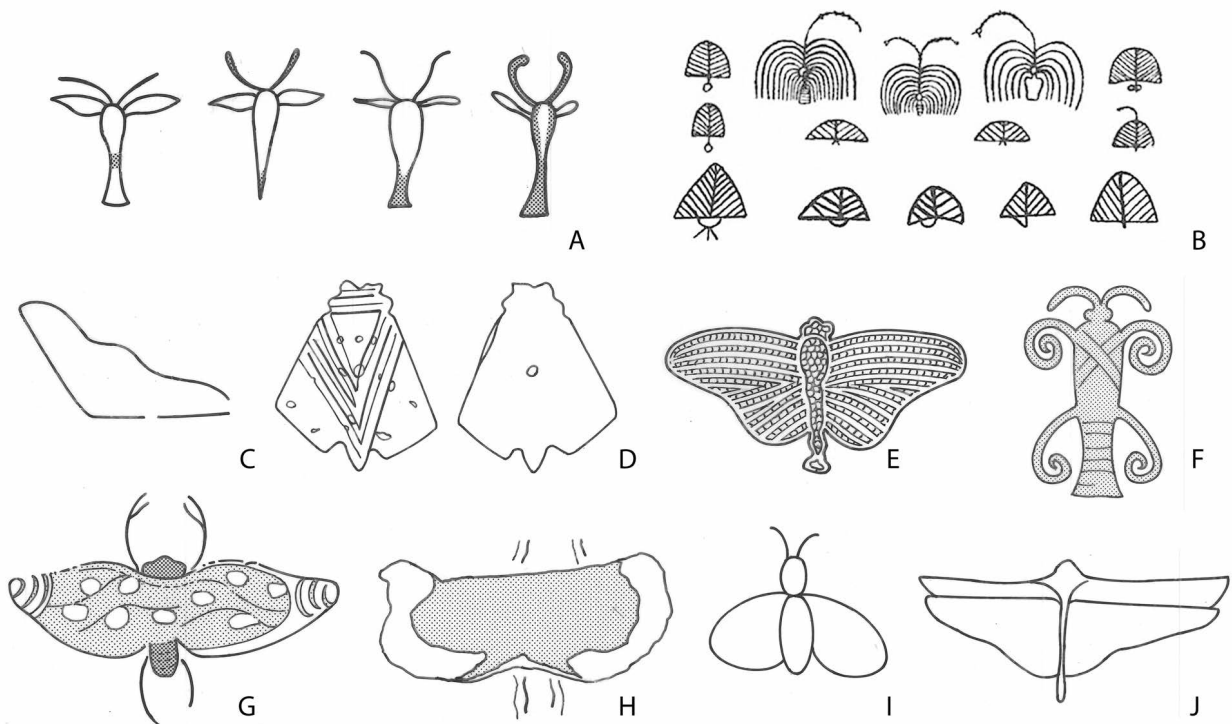


FIG. 6. Items excluded from this study. For corresponding information, see Table 2.

this period were also dissimilar and did not cluster together. Similar diversity was evident among the New Kingdom butterflies: The majority of examples from this period appeared in two monophyletic clusters, while a few from mid-Dynasty XVIII onwards (i.e. Amenhotep III<sup>73</sup>, Amenhotep IV/Akhenaton<sup>74</sup> and Montuemhat<sup>81</sup>) diverged from the rest.

The relief without provenance in the LACMA (Fig. 5) emerged as most similar to a butterfly from the Dynasty V tomb of Inefret<sup>29</sup> and in a large cluster with several other late Dynasty V-early Dynasty VI butterflies, mostly from Saqqara.

DISCUSSION

**Evolution of an art form.** Ancient Egyptian art conformed to very strict graphic principles, but it seems that butterflies were to some extent exempt from these rules as evident by variations in their representation, even within the same time period. The unique range of artistic manifestations expressed by the Egyptian artists in painting butterflies in tomb scenes extends throughout the Old and New Kingdom periods (2686-1069 BC): Some are abstract and stylized, while others show such great attention to detail that they can be easily identified to species today.

TABLE 2: Items excluded from this study. For identification Sources, see Table 1.

#	Period	Tomb owner / object type	Provenance	Tomb #	Image from	Identification
a	Predynastic	Letter T			Keimer 1934:205	bovine symbolism? (1)
b	Predynastic	Vase ornaments (von Bissing 1913)			Keimer 1934:188-191; in Cairo Museum	trees (6)
c	VI.1M-2E*	Ankhmahor: Seshi ( <sup>ṣ</sup> n ḥ- m- <sup>ṣ</sup> - ḥr: zꜣj)	Saqqara	ntn	Kanawati and Hassan 1997: pl. 72; fragment TNE95:147 (found inside the tomb)	not a butterfly (1)
d	XI-XII	faience plaque	Lisht	-	Keimer 1934; in Cairo Museum	stylized insect (1,6)
e	XII.1	Khnumet (Khenemet) Jewelry	Dahshur	-	Lilyquist 1993: 36-37.	not of Egyptian origin (Lilyquist 1993)
f	XVII-XVIII	insect with spiral wings on steatite amulet	Luxor	-	Keimer 1934; in Cairo Museum	stylized insect (1,6)
g	XVIII.6	Amenemhat	Sheikh Abd el-Qurna	TT82	Davies 1936:Pl.19	probably a Cicada (1)
h	XVIII.6-7	Menkheperaseneb	Sheikh Abd el-Qurna	TT79	Fleuren 2010	unfinished, butterfly? (1,2)
i	XVIII	unknown	Thebes		Raven 2000:68	probably Diptera (1)
j	XIX	Thutmoses (Djehutymose, Djehutymes)	El-Assasif	TT32	Kákosy et al 2004:p.267	locust (1)

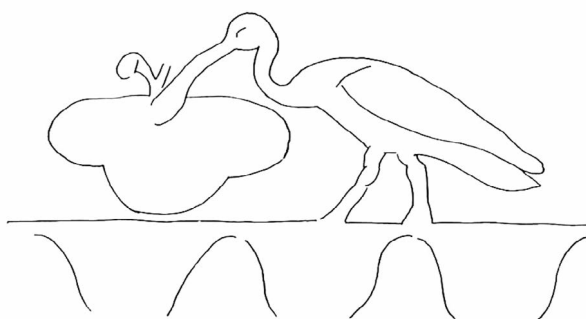


FIG. 7. Butterfly being hunted by an ibis, tomb of Mehu <sup>46</sup> (from Evans 2010).

Our results show that the artistic styles with which butterflies were represented in tombs reflects to a large extent the temporal divide in ancient Egyptian history. With a few exceptions, the butterflies of the Old Kingdom period clustered together, reflecting the relative consistency of the art during this period. While the Old Kingdom butterflies of Giza and Saqqara were relatively similar in style, those in the provincial cemeteries of El-Hawaish (Kahep/Theti-iker <sup>51</sup>) and El-Qasr wa'l-Saiyad (Idu: Seneni <sup>53</sup>) were drastically different, suggesting that their location, far away from the country's capital, may have contributed to a more unique type of representation. During the Middle Kingdom period, although some unique new forms appeared (e.g. faience amulets from Lisht <sup>60</sup>), representations of butterflies remained similar to the Old Kingdom styles popular in Saqqara and Giza. This finding accords well with other evidence indicating that Middle Kingdom artists actively copied earlier images in order to re-establish traditional decorative themes and styles that had been abandoned following the collapse of the Old Kingdom period in late Dynasty VI (Kanawati 2011).

By the beginning of the New Kingdom, very little was left of the designs of the Old or Middle Kingdom periods. Butterfly imagery flourished in form and began to appear outside of tombs, in palaces and temples. Most of the butterflies in this period were drawn with meticulous attention to detail (e.g. Nebamun <sup>72</sup>), although apparently realism was not always of concern. This freer approach to butterfly morphology possibly reflects radical changes to the traditional arts that took place briefly in the Dynasty XVIII reign of king Akhenaton (c. 1352–1336 BC), during which a more naturalistic style was encouraged. The greater diversity in butterfly shapes in the New Kingdom period may also indicate a growing interest in, and awareness of, the natural world, as does the increased number of identifiable species from this period (Table 1).

**Dating of unknown artifacts.** The close association between the LACMA relief (Fig. 5) and a butterfly from the Dynasty V tomb of Iyefret 29 in Saqqara strongly suggests an Old Kingdom date for the former, as well as a possible place of origin. Also, a polychrome faience inlay with painted decoration from the Cleveland Museum of Art <sup>76</sup>, currently dated to 1350–1296 BC (Dynasty XVIII.10–15), appeared among a number of New Kingdom butterflies from Dynasty XVIII.6–8, all from Thebes, hinting at a specific locality and a slightly earlier date for this artifact.

The predominance of two-winged butterflies prior to late Dynasty V in all but one tomb (Neferseshemtah/Sekhentiu <sup>15</sup>) suggests that the latter may have been dated incorrectly, and perhaps belongs to a later period. Indeed, our working date of Dynasty V.6–8E for the tomb is based on Swinton's (2014) recent re-assessment of the structure. Earlier studies (Moussa & Junge 1975; Harpur 1987, 2006), however, dated Neferseshemtah/Sekhentiu to Dynasty V.9, the reign of Unas (during which the proposed style change occurred). Our cladistic analysis suggests strongly that a later date is preferable and indeed, the butterfly in this tomb appears most similar to one from the tomb of Ankhmahor: Seshi <sup>41</sup>, recently re-dated by Swinton (2014) to early Dynasty VI. In addition, it would appear that the two-winged butterfly from the tomb of Kaemankh <sup>34</sup>, which has frequently been dated to early Dynasty VI (e.g. Junker 1940: 4; Smith 1978: 206, etc) and upon which our analysis was performed, more likely dates to late Dynasty V or earlier, agreeing with Kanawati (2001: 15–18) and Woods (2009: 172), who believe that architectural and artistic details support a date in the reign of Djedkare/Isesi (Dynasty V.8).

**Historical biogeography.** Past studies attempting to identify ancient Egyptian butterflies have tried to corroborate them with the present fauna of the region (Keimer 1934, Larsen 1979, Lopez-Moncet & Aufrère 1999, Fleuren 2010; etc.). Of the 61 butterfly species known to occur in Egypt today, it seems only a few were used as models by ancient Egyptian artists. Among the identifiable butterflies in Egyptian tombs, various forms of *D. chrysippus* and the dark male of *H. misippus* are unmistakable (Table 1). In general, *D. chrysippus* was the most commonly depicted butterfly throughout the pharaonic period (Fleuren 2010). All other identifications however should be considered doubtful and tentative. Here we propose that in at least two instances, both from the New Kingdom period (Dynasty XVIII), the depicted butterflies may have been modeled after species that no longer occur in Egypt: *Limenitis reducta* (tomb of Horemheb <sup>68</sup>, Sheikh Abd el-Qurna), and *P. octavia* (palace of Amenhotep III <sup>73</sup>, Malqata).





FIG. 8. Potential model butterflies for ancient Egyptian painters. (a) *Danaus chrysippus*; (b) *D. chrysippus* f. *alcippus*; (c) *D. chrysippus* f. *dorippus*; (d) *Precis octavia*; (e) *Colotis fausta*; (f) *Hypolimnna misippus* male; (g) *H. misippus* female; (h) *Limenitis reducta*. Photo Credits: 8a: Wikimedia Commons, CC license; 8b: Liyana Zolpakar, reproduced with permission; 8c: Elena Stefanova, reproduced with permission; 8d: Bart Wursten, reproduced with permission; 8e: Wikimedia Commons, CC license; 8f: Oleg E. Kosterin, reproduced with permission; 8g: Milind Bhakare, reproduced with permission; 8h: Bernard Fransen, reproduced with permission.

While these butterflies are common throughout their present range in Eurasia (*L. reducta*) and Africa (*P. octavia*) (Williams 1969; Higgins & Riley 1970) and their larval host plants still occur in Egypt (*L. reducta*: *Lonicera caprifolium*; *P. octavia*: *Plectranthus* spp.) (Muschler 1912), both species prefer humid habitats. If our identifications are correct therefore, it would suggest that the climate during the New Kingdom period was not as hot and dry as currently believed. Although both identifications are speculative, it is plausible to think that the species may have occurred in Egypt in the past but have since disappeared from the area, an argument that can also be made for many other animals depicted in ancient Egyptian art. For example, hippopotamus (*Hippopotamus amphibius*) and addax

(*Addax nasomaculatus*) are no longer found in the country, having succumbed to hunting and habitat pressure in the late 1800s, while other species (e.g. African elephants (*Elephas maximus*), Cape hunting dogs (*Lycaon pictus*) etc) may have become locally extinct during the pharaonic period (Osborn & Osbornová 1998). It is nevertheless unwise to infer either species occurrences or extinctions from Egyptian visual data as this was heavily constrained by tradition, such that animals might be illustrated for cultural reasons, irrespective of their natural occurrence. Artists frequently copied motifs from earlier tombs, which could potentially include animals that no longer survived in the region. It is interesting to note, therefore, the divergent butterflies found in the Dynasty XXV–XXVI



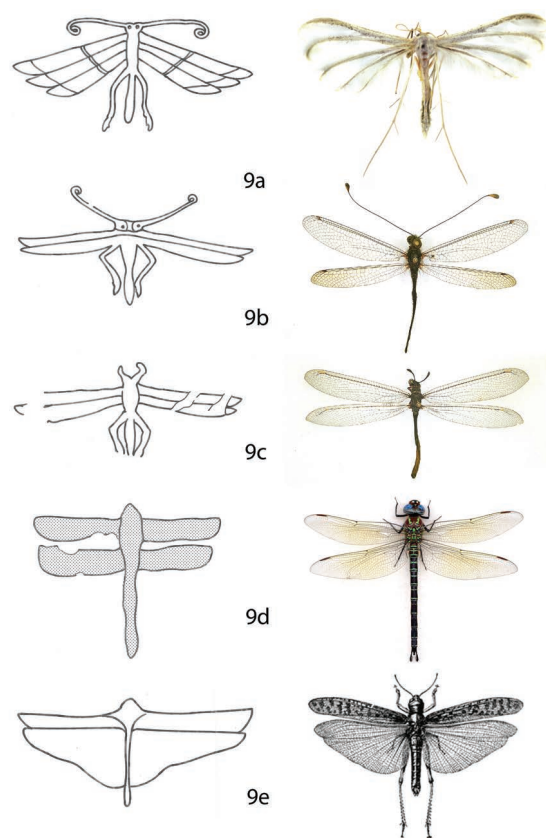


FIG. 9. Pterophorids and other insects in tombs. (a) Hesi<sup>40</sup>; (b) Nikauisesi<sup>42</sup>; (c) Seankhuptah: Hetepnptah<sup>39</sup>; (d) Nakht<sup>71</sup>; (e) Kaemnefert<sup>18</sup>.

tomb of Montuemhat<sup>80</sup> (see above), as this structure dates from a period when both the content and style of Dynasty V and VI tombs were copied frequently; indeed, Montuemhat is one of the most extreme examples of this archaistic practice.

**Symbolism.** The symbolic meaning of butterflies in art and history in later periods is well documented (Gagliardi 1976, Nazari 2014). The best examples come from the Roman era and the story of Psyche and Cupid, where the death and rebirth of the former is symbolized by the fragile wings of a butterfly going through the stages of metamorphosis ([Blatchford] 1889). Although some insects, such as scarab beetles, had clear religious or cultural connotations (e.g. Ward 1994), the symbolic significance of butterflies for the ancient Egyptians is yet to be determined. Several authors have argued that because the butterflies found in Egyptian tombs were part of the funerary goods of the deceased, they must also have possessed a symbolic or magical meaning related to the afterlife (e.g. Lopez-Monet & Aufrère

1999, Germond 2008, Espinel 2015). The marsh scene, where butterflies appear most often, has been variously interpreted to have a symbolic meaning, either as the re-establishment of order and defeat of chaos, as an identification of the tomb owner with the king who could perform fishing and fowling on sacred lakes as a royal ritual, or as a sexual unification between the tomb owner and his wife with aspects of rebirth (Dodson & Ikram 2008). Many of the elements in marsh scenes are considered to have symbolic meanings, e.g. the Nile tilapia (*Tilapia niloticus*) is described as a symbol of sexuality, rebirth and renewal, and the lotus flower, usually held by figures accompanying the deceased, is interpreted as an icon of fertility (Desroches-Noblecourt 1954). Similarly, butterflies have been interpreted as symbols of transformation and regeneration (Keimer 1934, Servajean 1999, Germond 2008). Lopez-Moncet & Aufrère (1999) have argued that because *Calotropis*, a host plant of *D. chrysippus*, was associated with the goddess Hathor and was known to have magical properties, the butterfly itself must also have had a great symbolic meaning for the ancient Egyptians.

Such speculations remain controversial however due to lack of concrete evidence. Considering the very large number of surviving Egyptian tombs, butterfly iconography must be considered quite rare. Among tombs with a marsh scene, only about 20% contain butterflies (Fleuren 2010). There is no evidence that the ancient Egyptians knew anything about metamorphosis, and in fact even the Egyptian word for butterflies is not yet known (Hannig & Vomberg 1998). Butterflies, together with birds and bats, were considered “beasts of the sky” (Levinson & Levinson 2009). These facts undermine the significance of butterflies as essential symbolic icons. Based on several ancient Egyptian texts, Feucht (1992) has argued that the meaning behind fishing and fowling scenes was simply that the tomb owners wished to continue the pleasure of these activities in the afterlife, and so butterflies were sometimes added as naturalistic elements of the marsh (Fleuren 2010). Today butterflies are commonly found in the Egyptian swamps, and the most common butterfly species in the country, *D. chrysippus*, is also the most frequently depicted in tomb scenes. It may be, therefore, that this species simply represented a faunal “type” by which to indicate the presence of butterflies in general in such environments (Evans, in press).

#### CONCLUSION

This study has demonstrated the utility of cladistic analysis in estimating dating patterns for archaeological artifacts of unknown origin when examined in the larger context of similar objects. It has also shown the ways in

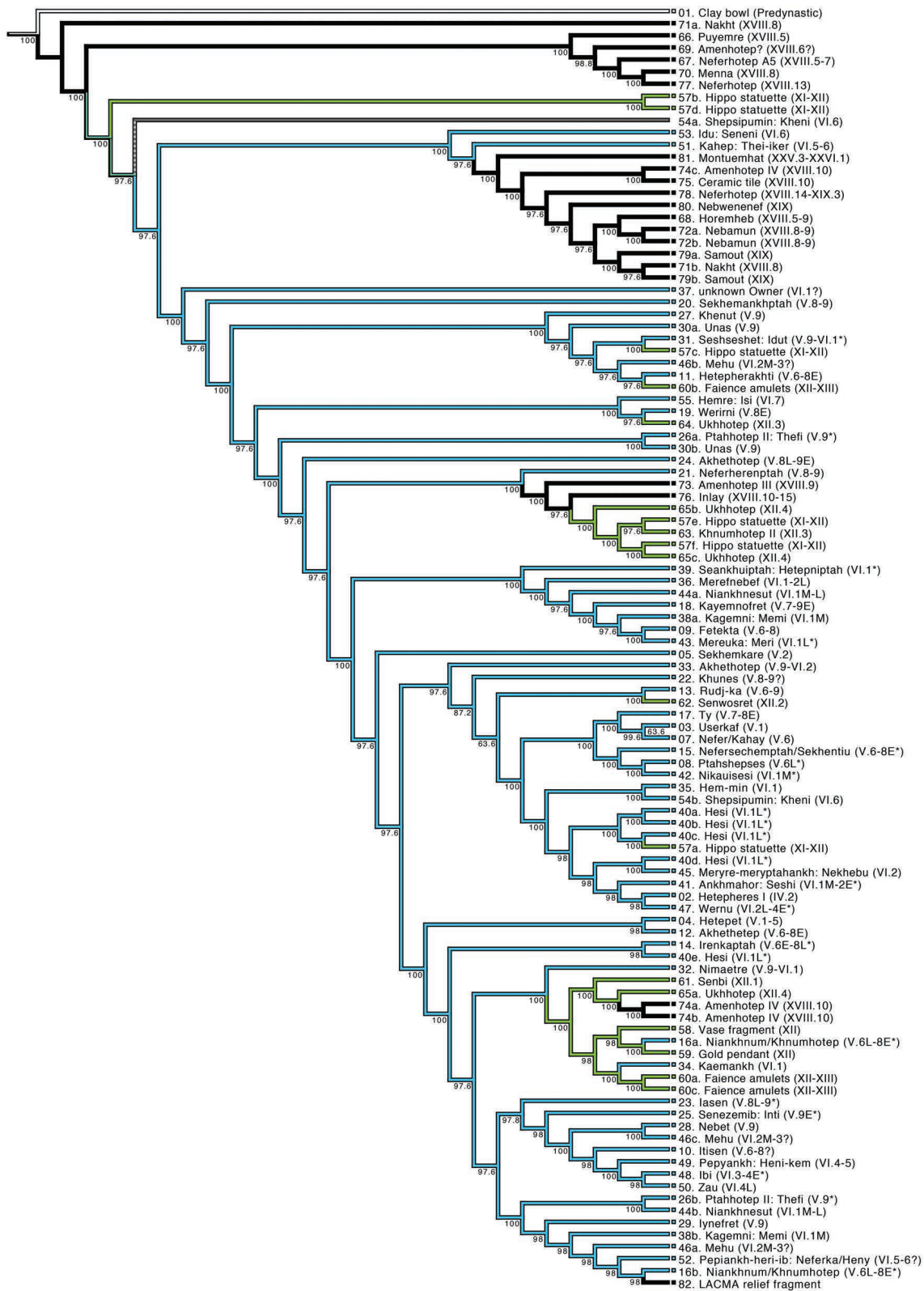


FIG. 10. Majority-Rule consensus tree of 500 equally parsimonious trees (TL=407). Percent consensus frequencies are plotted below each node. Branch colors were plotted post-tree reconstruction based on time periods (blue=Old Kingdom, green=Middle Kingdom, black=New Kingdom).

which butterflies featured in ancient Egyptian cultural materials throughout the pharaonic era. Although it cannot yet be understood what function these insects may have filled—perhaps as symbols of regeneration (Germond 2008) or a wish by the tomb owner to defeat death (Espinel 2015)—their representation may well have been thought to impart a beneficial effect of some kind. Indeed, the repeated occurrence of specific animal species, such as butterflies, within the tomb environment certainly hints at an underlying rationale for their inclusion (Evans, in press). Ultimately, however, as butterflies are inherently decorative, their greatest contribution to Egyptian culture will have been their brilliant colors and graceful forms, which made them a striking addition to artworks in any medium.

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SEE APPENDIX 1 & 2 ON THE NEXT 5 PAGES

## APPENDIX 1. Characters and character state definitions

1. General shape: trapezoid (0), "><" (1), "<>" (2), triangulate  $\Delta$  (3), round c (4), "olo" (5)
2. Discernible number of wings: 4 wings (0), 2 wings (1), >4 wings (2)
3. Forewing costa vs. body axis: 135-108° (4), 107-91° (3), 90° (2), 89-62° (1), 61-45° (0)
4. Head: absent (0), present (1)
5. Thorax: absent (0), present (1)
6. Abdomen: absent (0), present (1)
7. Eyes: absent (0), present (1)
8. Spots within eyes: absent (0), present (1)
9. Body ornamentation: none (0), dots (1), segmented thorax/abdomen (2), abdomen colored (3), body vertically divided (4), 1+2 (5), 2+3 (6), 1+3 (7)
10. General proportions: ~2:1 (0), ~1:1 (1), ~1:2 (2)
11. Groove between forewing and hindwing: absent (0), slight (1), normal (2), very deep (3), wavy or serrated edge (4)
12. Line dividing FW and HW: absent (0), present (1)
13. Fringes: absent (0), present (1)
14. Wings: open (0), closed (1)
15. Costal band: absent (0), present (1)
16. Forewing marginal band: absent (0), present (1)
17. Hindwing marginal band: absent (0), present (1)
18. Forewing apical area: absent (0), present (1)
19. Forewing apical patch: absent (0), present (1)
20. Dots on the wings: absent (0), present, positive (1), present, negative (2)
21. Wing venation: absent (0), present on both wings (1), present on HW only (2), present on FW only (3)
22. Antennae: absent (0), present (1)
23. Antennae length if unrolled: less than half length of FW (0), equal or more than half length of FW (1), longer than the length of FW (2)
24. Antennae filament: straight (0), curved inwards (1), curved outwards (2), wavy (3)
25. Antennae Club: absent (0), present, straight (1), present, curved inwards (2), present, curved outwards (3)
26. Antennae positioning compared to Forewing costa: 90° (0); 90°-45° (1), 45°-0° (2).
27. Number of front legs: 0 (0), 2 (1), 4 (2)
28. Number of thoracic legs: 0 (0), 2 (1), 4 (2)
29. Number of hind legs: 0 (0), 2 (1), 4 (2)
30. Hairpencils: absent (0), present (1)
31. Mouthparts: absent (0), present (1)
32. Location: Northern Egypt (0) (incl. Abusir, Abu Ghurab, Dahshur, Giza, Lisht and Saqqara); Middle Egypt (1) (incl. Amarna, Beni Hassan, Deir el-Gebrawi, El Sheikh Said, Meir, Zawyet el-Amwat); Lower Egypt (2) (incl. Abydos, El-Hawawish, El-Qasr wa'l-Saiyad, Luxor, Malqata, Naqada, and Thebes [Deir el-Medina, Dra Abu el-Naga, El-Assasif and El-Khokha and Sheikh Abd el-Qurna]); Nubia (Kerma, modern day Sudan) (3)



Appendix 2. Data matrix.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
01 Clay bowl Predynastic	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	?	?	-	0	0	0	0	0	0	0	2
02 Hetepheres I IV:2	0	2	2	1	1	1	0	0	3	0	4	1	0	0	0	1	1	1	0	0	0	1	0	1	0	1	0	0	0	0	1	0
03 Userkaf V.1	0	0	1	?	1	1	0	0	0	0	1	0	0	0	1	1	1	1	1	0	0	1	0	1	2	1	0	0	0	0	0	0
04 Hetepet V.1 5	2	0	3	?	1	1	0	0	0	0	?	0	0	0	0	1	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
05 Sekhemkare V.2	0	1	3	1	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	-	-	-	-	0	0	0	0	0	0
06 Niuserre V.6	0	0	3	?	1	?	?	?	0	0	1	1	0	0	0	0	0	0	0	0	2	?	?	?	?	?	?	0	0	0	?	0
07 Nefer/Kahay V.6	0	0	1	?	1	1	0	0	2	0	1	0	0	0	1	1	1	1	0	0	0	1	0	1	2	0	0	0	0	0	0	0
08 Ptahshepses V.6L*	?	0	3	1	1	1	1	0	0	?	?	0	0	0	1	?	1	?	?	0	1	1	0	2	3	1	0	0	0	0	0	0
09 Fefekta V.6-8	0	0	1	1	1	1	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	1	2	1	2	1	0	0	0	0	0	0
10 Itisen V.6-8?	3	1	4	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	1	0	0	0	0	0	0
11 Hetepherakhti V.6-8E	0	0	3	?	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	2	3	1	0	0	0	0	0	0
12 Akhetetep V.6-8E	0	0	3	1	1	1	1	0	0	1	0	0	0	0	?	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
13 Rudj-ka V.6-9	2	0	3	1	1	1	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	-	-	-	-	0	0	0	0	0	0
14 Irenkaptah V.6E-8L*	0	0	3	?	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0	0	0	0	0	0
15 Nefersechemptah/ Sekhentiu V.6-8E*	0	0	3	1	1	1	1	0	0	0	2	1	0	0	?	1	0	1	1	0	0	1	1	2	0	1	0	0	0	0	0	0
16a Niankhnum/ Khnumhotep V.6L-8E*	0	0	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0
16b Niankhnum/ Khnumhotep V.6L-8E*	0	0	3	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	2	0	0	0	0	0	0	0
17 Ty V.7-8E	0	0	1	1	1	1	0	0	0	0	1	0	0	0	1	1	1	1	1	0	0	1	1	1	0	1	0	0	0	0	0	0
18 Kayemnofret V.7-9E	0	0	1	1	1	1	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	1	1	2	1	0	0	0	0	0	0
19 Werimi V.8E	0	0	3	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	2	0	1	0	0	0	0	0	1
20 Sekhemankhptah V.8-9	0	0	3	1	1	1	0	0	4	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0
21 Neferheretptah V.8-9	0	0	3	?	1	1	0	0	0	0	1	0	0	0	1	1	1	0	0	0	1	1	0	2	1	1	0	0	0	0	0	0
22 Khunes V.8-9?	0	0	3	?	1	1	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	1	0	3	?	?	0	0	0	0	0	1
23 Iasen V.8L-9*	0	0	3	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	0	0	0	0	0	0
24 Akhetetep V.8L-9E	0	0	3	1	?	1	0	0	0	0	1	1	0	0	1	1	1	0	0	0	0	1	0	2	0	1	0	0	0	0	0	0
25 Senezemib: Inti V.9E*	0	0	3	1	?	?	?	?	?	?	2	0	0	0	0	0	0	0	0	0	?	?	?	?	?	?	?	?	?	?	?	?
26a Prakhhotep II: Theft V.9*	0	0	3	1	1	1	0	0	0	0	1	1	0	0	1	1	0	1	0	0	1	0	2	3	1	0	0	0	0	0	0	0
26b Prakhhotep II: Theft V.9*	0	0	-	1	1	1	0	0	0	-	2	1	0	1	0	0	0	0	0	0	0	1	1	1	2	3	1	0	0	0	1	0
27 Khenut V.9	0	0	3	?	?	?	?	?	?	?	2	0	0	0	0	0	0	0	0	0	0	1	1	2	3	1	0	0	0	0	0	0
28 Nebet V.9	0	0	4	1	1	?	?	?	?	?	-	2	1	0	1	0	1	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0
29 Iynefret V.9	0	0	3	1	1	1	1	0	0	0	2	1	0	0	0	0	0	0	0	0	0	1	1	1	2	0	0	0	0	0	0	0

[illegible]

Appendix 2. Data matrix. (continued)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
50 Zau VI.4L	4	0	4	?	?	?	?	0	0	?	1	3	1	0	0	0	0	0	0	?	0	?	?	?	-	-	0	0	0	0	0	1
51 Kahep: Thei-iker VI.5-6	4	1	1	?	1	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	?	?	?	-	-	1	0	1	0	0	2	
52 Pepiankh-heri-ib: Neferka/Heny VI.5-6?	0	0	3	?	?	1	0	0	0	0	3	1	0	0	0	0	0	0	0	0	1	1	1	2	1	0	0	0	0	0	1	
53 Idu Seneni VI.6	4	?	2	1	1	1	0	0	0	1	0	?	0	0	1	0	0	0	0	0	0	-	-	-	-	1	0	1	0	0	2	
54a Shepsipumin Kheni VI.6	0	0	3	1	?	1	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	-	-	-	-	0	0	0	0	0	2	
54b Shepsipumin Kheni VI.6	0	0	1	1	?	1	0	0	0	2	2	1	0	0	1	0	1	0	0	0	0	-	-	-	-	0	0	0	0	0	2	
55 Hemre: Isi VI.7	0	0	3	?	1	?	0	0	0	0	2	1	0	0	0	0	0	0	0	?	-	-	-	-	-	0	0	0	0	0	1	
56 Intef XI.4	0	4	1	1	?	?	0	0	?	0	3	0	0	0	0	1	1	0	0	1	0	1	1	0	0	0	0	0	?	0	2	
57a Hippo statuette XI-XII	0	0	3	1	1	1	0	1	3	-	2	1	0	1	1	1	?	1	?	1	1	1	3	0	2	1	1	0	1	1	2	
57b Hippo statuette XI-XII	0	0	3	1	1	1	0	0	2	0	2	1	0	0	0	0	0	0	0	0	0	-	-	-	?	0	0	0	0	0	2	
57c Hippo statuette XI-XII	0	0	1	1	1	1	0	0	2	0	1	1	0	0	1	1	0	0	0	1	1	0	2	?	2	0	0	0	0	0	?	
57d Hippo statuette XI-XII	0	0	3	1	1	1	0	0	2	0	2	?	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	2	0	0	2	
57e Hippo statuette XI-XII	0	0	3	1	1	1	1	1	2	0	1	?	0	0	1	1	1	0	0	1	1	2	3	1	2	0	0	0	1	0	?	
57f Hippo statuette XI-XII	0	0	1	1	1	1	1	0	2	0	2	0	0	0	1	1	1	0	0	1	1	1	3	1	2	0	0	0	1	0	?	
58 Vase fragment XII	0	0	1	1	1	?	1	1	0	0	1	?	0	0	?	0	?	0	0	0	1	1	0	1	0	1	0	0	0	0	3	
59 Gold pendant XII	0	0	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	3	1	2	0	0	0	0	0	?	
60a Faience amulets XII-XIII	4	0	1	1	?	1	0	0	1	1	?	?	0	0	0	0	0	0	0	0	1	0	-	-	-	-	0	0	?	0	0	0
60b Faience amulets XII-XIII	4	?	3	1	?	1	0	0	1	1	?	?	0	0	0	0	0	0	0	0	1	0	-	-	-	-	0	0	?	0	0	0
60c Faience amulets XII-XIII	4	1	?	1	?	1	0	0	1	1	?	?	0	0	0	0	0	0	0	0	1	0	-	-	-	-	0	0	?	0	0	0
61 Senbi XII.1	0	0	1	1	1	1	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	-	-	-	-	0	0	0	0	1	
62 Senwosret XII.2	0	0	3	1	1	1	0	0	3	0	1	1	0	0	1	0	0	?	?	0	0	0	-	-	-	-	0	0	0	0	0	0
63 KhnumhotepII XII.3	0	0	3	0	1	1	1	1	5	0	1	1	0	0	1	1	0	1	0	1	1	1	3	1	2	1	1	1	0	1	0	1
64 Ukhhotep XII.3	0	0	3	?	?	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	
65a Ukhhotep XII.4	0	0	1	1	1	1	0	0	3	0	2	1	0	0	0	0	0	0	0	0	3	0	-	-	-	-	0	0	0	0	1	
65b Ukhhotep XII.4	0	0	3	1	?	1	1	0	2	0	2	1	0	0	1	1	0	0	0	0	0	-	-	-	-	-	0	0	0	0	1	
65c Ukhhotep XII.4	0	0	1	1	1	1	0	0	0	0	2	1	0	0	?	1	0	0	0	0	1	0	-	-	-	-	0	0	0	1	?	1



66	Pnyemre XVIII.5	1	1	0	1	1	1	0	0	6	1	0	0	0	1	0	1	0	0	1	0	1	0	1	0	1	1	1	2	0	1	0	0	0	2	
		1	1	0	1	1	1	0	0	6	1	0	0	0	1	1	0	1	1	0	1	2	0	0	1	0	0	-	-	1	?	1	?	0	2	
67	Neferhotep XVIII.5-7	1	1	0	1	1	1	0	0	6	1	0	0	0	1	1	0	1	1	0	0	1	2	0	0	-	-	-	-	-	1	?	1	?	0	2
68	Horemheb XVIII.5-9	0	1	1	1	1	1	1	0	3	0	0	0	0	0	0	0	0	0	0	2	0	?	?	-	0	1	1	0	1	0	0	0	2		
69	Amenhotep? XVIII.6?	1	1	0	1	?	?	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	-	-	-	-	-	0	0	0	0	0	2		
70	Menna XVIII.8	1	1	0	1	1	1	0	0	3	0	4	0	0	1	1	0	0	1	0	0	1	0	0	-	0	0	1	0	1	0	1	0	0	2	
71a	Nakht XVIII.8	0	1	1	0	0	0	0	?	?	0	1	0	0	0	0	0	0	0	2	0	0	-	-	-	-	-	0	0	0	0	0	0	0	2	
71b	Nakht XVIII.8	0	2	1	1	1	1	0	3	0	4	1	0	0	0	1	0	0	2	1	?	?	-	0	?	1	0	0	0	0	0	0	0	0	2	
72a	Nebamun XVIII.8-9	0	0	1	1	1	1	0	7	-	1	1	0	1	0	0	0	1	?	1	0	1	0	0	1	0	0	1	0	1	0	1	0	1	2	
72b	Nebamun XVIII.8-9	0	0	1	1	1	1	0	7	0	1	1	0	0	0	0	0	1	?	1	0	1	0	0	1	2	0	1	0	1	0	0	0	0	2	
73	Amenhotep III XVIII.9	0	0	3	?	1	1	0	0	3	0	1	0	0	1	?	1	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	2	
74a	Amenhotep IV XVIII.10	0	0	1	1	1	1	0	0	3	0	1	0	1	0	0	0	0	0	0	0	0	0	-	-	-	-	0	0	0	0	0	0	1		
74b	Amenhotep IV XVIII.10	?	1	1	1	1	1	0	0	3	0	0	1	1	1	0	1	0	0	1	0	1	0	0	-	0	0	0	0	0	0	0	0	0	1	
74c	Amenhotep IV XVIII.10	?	0	1	1	1	1	0	0	3	0	0	0	0	0	0	0	0	0	0	?	?	-	0	0	1	0	1	0	0	1	0	0	1		
75	Ceramic tile XVIII.10	0	0	1	1	1	1	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	1	0	1	0	0	1			
76	Inlay XVIII.10-15	5	1	3	1	1	1	0	0	3	1	0	0	0	1	1	0	0	1	0	0	1	0	0	-	-	-	-	0	0	0	0	0	0	?	
77	Neferhotep XVIII.13	5	1	0	1	1	1	0	0	?	0	0	0	0	?	?	0	0	0	0	1	0	0	-	?	0	?	?	?	?	?	?	?	2		
78	Neferhotep XVIII.14-XIX.3	5	1	1	?	1	1	0	0	1	0	0	0	0	?	?	?	0	0	1	1	?	?	-	-	-	-	?	0	1	0	0	2			
79a	Samout XIX	5	1	1	1	1	1	0	0	3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
79b	Samout XIX	5	1	1	1	1	1	0	0	3	-	0	0	0	1	0	0	0	1	0	1	0	1	1	1	1	1	0	1	0	0	0	0	0	2	
80	Nebwenenef XIX	1	1	1	1	1	?	0	0	?	0	0	0	1	0	0	?	?	0	0	?	1	1	1	1	0	1	0	0	1	0	0	2			
81	Montuemhat XXV.3-XXVI.1	0	0	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	0	1	0	0	2		
82	LACMA Relief fragment	0	0	3	1	1	1	0	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	1	0	1	2	1	0	0	0	0	0	?		