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Book Reviews

The Lost Throne of Queen Hetepheres from Giza: An Archaeological Experiment in Visualization and Fabrication

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Abstract

In 1925, one of the greatest discoveries made at Giza revealed a small, unfinished chamber (labeled "G 7000 X") more than twenty-seven meters underground, just east of the Great Pyramid. The Harvard University–Boston Museum of Fine Arts Expedition found there the deteriorated burial equipment, sarcophagus, and other objects belonging to Queen Hetepheres I, presumed consort of Snefru and mother of Khufu. Since the discovery of this rare Old Kingdom royal assemblage, the thousands of small fragments have remained in storage in the Egyptian Museum, Cairo. Meticulous documentation allowed the excavators to reconstruct some of the queen's furniture. However, the most exquisite piece, her "second" chair or throne, made of cedar with hundreds of faience inlays and completely gilded, was never reconstructed. This paper describes an interdisciplinary collaboration initiated by the Giza Project at Harvard University to create a full-scale reproduction of Hetepheres's second chair in modern cedar, faience, gold, gesso, and copper. The goals for this visualization experiment were to reconstruct the excavation history, the iconography, and to document, insofar as possible, the ancient workflow the Egyptians used to construct this Old Kingdom masterpiece. The final results produced a new museum display object and research/teaching tool.

Two significant features of Hetepheres's tomb complex stand out today. One consists of the anomalies: the lack of a (surviving?) superstructure, along with the empty sarcophagus and missing body, despite the presence of a canopic chest most likely packed with the queen's viscera.[1] And the second feature is the spectacular, albeit thoroughly deteriorated, royal furniture, among the oldest from the ancient Mediterranean world.[2] This paper will not focus on the enigma of the burial itself, a subject I hope to revisit elsewhere, but instead on "chair ii," one particular piece of Hetepheres's furniture that has until now never been restored or reconstructed.

[1] For a different interpretation of the canopic chest, see T. Rzeuska, "And where are the viscera…? Reassessing the function of Old Kingdom canopic recesses and pits," in N. Strudwick and H. Strudwick, eds., *Old Kingdom, New Perspectives. Egyptian Art and Archaeology 2750–2150 BC* (Oxford and Oakville, 2011), 244–55. Compare this interpretation to the one in P. Der Manuelian, "Harvard University–Boston Museum of Fine Arts Expedition Contributions to Old Kingdom History at Giza: Some Rights and Wrongs," in P. Der Manuelian and T. Schneider, eds., *Towards a New History for the Egyptian Old Kingdom: Perspectives on the Pyramid Age. Papers from a Symposium at Harvard University, April 26, 2012,* Harvard Egyptological Studies 1 (Leiden/Boston, 2015), 328.

[2] For reference, I provide here a concordance list of the accession numbers of the Egyptian Museum, Cairo, restored furniture and the reproductions created for the Museum of Fine Arts, Boston: chair i (reconstruction = Cairo JE 53263; reproduction = MFA 38.957); canopy (reconstruction = Cairo JE 57711; reproduction = MFA 38.873); curtain box (reconstruction = Cairo JE 72030, reproduction = MFA 39.746); bed (reconstruction = Cairo JE 53261; reproduction = MFA 29.1858); headrest (reconstruction = Cairo JE 53262; reproduction = MFA 29.1859); bracelet box (reconstruction = Cairo JE 53265); carrying chair (reconstruction = Cairo JE 52372, reproduction = MFA 38.874).

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1. Excavation History of G 7000 X

On Saturday evening, March 7, 1925, the day of the first modern-era glimpse into Queen Hetepheres's subterranean burial chamber, key members of the Harvard University–Boston Museum of Fine Arts Expedition could hardly have been further apart from one another. George Reisner was in Boston, preparing for his Monday morning 9:00 am Harvard class, "Egyptology 3: History of Egypt," with a total of sixteen undergraduates. Dows Dunham, rather unceremoniously "fired" by Reisner back in the fall of 1923, was living in Maadi, working for the Egyptian Government under Cecil Firth at Saqqara, and occasionally at the Mastabat el-Faraon with G. Jéquier. (Dunham was among the first to see the *heb sed* statue of Djoser on the north side of the Step Pyramid.) William Stevenson Smith was studying as an undergraduate at the University of Chicago. The following year he transferred to the Harvard class of 1928, and only joined Reisner as a graduate student in 1929. Alan Rowe, T. R. Duncan Greenlees, and *reis* Said Ahmed Said were the men supervising the HU-MFA Expedition's relocation over to the Eastern Cemetery at Giza.

Expedition photographer Mohammedani Ibrahim's tripod had slipped on "Queens Street," which runs north–south between the three queen's pyramids GI-a through c, and the westernmost row of great twin mastabas, to reveal the plaster covering and limestone fill blocks beneath it (fig. 1). This accidental discovery took place on either February 2 or 9, 1925, depending on which account one reads.[3] Ibrahim was slightly west of shaft P of mastaba G 7101, belonging to the Sixth Dynasty official named Qar (figs. 2–3).[4]

On Sunday, Feb. 22, 1925, word was sent to inspector James Quibell to inform him of the find. By Saturday, March 7, 1925, the burial chamber south of the shaft finally appeared (fig. 4), as described in the Expedition Diary kept by T. R. D. Greenlees:[5]

> At the depth of 2550 at 3:30 p.m. it was observed that the rock surface on the south, here extremely good, fell away at an angle, and immediately afterwards the top of the door to a chamber was revealed. One limestone block was loosened and removed in order to see in. A large chamber is visible extending up a little to east and west of the door. It is possible to see what appears to be a sarcophagus in the foreground upon which are several staves or maces with gilded tops. A good deal of gilding appears on other objects upon the ground. It is certain that the burial is intact.
>
> Work was now diverted towards re-blocking this small hole lest dust should trickle in to the damage of objects unseen and near the door.

Five days later, on March 12, 1925, Reisner ordered the tomb closed and sealed.

There was a back-story here. Alan Rowe was keen on continuing the excavation and clearing the burial chamber despite Reisner's absence. Reis Said Ahmed Said felt that the complex nature of the deposit required far more expertise than Rowe or Greenlees possessed, and he favored waiting for Reisner's return from America. While the Expedition workmen slaughtered a bull and celebrated the discovery with a "fantasia," Said Ahmed telegraphed Reisner. This resulted in Reisner wiring Cecil Firth with a request to investigate the situation. Firth and Dows Dunham visited the site, and Firth agreed with reis Said Ahmed. Firth wired back to Reisner that both he and Pierre Lacau felt the tomb should be closed. So Reisner wired Rowe asking him to obtain Lacau's permission to shut down the operation.[6]

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[3] For the earlier February 2, 1925 date: G. Reisner and W. Stevenson Smith. *A History of the Giza Necropolis* 2, *The Tomb of Hetep-Heres the Mother of Cheops: A Study of Egyptian Civilization in the Old Kingdom* (Cambridge, Mass., 1955), xxiii, xxv ("first record" made February 19, but see below); W. Stewart, "Tomb of Hetepheres. Mother of Cheops," unpublished manuscript in the Giffith Institute, Oxford, 7 (ms. p. 2). For the later February 9, 1925 date: G. Reisner, "Hetep-Heres, Mother of Cheops," *BMFA* 25, Supplement (May 1927), 1–36, esp. 6. The Arabic Expedition diary, kept by Said Ahmed Said, mentions on February 9, 1925 the "layer of plaster that was photographed and drawn recently…".

[4] W. Simpson, *The Mastabas of Qar and Idu*, Giza Mastabas 2 (Boston, 1976).

[5] HU-MFA Expedition Diary vol. 13, 279 (English version).

[6] This account derives from Said Ahmed Said's Arabic diary, 5–6, as translated with annotations, by Reisner himself. The account differs extensively from the Arabic diary account acquired from the descendants of Said Ahmed in 2006, and from the English diary kept by the Expedition staff. It is part of the HU-MFA Expedition archives; see P. Der Manuelian, *Digital Giza. Visualizing the Pyramids* (Cambridge-London, 2017), 117–18, fig. 3.15.

Reisner was not only concerned about utilizing proper excavation methodology (and, one assumes, about being personally present to enjoy the discovery), but also about controlling the publicity coverage. Having seen Snefru's name on fragments of the bed canopy lying on top of the sarcophagus on March 8, 1925, Alan Rowe apparently went to the press. Local US papers as well as the London Times bear press dates as early as March 9, 1925. Reisner did all he could to argue against G 7000 X being the tomb of Snefru, and while he had Alan Gardiner on his side, Wallis Budge and H. R. Hall in England felt otherwise. This cast a pall over Reisner's relationship with Alan Rowe that would only worsen with time.

Rowe apparently caught malaria after a meal downtown with General Allenby. After many days in bed, Rowe was back at work in mid-March, 1925. At this time, a Fox news cameraman named Ben Miggins had been lurking around Giza for three days trying to cover the story. The notes accompanying the movie footage he eventually shot record the events:

> "I had to steal this with the aide of Mr. Rowe who is unable to help me because Dr. Ressner [sic] has issued an order that no photographs be made. I worked around the pyramids for three days waiting for Mr. Rowe has been sick in bed two weeks and this is his first day up. He could not connect himself with me so I had to wait until he was around."

Figure 5 shows Rowe and no doubt a coerced Said Ahmed preening before Miggins's camera; being the "first day back" for Rowe, a corroboration with Said Ahmed's diary fixes figure 5 at March 21, 1925.[7] As a result of these and other events, Rowe's departure on August 1 to direct the University of Pennsylvania Expedition was a great relief to Reisner.[8]

On March 16, 1925, Said Ahmed and Greenlees blocked up the entrance to the burial chamber.[9] Reisner himself jumped into the PR business with a note in the *Harvard Alumni Bulletin,* dated March 19, 1925. From Boston, Reisner, who had yet to see the tomb with his own eyes, reported that on the coffin "lay an elaborate, woven-gold mat with a line of incised hieroglyphics, giving the name Nebti-Sneferuw, which is apparently the name of the person buried in the coffin. The name indicates that the person was a woman, probably a princess."[10] On April 4, Quibell sent word that Antiquities Service director Pierre Lacau did not wish the tomb reopened.

With the spring semester finished at Harvard, Reisner booked passage back to Egypt, leaving from New York on June 13, 1925, and reaching Giza on July 22.[11] In the wake of Alan Rowe's looming departure (August 1),[12] Reisner ordered Duncan Greenlees to cancel his planned trip to Boston, where he had just been named assistant curator of Egyptian Art at the MFA, and return to Cairo from London. Reisner also hired Lt. Commander Noel F. Wheeler as surveyor; Wheeler would remain with the HU-MFA Expedition until September, 1933. Reisner had also brought a young Alexander Boyd Hawes, son of Cretan archaeologist Harriet Boyd Hawes and MFA associate director Charles Henry Hawes, to Giza with him.[13] Other changes included the sudden departure of Duncan Greenlees for India (Dec. 8, 1925), and the rehiring of Dows Dunham to take his place.

The excavations in G 7000 X should then have continued promptly after the preparation work was completed, but Reisner came down with a case of shingles (herpes). By September 6 he was ordered to the Anglo-American Hospital. He returned on Sept. 14; November 18, 1925 was the first official day of the 1925–26 season, and work finally commenced in the burial chamber of G 7000 X on January 21, 1926.[14] The real "all-clear" came three days later when acting director C. C. Edgar descended with Reisner into the tomb to examine the

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[7] I am grateful to Benjamin Singleton of the Moving Image Research Collections, University of South Carolina, for his help in procuring this image and Ben Miggins's log. Miggins had filmed "The Shepherd King" two years earlier.

[8] I hope to detail Reisner's interactions with Rowe further in a forthcoming biograpy of Reisner's life and career.

[9] Diary of Said Ahmed, p. 6: A much shorter entry is given in the official Arabic Diary, 337 (Book 5).

[10] G. Reisner, "A New Discovery in Egypt," *Harvard Alumni Bulletin* (March 19, 1925), 737.

[11] Reisner letter of June 5, 1925; HU-MFA Expedition Archives.

[12] See *Expedition Magazine* (University of Pennsylvania Museum, Winter 1979), 26–29; and J. Copland Thorn, "Alan Rowe: Archaeologist and Excavator in Egypt, Palestine and Cyrenaica," *Libyan Studies* 37 (January 2006), 71–83.

[13] M. Allsebrook, *Born to Rebel: The Life of Harriet Boyd Hawes* (Oxford, 1992), esp. 182–83; V. Fotou and A. Brown, "Harriet Boyd Hawes (1871–1945)," in G. Cohen and M. Sharp Joukowsky, eds., *Breaking Ground: Pioneering Women Archaeologists* (Ann Arbor, 2004), 198–273.

[14] Reisner and Smith, *Giza Necropolis* 2, xxv.

burial chamber. He compared the appearance of the deposit before his eyes, on January 24, 1926, with prints of HU-MFA Expedition Photos A 3598 and A 3606, both from March 9, 1925, and concluded that there had been no changes to the tomb's condition since the previous year. The final delay was the wait for artist and conservator William A. Stewart to paint a watercolor rendering of the untouched burial chamber (January 29 to February 3, 1926). Stewart was to receive no credit for this work, however, for the Boston painter Joseph Lindon Smith later arrived and created his own oil painting at Harvard Camp (color fig. 6), based on Stewart's *Vorlage*. Stewart's illustration has apparently not survived or still remains to be located.[15]

Clearance of the armchairs "i" and "ii," along with the carrying chair, ointment vessels, bed, inlays of chair ii, and some ceramics, all took place between January and July 15, 1926. Before we leave this excavation history summary, just a few more key dates are worth summarizing. The first was the tragic loss of the truly unique *reis* (since 1909) Said Ahmed Said to pneumonia on February 14–15, 1926.[16] The queen's name was finally read, and noted in the Expedition's Communiqué no. 4, on April 14, 1926 as "Hetepet-heres" (from inscriptions on the back of the carrying chair). There were to be twelve public communiqués in all. By December 23, 1927, Dunham had secured W. A. Stewart's help in restoring the furniture, a "two-year task and to be paid for by Harvard Research Fund."[17] Two years was a low estimate.

Figure 7 shows much of the contents of G 7000 X already cleared, and figure 8 presents a completely cleared floor, with the sarcophagus and niche alone remaining. The opening ceremony, revealing what turned out to be an empty sarcophagus, took place on March 3, 1927. The canopic chest from the blocked and plastered eastern niche, was removed on May 23, 1927. In all, the project had taken up approximiately 1,701 pages of plans, notes, and drawings; 1,057 photographs on glass plate negatives; and 321 working days.

2. Chair ii of Queen Hetepheres

The restored furniture of Queen Hetepheres I is now justly famous, both in Cairo and Boston (figs. 9–10).[18] "The furniture of Hetep-heres shows that by the early part of the third millennium B.C. accurate joinery had already a long tradition. Its simple and elegant proportions accord with the restrained taste of this classic period of Egyptian art."[19] Indeed, Hetepheres's sitting chair (as opposed to the carrying or sedan chair), so-called chair i, with arms composed of three bound papyrus plants in open-work decoration, is almost emblematic among Egyptologists and others for the tomb today (fig. 36). But for almost three decades since the original discovery, the second of the two armchairs, which Reisner labeled "chair ii," continued to plague the original Expedition staff members regarding its original design. The problem outlasted Reisner himself; witness his remarks in his Report no. 4 where he notes that chair ii "seemed of simpler form" than chair i. In fact, the exact opposite was true.

Extracting the thousands of tiny fragments of chair ii from the surrounding items on the chamber floor was a daunting task. That a second chair existed was proven by the four gilded lion legs found in addition to those belonging to chair i. In the *Bulletin of the Museum of Fine Arts, Boston* from 1927, Reisner described this area of the burial chamber: "In the course of time the debris in the pit itself had settled about 15 cm., enough to expose the southern side of the pit for about half its length from the east; and this settlement had brought about the collapse towards the north of a chair which stood partly over the southern part of the pit. This was the area on which

[15] Joseph Lindon Smith (1863–1950); oil on canvas, 38.5 × 64 cm (15 3/16 × 25 3/16 in.); Anonymous gift; courtesy of the descendants of Joseph Lindon Smith, MFA 27.388; published in Reisner, "Hetep-Heres, Mother of Cheops," 11; D. Dunham, *Recollections of an Egyptologist* (Boston, 1972), 31; G. Johnson, "The Mysterious Cache-Tomb of Fourth Dynasty Queen Hetepheres," *Kmt* 6:1 (spring 1995), 37, and Manuelian, *Digital Giza,* 167, fig. 5.5 (middle).

[16] Reisner, "Hetep-Heres, Mother of Cheops," 11.

[17] Dows Dunham to the MFA Director's office, December 23, 1927; archives of the Museum of Fine Arts, Boston.

[18] Z. Hawass, "The Mystery of Hetepheres," in Z. Hawass, ed., *Treasures of the Pyramids* (Vercelli, 2003), 152–55; idem, *Inside the Egyptian Museum with Zahi Hawass* (Cairo, 2010), 96–99; G. Reisner, "The Household Furniture of Queen Hetep-heres I," *BMFA* 27, no. 164 (December 1929), 83–90.

[19] C. Aldred, "Fine Wood-work," in C. Singer, E. Holmyard, and A. Hall, eds., *A History of Technology I: From Early Times to Fall of Ancient Empires* (Oxford, 1954), 699.

we were forced to begin."[20] In the drawings for each layer, Dunham represented the gold in red ink, wood and other types of objects using purple, and the stones and walls in black (fig. 11). Fragments were numbered (from 1 to over 1600) on photographs and on Dunham's drawings, removed individually to trays, then examined and recorded in the Object Register with all relevant metadata.

To explain the disappearance of the wood, Reisner wrote: "Fungus generally flourishes in a moist atmosphere, and there are stains of copper and wood on the coffin which prove that at some time rainwater had worked its way down from the surface, probably through the natural fissures of the rock and in particular through that fissure which formed the southern wall of the shaft."[21]

In one of his work reports, Reisner described the extraction process for the area where chair ii had collapsed, running from about mid-February to mid-April, 1926:

(1) A large scale photograph is prepared of the area in hand.[22]
(2) A drawing is made to about 1:2 of the same inlays.
(3) After examination, Dunham and I agree as the first inlay to be moved and the order in which the following inlays are to be taken so as to enable us to reconstruct the original setting.
(4) The selected inlay is numbered on the photographic print and drawing.
(5) Dunham then lifts it without disturbing anything else—an act which requires great steadiness of hand and skill (the game of *spillikins*, we call it).
(6) We both examine it. In the list which I keep in ink on a sheet of paper of the size and quality of the sheets used in this report, I make a sketch of the object opposite its No. and write down the measurements taken by Dunham.
(7) We have thin boards with raised edges and covered with cotton cloth (to keep the inlays from slipping. On this the inlay in question is laid in its proper position.
(8) The same process is followed with each succeeding inlay which after recording is laid on the board in its proper relation to those already taken up.[23]

Even an earthquake of February, 1926 failed to jostle the tomb's contents, and Reisner and Dunham only learned of the event by subsequent consultation of the newspapers.[24] A selection from Reisner's report follows (fig. 12):

> On Feb. 27 we began to remove chair No. ii which seemed of simpler form than chair No. i. It had stood west of chair i with its front towards the south[25] and had decayed in place with a slight pitch towards the southeast. Across the back part lay a board decorated with inlays and gold (X). The elements of the decoration were of two types,—a row of 7 vertical feathers and a gold rectangle cut out in a flower pattern and inlaid with colored faience pieces. The flower element also consisted of faience inlays (blue with black tips) in a gold frame-work. The two types of elements alternated. By March 2nd, we had worked out mostly in the original order, eleven of these elements [see fig. 13].
>
> At this point, further progress was impeded by inlays and fragments of gold sheet which lay dislocated. By the 6th, we had cleared these away, carefully recorded and also the two hind legs and some other parts of the chair ii. It was then apparent that another decorated board (Z) similar to the first ran about at right angles to it and that the whole area was underlaid by a great sheet of gold decorated with large flowers inlaid with blue faience. This great sheet (Y) ran under the bird's wing visible on the east and lying over the gold-cased bars of the bed (iii). It was therefore necessary to begin removing the bird's

[20] Reisner, "Hetep-Heres, Mother of Cheops," 10.

[21] Reisner, "Hetep-Heres, Mother of Cheops," 36.

[22] By "large scale" Reisner means an "A"-sized negative, 8×10 inches, or 20×25 cm; see P. Der Manuelian, "George Andrew Reisner on Archaeological Photography," *JARCE* 29 (1992), 1–34.

[23] G. Reisner, unpublished "Report" No. 4, March 28, 1926, 5 (HU-MFA Expedition archives).

[24] Reisner, "Hetep-Heres, Mother of Cheops," 9 with n. 1.

[25] Actually the front of the chair faced north, according to the Expedition's reconstruction drawings; see Reisner and Smith, *Giza Necropolis* 2, fig. 20.

> wing. This wing consisted of feathers of blue faience with black tips separated by strips of gold,—the whole set in gesso (carbonate of lime). No. 208 was a group from the tip of the wing which had fallen apart and lay against the southwest leg (left foreleg) of chair i. These were removed and then this leg of chair i and some scattered inlays fallen down from the first decorated board (X). Then on March 8th, we began clearing away the second decorated board (Z) which was not finished until March 16. It was a board 22 cm. high, four cm. thick and of a width not yet exactly determined, inlaid on one side and edges with black-tipped blue faience elements in regular rows set in a gold frame…."
>
> …Then we were obliged to clear away various parts of the arm of a chair apparently belonging to chair ii. This gave us access to further parts of the board Z which we removed by the [sic] March 16th and further parts of (X)…
>
> … On the 18th of March we attacked the main part of the wing which lay face up and by the 21st had pieced it together. Under this was a layer of crumbled plaster, a layer of wood, a second layer of crumbled plaster, and then a layer of inlays face down.[26]

After Reisner's death in 1942, and owing to the challenges of the Second World War, much miscellaneous material remained at Harvard Camp, on the Giza Plateau, for decades after the excavation of G 7000 X. It was not until early 1947, when William Stevenson Smith and Dows Dunham returned to Giza to assess, and eventually to close down, the HU-MFA Expedition, that this material came once more under scrutiny.

> Another task, done partly by me and partly by Bill Smith, was the final study of the Hetep-heres material before its delivery to Cairo. First we went through the many boxes and threw away a large quantity of decayed wood, cloth, and miscellaneous rubbish which could have no usefulness. Then a good deal of time was spent by Bill Smith in re-arranging and adding to the various groups of inlays, so as to get them consolidated and easier to deal with….[27]

An Egyptian Museum photographer came to document the material, and in the end Smith and Dunham personally drove thirty boxes to the Museum in downtown Cairo in their car. "There, they were placed in a special room in the basement for future study and reconstruction. We do not know whether they stood the journey without damage."[28] The Museum authorities assigned the Temporary Registration Number of April 18, 1947, No. 5 (fig. 14).

The greatest achievement of the HU-MFA Expedition in G 7000 X was the meticulous documentation that allowed the staff to reconstruct many objects, some physically, some on paper. George Reisner, Dows Dunham, Noel F. Wheeler, Hagg Ahmed Youssef, William A. Stewart, Bernard Rice, Marion Thompson (Mrs. Dows Dunham), and woodworker Said Halaby were all integral to the success of the reconstructions.[29] New wood had to replace completely disintegrated beams, planks, and legs, while intricate inlay patterns and sophisticated joinery had to be recreated, always after countless hours of painstaking research. In fact, it was only in late 1949 and early 1950 that William Stevenson Smith, back in Boston, felt he had finally deciphered the original look of Hetepheres's second chair.[30] He reproduced the results in fig. 32 of the primary source publication of the tomb, *Giza Necropolis* 2, which I have modified with labels on the individual elements (fig. 15).[31] The volume was

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[26] G. Reisner, unpublished "Report" No. 4, March 28, 1926, 2–3 (HU-MFA Expedition archives). Additional photographs of the area where chair ii had collapsed may be found in Reisner and Smith, *Giza Necropolis* 2, pls. 17a-b, 19c-d, 20a-b, 21b, and 23b.

[27] D. Dunham, unpublished report on the closing of Harvard Camp, 1947 (HU–MFA Expedition archives), 7.

[28] Dunham, unpublished report on the closing of Harvard Camp, 8.

[29] Hagg Ahmed Youssef inscribed the copy of the curtain box that now resides in the Museum of Fine Arts, Boston (MFA 39.746) in Arabic: "Exact replica model of Hetepheres box. Made by me, Ahmed Yousef Mostafa -1939. Technical assistant at the casting molds manufactury of the Egyptian Museum."

[30] W.S. Smith to W.A. Stewart, February 23, 1950; Griffith Institute, University of Oxford.

[31] Reisner and Smith, *Giza Necropolis* 2, pls. 17–24. This illustration, or portions thereof, has been reproduced in W. Stevenson Smith, *History of Egyptian Sculpture and Painting in the Old Kingdom* (London, 1949), 147–48, figs. 58–59 (hereafter *HESPOK*); S. Hendrickx, "Two Protodynastic Objects in Brussels and the Origin of the Bilobate Cult-Sign of Neith," *JEA* 82 (1996), 34, fig. 8; H. Baker, *Furniture in the Ancient World Furniture in the Ancient World* (New York, 1966), 40 fig. 30; R. el-Sayed, *La déesse Neith de Sais* II (Cairo, 1982), pl. IV, doc. 191; W. Stevenson Smith, "The Tomb of Hetep-heres I," *BMFA* 51, No. 284 (June 1953), 28, fig. 7; n.a., "A Queen's Furniture of 5000 Years ago: Final Reconstructions for the unique Treasures from the Tomb of Hetep-heres, Mother of Cheops," *Illustrated London News*, May 8 (1954), 764,

based on Reisner's earlier manuscripts, but did not appear until 1955, thirteen years after his death at Harvard Camp, Giza. In 1953, Smith wrote: "It is to be hoped that the Cairo Museum may eventually find it possible to reconstitute the armchair and inlaid box from the very fragile elements which are at present arranged in trays, according to their various patterns and packed away in storage."[32]

3. Summary Description of the Chair ii Elements

Chair ii of Queen Hetepheres outstrips its simpler and better-known counterpart—chair i with its three papyrus flower arms—by virtue of its exquisite craftsmanship. In fact, there is probably no reason to avoid referring to it as a throne in the wider sense of the word.[33] A (most likely) woven seat probably appeared in the center of four rails that once interlocked by means of mortise and tenon joints (fig. 15). The seat was supported by four feet carved in imitation of lion's legs (among the earliest examples known) and likewise connected with mortise and tenons, and reinforcing leather bands. The front legs are taller by 2.54 cm, giving the chair a gentle backwards slope of three degrees.[34] A cushion or cushions would have rendered the dimensions more comfortable. Beneath the feet are the ribbed drums or supports customarily found on theriomorphic furniture; in this case, the drums were of rilled copper. We will return to the topic of possible limestone cone supports further below.

The arms consist of four primary elements on each side. One rail runs from the back of the chair forward, resting on the seat and connecting at a right angle to an armchair support rail placed vertically. Both rails are inlaid on multiple sides with an alternating pattern of vertical feathers and rosettes.[35] The vertical rail is capped by a horizontal armrest rail with a semicircular top that is not inlaid but rilled with a pattern of intersecting lines. (These appear on chair i as well.) Hidden leather ties passing diagonally through the front and back mortises and tenons of the armrest helped to secure the ensemble. Filling the square "window" produced by these elements is a Horus falcon resting on a palm column, with outstretched wings adorned with numerous faience inlays (figs. 16–17). The Horus motif with outstretched wings also occurs six times in raised relief in exquisitely detailed hieroglyphs on the queen's gilded canopy inscriptions (fig. 18); it appears with furled wings an additional six times.[36] This open-work motif must have attached for stability to the chair rails at the head of the falcon, the

fig. 4; A. Pepler-Harcombe, *Ancient Egyptian Furniture in Context: From Ancient Production, Preservation to Modern-Day Reconstruction and Conservation* (Unpublished MA dissertation, University of South Africa, 2011), 166, image 61; and Manuelian, *Digital Giza,* 200, fig. 6.6. For a similarly annotated chair drawing, see M. Eaton-Krauss, *The Thrones, Chairs, Stools, and Footstools from the Tomb of Tutankhamun* (Oxford, 2008),149, fig. 1.

[32] Reisner and Smith, *Giza Necropolis* 2, xxiii. A similar anonymous statement appeared in the *Illustrated London News:* n.a., "A Queen's Furniture of 5000 Years Ago," 764–65. This issue also notes the magazine's previous coverage of tomb G 7000 X: first notice on March 12, 1927; on November 24, 1928, photographs of the carrying-chair; on August 24, 1929, her bed and Chair i; on May 7, 1932, the bed canopy and a "jewel box;" and on November 18, 1939, the curtain box.

[33] Eaton-Krauss, *The Thrones, Chairs, Stools, and Footstools from the Tomb of Tutankhamun,* 21, n. 3, citing K. Kuhlmann, *Der Thron im alten Ägypten: Untersuchungen zu Semantik, Ikonographie und Symbolik eines Herrschaftszeichens* (Glückstadt, 1977), esp. 3–7.

[34] G. Killen, *Ancient Egyptian Furniture* I, *4000–1300 BC* (Warminster, 1980), 59, notes for chair i (Cairo JE 53263) that "the back legs would have to be slightly raised in order to keep the seat horizontal," but why assume that this was the ancient Egyptians' goal? See J. Panero and M. Zelnik, *Human Dimension & Interior Space. A Source Book of Design Reference Standards* (New York, 1979), 129: "The angle formed by thighs and trunk should not be less than 105˚…." "A seat angle of about 15˚ should be adequate." For roughly contemporary furniture representations at Giza, only three of the surviving Giza slab stelae show leonine legs on their owner's stools, instead of bull's legs: Khufunakht (G 1205), Nefer (G 1207), and Seshat-sekhentiu (G 2120); see P. Der Manuelian, *Slab Stelae of the Giza Necropolis,* PPYE 7 (New Haven-Philadelphia, 2003), pls. 5–8, 17–18.

[35] Concerning the decoration on the inside of the chair arms, note that Reisner and Smith, *Giza Necropolis* 2, 30, state: "There were no inlays which could be assigned to the inner surface of the frame of the arm, although the hawks and the plants on which they are poised were inlaid on both the outer and inner faces. Perhaps the frame on the inside was covered with gold which has not been identified, like the frame of the chair seat." In our modern fabrication, we opted to inlay the interior and exterior of the chair arms identically.

[36] The canopy's top left side falcon drawing reproduced in fig. 18 is by Harvard student Vera Jin, but I would also like to thank Harvard graduate students Hilo Sugita, Inês Torres, and Sara Zaia, all of whom likewise produced publishable (uncollated) drawings of selected Hetepheres falcons as part of a digital epigraphy class during the fall semester of 2016. For the canopy's right side, compare the montaged photograph in Reisner and Smith, *Giza Necropolis* 2, pl. 8.

base of the palm column, and perhaps also the tips of the wings.[37] A similar system may be observed with the papyrus umbels of chair i.

The front-facing decoration of the chair's back contains four emblems of the goddess Neith, each on its own standard, and each pair of standards facing inwards towards the center (fig. 15). Above the Neith emblems is a frieze of sixteen braided and inlaid sidelocks, very similar to royal or divine beards, and the entire ensemble is framed by additional feather and rosette patterns.[38] On the rear-facing back of the chair, the feather and rosette pattern frame continues, with the addition of a central vertical slat. On either side of this vertical piece is an additional, larger Neith emblem on a standard, this time with two platforms and two streaming pennants each, almost resembling a diadem viewed from behind. Surrounding the emblems is an intricate zigzagging or basket-weave pattern of rectangular faience tiles. The overall dimensions of the chair, as collected from our modern reproduction, are listed as follows:

Width: 64.135 cm = 25 1/4 inches
Depth: 66.04 cm = 26 inches
Height of chair minus the legs: 63.5 cm = 25 inches
Height of front legs: 26.67 cm = 10.5 inches
Height of rear legs: 24.13 cm = 9.5 inches

4. Modern Fabrication of Hetepheres's Chair ii

The Giza Project, first at the Museum of Fine Arts, Boston, and more recently based at Harvard University, began a collaboration in 2008 with 3D modeling company Dassault Systèmes of Paris. The goals included creating an immersive 3D visualization of the entire Giza Plateau, as an aid to academic teaching and scholarly research.[39] By 2014, the Giza Project at Harvard had built an interactive 3D computer model of the tomb of Hetepheres and its contents (figs. 19–20). This included a 3D rendering of the queen's second chair (fig. 21), and since computer-driven additive (3D printing) and subtractive (3D milling) machines had come of age, Giza Project lead technical artist Rus Gant explored whether we might move in a reverse direction: from the virtual back to the physical worlds. That is, we hoped that by using digital tools we might be able physically to fabricate the second chair of Queen Hetepheres, based on the archaeological record that the original excavators had felt was too poorly preserved, too complex and confusing to restore or reconstruct. Sources for this initiative included the HU-MFA Expedition photography, pages of notes on the individual fragments, English and Arabic Expedition diaries, a conservation manuscript at the Griffith Institute, University of Oxford, comparative study and new photography of the (modern) companion pieces in the Museum of Fine Arts, Boston, and new photography of the Hetepheres fragments generously supplied by our Egyptian colleagues at the Egyptian Museum, Cairo

[37] For another intricately patterned open-work sidearm design, see the recumbent lion on the south wall of the tomb of Meresankh: D. Dunham and W. K. Simpson, *The Mastaba of Queen Mersyankh III* Giza Mastabas 1 (Boston, 1974), 16 (register 4), pl. 9b, fig. 8. The palm column may be seen in other contemporary contexts in the slab stela of Setji-hekenet (G 1227), Manuelian, *Slab Stelae,* pls. 13–14; the end poles of the carrying chair of Hetepheres (Egyptian Museum, Cairo JE 52372, reproduction MFA 38.874), M. Saleh and H. Sourouzian, *Egyptian Museum Cairo. Official Catalogue* (Mainz, 1987), cat. 29; Hawass, *Inside the Egyptian Museum*, 96–97; Reisner and Smith, *Giza Necropolis* 2, pls. 27a, 28c; Metropolitan Museum of Art, *Egyptian Art in the Age of the Pyramids* (New York, 1999), 218–19, cat. 33; Yvonne Markowitz, J. Haynes, and R. Freed, *Egypt in the Age of the Pyramids. Highlights from the Harvard University-Museum of Fine Arts Boston Expedition* (Boston, 2002), 50(f); N. Cherpion, *Mastabas et Hypogées d'Ancien Empire* (Brussels, 1989), 32–33, fig. 13, who also notes a two-dimensional example from the tomb of Kapunisut Kai (G 4651), ibid, pl. 30; and the column inside the Khufu boat, N. Jenkins, *The Boat Beneath the Pyramid* (New York, 1980), 15, fig. 5, 105, fig. 90.

[38] Through misadventure, our fabricated chair ended up with just thirteen sidelocks, but they show the correct size and proportions. The original sixteen must have been more tightly grouped side by side.

[39] Manuelian, *Digital Giza,* chapter 4, 124–53. I thank my friend and colleague, Mehdi Tayoubi, of Dassault Systèmes, Paris, for many years of fruitful collaboration, encouragement, and support. I thank his colleagues in Paris as well: Karine Guilbert, Richard Breitner, Nicholas Serikoff, Emmanuel Guerrero, Fabien Barati, and Pierre Gable. Bob Brier was also instrumental in helping us forge this partnership. Dassault Systèmes's interest in the Giza Pyramids began with the pyramid construction theories of Jean-Pierre Houdin.

(figs. 22–23).[40] We hoped to learn more about Fourth Dynasty woodworking, and specifically the construction sequence for the individual elements of the chair. Wherever possible, we wanted to use the same materials as the ancient Egyptians, although clearly our digital tools precluded a complete correspondence between our methodology and that used in antiquity. (If the Giza Project staff had included or could have afforded the services of high-end woodworking craftsmen, we might have opted to follow the ancient routine with human labor more closely.) A completed chair would give us the opportunity to study the iconography in greater detail, and take a closer look at the significance of the goddess Neith's dominating presence in its decoration program. The deliverable, we hoped, would be a museum-quality object that would serve as both a teaching and a research tool.

Working with Giza Project digital artist David Hopkins, and supported by the Giza Project's Egyptological staff members Nicholas Picardo, Rachel Aronin, and Jeremy Kisala, Rus Gant began the project in earnest in 2015. It had taken Reisner's team ten months to empty the contents of G 7000 X. It took the Giza Project team eighteen months, amongst much other work, to recreate the lost chair of Queen Hetepheres. We believe the results represent fairly accurately the original chair's appearance, but one should bear in mind the derivative nature of our archaeological experiment. William Stevenson Smith was not present at the original excavation of G 7000 X in 1925–27, although he must have consulted Dows Dunham, who was directly involved in the tomb's clearance, during his (Smith's) reconstruction efforts in the late 1940s. Our reconstruction is based in turn on Smith's, and so any errors of his may be perpetuated in our results.

4.1 Wood

As noted above, lacking master woodworkers on the Giza Project staff, and restricted by a limited budget, we obtained a CNC (computer numeric control) 3-axis milling machine, generously loaned by ShopBot Tools, Inc., and controlled by our 3D model to carve all the individual pieces of cedar wood.[41] We are especially grateful to Neil Gershenfeld, Director of the Center for Bits and Atoms at MIT, for putting us in contact with representatives from ShopBot, and for allowing us to 3D-print some small resin and plastic examples of both of Hetepheres's chairs i and ii (fig. 24). The ShopBot router cut all the intricate patterns from the digital file of the chair created by David Hopkins in 3D Studio Max (figs. 25). Additional "human" touches (see below) were necessary to achieve the final effect, but overall the device quite successfully produced everything: the theriomorphic chair legs, the seat and back, rilled armrests, and even elaborate Horus falcon arm elements, including the numerous cut-out areas in the feathers to hold to the faience inlays.[42]

Figure 26 displays one of the legs in both rough and fine cut, using a rough drill bit first, then a 1/16 inch drill bit for finer detail. The speed of the carving process was managed carefully so as to avoid breaking drill bits, or starting a fire by igniting the resulting dust. The average carving time on one side was 8–10 hours, a time-intensive process. Detailing work remained to be completed by hand with other tools, such as a hammer and chisel to carve out mortise and tenons; and rounding, sanding and gluing. Simple mortise and tenons were used for the seat base. Leather ties would have secured these mortise and tenons for the chair's upper arm, bottom arm, and vertical support. The falcon's wing tips and the top of the head would have locked themselves in

[40] I would like to express my gratitude to colleagues in the Ministry of State for Antiquities, and the Egyptian Museum, Cairo: Minister of Antiquities Dr. Khaled el-Enany, Egyptian Museum, Cairo, Director General Sabah Abdel Razek, Assistant to the Minister for Museum Affairs Yasmin el-Shazly, conservator Dr. Nadia Lokma, and Eman Amin of the Museum's Registration, Collections Management and Documentation Department. We must also acknowledge here the countless hours of research and conservation that Dr. Lokma had already invested in the chair's ancient fragments long before we undertook this fabrication initiative.

[41] Cedar was not the only wood used for Hetepheres's furniture; see the ebony mentioned in relation to the carrying chair, Reisner and Smith, *Giza Necropolis* 2, 33–34.

[42] For more on Egyptian woodworking, see Baker, *Furniture in the Ancient World,* esp. 39–49, drawing on 40, fig. 30; short discussion on 42; H. Fischer, "Möbel," in *LdÄ* IV, 180–89; Killen, *Ancient Egyptian Furniture* I, esp. 59–61 with fig. 31; idem, *Egyptian Woodworking and Furniture* (Buckinghamshire, 1994); A. Wenzel, *Die Formen der altägyptischen Liege- und Sitzmöbel und ihre Entwicklung bis zum Ende des Alten Reiches,* PhD dissertation, Munich (Heidelberg, 1939); R. Gale, P. Gasson, N. Hepper, and G. Killen, "Wood," in P. Nicholson and I. Shaw, eds., *Ancient Egyptian Materials and Technology* (Cambridge, 2000), 334–71; E. Leospo, "Woodworking, Furniture and Cabinetry," in A. Roveri, ed., *Egyptian Civilization: Daily Life* (Milan, 1987), 136–61: 93–161; and D. El Gary, *Chairs, Stools and Footstools in the New Kingdom: Production Typology, and Social Analysis* (Oxford, 2014).

place within the frame of the chair's arms. A dry test assembly proved that all the wooden elements fit together as originally envisaged (figs. 27–28).

4.2 Gilding

We received expert advice from conservator Christine Thomson and her assistant Wenda Kochanowski, who served as consultants for the gilding process. We wanted to recreate as much as was possible the original appearance of gold leaf on a wood substrate. To achieve this, it was necessary to research Egyptian gilding processes and understand the types of materials that were available in antiquity and how they might have been used.

The goal of the gilding process in general is to give the illusion that an object is made of solid gold when it is actually made of wood, stone or other less valuable material. Applying a thin veneer of gold onto the surface can create this illusion convincingly. The Egyptians were among the first to devise methods of beating gold with a hammer into thin sheets or "leaves" then applying the leaves onto a surface using some sort of adhesive.[43] Before the application of gold leaf, the surface was prepared by brushing on thin layers of gesso (chalk and animal glue mixed together with water) that helped to fill holes, dents and imperfections in the wood. It could be sanded very smooth, thereby obliterating all evidence of wood grain or tool marks. The smoother the preparation surface underneath, the brighter and more metallic-looking gilding will be the result. The process of gilding today uses nearly identical materials and techniques to those used in Fourth Dynasty Egypt. This includes the use of gesso, gold pounded into thin layers, an adhesive to adhere the gold to the wood, and burnishing with a polished stone (traditionally an agate) to remove wrinkles and imperfections in the gold.

A close examination of photographs of gold surviving from the original Hetepheres chair ii showed that the gold used then was much thicker (like foil) than the typical gold leaf used today for gilding. When considering the results of applying modern gold leaf versus gold foil onto the wood, we felt that the appearance of gold foil would be more in keeping with the look of Egyptian-produced gilding. Unfortunately, the cost of using real gold foil to gild the chair would have been prohibitive, so alternatives had to be considered. We consulted with Epner Technology of Brooklyn, NY, who provided us with samples of copper foil electroplated with 24K gold. This gave the appearance of solid gold foil at a lower cost and turned out to be an excellent alternative to using gold only (figs. 29–30).

Traditionally, the Egyptians would have adhered the gold foil to a prepared surface with animal hide glue, but in this case we found that the hide glue did not produce a sufficiently strong bond between the gold plated foil and the substrate. Instead, we turned to a synthetic adhesive, a polyvinyl acetate resin-based glue (Jade 403, from Talas, New York, NY), and found it better for attaching the gold plated copper to the prepared wood.[44] It will also hold up longer against the effects of the environment than traditional hide glue. The only difficulty with the gilded copper was that it was not as malleable as pure gold, and therefore could not be as easily burnished to eliminate wrinkles. Its use, however, did give the chair the appearance of an object made of solid gold. It was then relatively easy to "punch" out holes in the gilding over the carved depressions and inset in the wood where the faience inlays belonged.

[43] On ancient gilding in general, see P. Hatchfield and R. Newman, "Ancient Egyptian Gilding Methods," in D. Bigelow, ed., *Gilded Wood: Conservation and History* (Madison, 1991), 27–47; E. Figueiredo, R. Silva, M. Fátima Araújo, and J. Senna-Martinez, "Identification of ancient gilding technology and Late Bronze Age metallurgy by EDXRF, Micro-EDXRF, SEM-EDS and metallographic techniques," *Microchim Acta* 168 (2010), 283–291 (doi: 10.1007/s00604-009-0284-6). In 2000, microscopic analysis was conducted on the (modern) reproduction furniture in the MFA, Boston, by Robert Mussey Associates, Inc. The goal was to understand the layer structure of each gilded object in order to devise the best strategy for stabilization. In the case of the papyrus-armed chair i (MFA 38.957), "the preparatory layers on the chair consist of two to three layers of red bole or paint, but no gray layer. The red layer has the same fluorescence in ultraviolet light and the same uneven chunky red and black pigments as the red layer on the canopy and bed. There is no evidence of any toner or coating over the gold layer. The white-fluorescing chunks in the red layer are either a reisnous material or animal hide glue." Christine Thomson, "Microscopy Report, October 23, 2000," on file in the MFA, Boston, 4.

[44] Cf. R. Newman and M. Serpico, "Adhesives and Binders," in *Ancient Egyptian Materials and Technology*, 475–94.

4.3 Faience

Perhaps the greatest challenge to the entire project was the production of faience inlay tiles: the manufacture method, the color, the best procedure for cutting to the desired shapes, and the insertion of the pieces into the gilded wooden sections of the newly fabricated Hetepheres chair. Once fired, faience reacts like glass, with a factor of 7 on the hardness scale. It is difficult to cut to shape without fracturing. It can be sanded from the sides but is resistant, and in fact, using modern tools we discovered that a belt sander belt wears out after shaping about five pieces.

We had the good fortune to collaborate on faience production with Kathryn King, Director of Education, Ceramics Program, Office for the Arts at Harvard. Along with her Ceramics Associate Darrah Bowden, she performed countless tests on chemical composition and hue, and supervised the faience fabrication process from start to finish. Intensive study of the Egyptian Museum fragments also helped us in our research, even as they raised new questions about color fidelity, and the mutability of faience inlays over time and resulting from long contact with metals or other materials. To put it bluntly: Was Hetepheres's chair gilded with green or with blue faience inlays? The surviving faience inlays show wide-ranging color shifts between various tiles. As a first caveat, we should note that it was not always easy to discern whether a given faience inlay actually belonged to chair ii, or to another one of the queen's furniture items.[45] Secondly, the color range could have resulted from "fading" in some instances, but in others from contiguous proximity to copper elements over several millennia. Analysis of the Djoser tiles from the Step Pyramid complex has revealed that

> … the faience tiles suffered from high degradation because of rising damp in the supported walls and crystallization of soluble salts. Failure of faience tiles is most commonly water related, where the units are highly susceptible to glaze cracking, spilling and material loosing …. Also when a glass or glaze is subjected to weathering by the action of water, the alkali ions (Na+ and K+) are replaced by hydrogen ions (H+) and the glass network progressively breaks up. Thus, the silica glass structure is lost and replaced by amorphous layer so-called silica gel. In addition to leaching out of the alkalis, there are also some leaching out of the colorants which will no longer be present as ions but will have been deposited as fine amorphous or poorly crystalline compounds resulted in the change the chemical composition of faience surfaces.[46]

Most of our faience consulting experts, such as Paul Nicholson of Cardiff University, to whom we are very grateful, agreed that the Hetepheres faience fragments had undergone significant change over time. It is also possible that the original color scheme for the chair may have lacked a uniform faience appearance. The rosettes differed from the feathers, and the papyrus column on which the falcons stand differs from everything else.[47]

For our faience production work we were interested in limiting the amount of customized hand labor for each individual inlay. We tested several technologies, including producing squares of faience that were subsequently carved to shape using a water-jet cutter. We ultimately concluded that producing the inlays with molds made the best sense. We practiced with some terracotta mold tests to see if the Egyptians might have worked this way. But to save time and meet our deadlines, we opted for a 50/50 mix of plaster and silica (fig. 31). Such molds, used in glass slumping, can be placed in the kiln and fired, whereas standard plaster molds cannot. We were in essence treating the faience as glass, a relationship possibly seen by the Egyptians as well. Our workflow involved settling

[45] Reisner and Smith, *Giza Necropolis* 2, 29.

[46] F. Madkour, M. Khallaf, "Degradation Processes of Egyptian Faience Tiles in the Step Pyramid at Saqqara," *Procedia - Social and Behavioral Sciences* 68 (2012), 73 (§ 5.5). For a study of multicolored faience techniques, based on New Kingdom samples, see C. Riccardelli, J. Mass, and J. Thornton, "Egyptian Faience Inlay Techniques: a process for obtaining detail and clarity by refiring," *Materials Research Society Online Proceeding Library* 712 (October 2002), 1–26. And on faience in general see F. Friedman, et al., *Gifts of the Nile: Ancient Egyptian Faience* (New York, 1998), esp. 66, 72–73, and P. Nicholson and E. Peltenburg, "Egyptian Faience," in *Ancient Egyptian Materials and Technology*, 177–94. The Djoser tiles also appear in D. Patch, *Dawn of Egyptian Art* (New York, 2011), 205, fig. 49.

[47] It was inevitable that in ancient times small workshops must have used slightly different chemical compositions for their faience. The purity of the main ingredients would have impacted the texture and color of the final product. Evidence from the Cairo fragments suggests that some faience inlays consisted of individual sections, some blue, some black, while others were larger pieces overpainted to show multiple colors; Paul Nicholson, personal communication, April 29, 2015.

the faience paste into the plaster/silica mold, firing it, and then breaking away the brittle mold to free the faience tiles. The falcon-shaped arms of the chair required replacing the preliminary clay molds with modern rubber ones to create the resulting plaster/silica mold (fig. 32). Thicker faience tiles for the arms and legs were easier to produce; in these cases we returned to the ShopBot router, using the same computer model data we employed for carving the wood to produce molds for the faience. Except for some of the modern tools, we believed that this system may mirror at least portions of the ancient workflow.

Our faience paste took the following chemical composition:

Cone 010 - 06 (Tested to 09)
Gram Batch Amounts:
Soda Feldspar (Minspar) 39.0
Silica 39.0
Ball Clay (Old Mine 4) 12.0
Soda Ash 6.0
Sodium Bicarbonate 6.0

With efflorescence, the metal and silica content created a glass coating towards the top; when we altered the percentages of materials, the colors changed wildly from light to dark blues, greens, and even into black. While we were able to produce a color range from blue to green, the color that was always the most stable with the hardest surface turned out to be blue. The final faience color that worked successfully contained 3% copper (fig. 33, color fig. 34). Reisner's statement on observing blue faience tiles (see above) further encouraged us to stay with blue as the dominant color for the chair's decorative program. The firing temperature was to approximately 900 C.

In creating the faience tiles, we failed to factor in the addition of the thin gilding layers in the side walls of the inlays holes. The gold created 1/100th of an inch difference, but this nevertheless required much hand sanding to reduce and fit the faience tiles in. A tile cutter proved the best tool for cutting the faience into smaller forms.

In the case of the Horus falcons, the contents of Hetepheres's burial chamber revealed two strips of metal on one of the falcon arms, ranging from gold to black. It is possible that these could represent an intentional ancient color scheme. Perhaps silver was used on one side of the lower wing of each falcon, while gold was chosen for the other side. Over the millennia, the silver oxidized to black, while the gold retained its hue. Due to the uncertain nature of the original composition of the falcons, we opted to use gold for both sides and wings of the falcons.

Once the faience falcon wing feather inlays were complete,[48] we turned to the back of the chair with its intricate basket-weave pattern surrounding the Neith emblems. The faience was rolled into thin slabs and then cut into strips. It was then easy to break them off cleanly to create the desired length in the basket weave pattern. Towards the end of our layout preparations, we realized we had to double the size of the individual faience pieces. This larger tile size resulted from study of one of the Reisner notebook drawings, which showed the width of the bottom of the large Neith streamer relative to the faience inlays. With the completion of the Neith emblem we could determine that bottom of her streamer was the width of two faience inlay pieces, instead of three, as we had previously estimated. This reduced considerably the number of individual pieces required for the back (fig. 35).

4.4 Seating Cordage

Decades ago, both the Cairo conservators and the Boston furniture maker Joseph Gerte reconstructed their versions of the better-known chair i of Hetepheres with a simple flat wood board for a seat (fig. 36). The assumption was that a cushion would have rendered the chair more comfortable. But after closer inspection of ancient Egyptian furniture parallels, we began to suspect that this reconstruction was too simplistic, and that most Egyptian chairs displayed cordage or thatching of one form or another. Stools could show solid wood seats in panels,

[48] A useful parallel for the faience inlays on the outstretched wings is provided by the arms with winged cobras on the gold throne of Tutankhamun: M. Eaton-Krauss, "Seats of Power. The Thrones of Tutankhamun," *Kmt* 19:2 (Summer 2008), 29 = *Amarna Letters* 5 (2015), 176.

but the chair seats were most often woven. We selected a tabby (as opposed to a diagonal twill) pattern, using a \4/3\\4 open formula (fig. 37).[49]

4.5 Copper and Chair Supports

Rilled bands of copper beneath the leonine legs complete the composition of the Hetepheres chair. Limestone chair supports, in the form of truncated pyramids, would have served to raise the height of both Hetepheres chairs. Eight of these supports, four per chair, were discovered in the fill of the tomb shaft, between 22 and 24.5 m. deep. Each contained a hole about 6 cm in diameter at the top, along with a hieroglyph which, Smith believed, related to positioning of a canopy (figs. 38–39).[50] The excavators assigned the object register numbers 25-3-232, 233, 234, 235, and 236 to these limestone supports, but they never reached Boston, and have so far not been located in the Egyptian Museum, Cairo.[51] Since the diameter of the legs of chair ii measures about 5 cm, there should be a snug fit of the chair's legs into the limestone supports.

With the completion of the fabricated chair ii of Queen Hetepheres (shown in figs. 40–41), we can summarize the various elements:

19 major wood elements, each sheathed in 1–5 pieces of gold (about 57 separate pieces)
403 inlays for the flowers
414 inlays in the falcon wing feathers
376 inlays in the falcons
about 1,000 inlays in the basket weave faience pattern on the back
13 sidelock pieces
16 pieces for the Neith emblems
12 wood pieces for the back Neith
2 1/4 inch pieces of plywood for the back
2 100-foot spools of hemp
8 wood pegs
2 leather ties
black paint
Jade glue
4 pieces of copper wrap

Total: approx. 2,330 elements

1,000 person-hours, spread over 18 months

5. Iconography of Chair ii

Overall, the chair shows some affinities with other pieces of Hetepheres's furniture, indicating that they may all derive from the same (royal) workshop, despite the presence of Snefru's name on certain pieces and its absence elsewhere (more on this below). Perhaps the most eye-catching and significant elements of the chair are the six emblems (four to the front, two to the back) of the goddes Neith, and the ornate images of the falcon god Horus

[49] W. Wendrich, "Basketry," in *Ancient Egyptian Materials and Technology,* esp. 258 and fig. 10.4.

[50] Reisner and Smith, *Giza Necropolis* 2, figs. 17–18, pl. 3; M. Lehner, *The Pyramid Tomb of Hetep-heres and the Satellite Pyramid of Khufu*, SDAIK 19 (Mainz, 1985), 32 with n. 12.

[51] For a recent comparable discovery of three additional truncated supports in a non-funerary context see M. Lehner, "Discovery 2015: House of a High Official," *Aeragram* 16.1 (Spring 2015), 6, and idem, "Supporting Egypt's Archaeologists: Field Training in the Heit el-Ghurab Settlement of the Giza Pyramids," *BARCE* 207 (Winter 2015/2016), 10, fig. 10a-c. See also J. Vercoutter, "Supports de meubles, éléments architectoniques, ou 'établis'?" *BIFAO* 78.1 (1978), 81–102.

with outstretched wings, adorning both arms. The following remarks briefly touch on some of the iconographic elements of Hetepheres's second chair.

5.1 Neith (and her Arrows and Beetles)

The goddess Neith, of northern origin (Sais, red crown), was one of the most revered deities at the outset of Egyptian history. Numerous Early Dynastic queens bear names compounded with that of Neith.[52] In fact, she was so important in the Old Kingdom that the claim has been made that 40% of all names compounded with that of a deity use Neith's name.[53] (Hathor's popularity rises during and after Dynasty 4; whether we have a parallelism between Hathor and Neith in Hetepheres's two chairs will be touched upon below). Eventually, Neith comes to play many roles in the Egyptian pantheon. A cursory glance at Christian Leitz's *Lexikon der ägyptischen Götter und Götterbezeichnungen* reveals her association with a stunning array of powers, concepts, deities, and locations. In connection with the cosmos, she has affiliations with the heavens, sun, moon, stars, wind, water, earth, and the netherworld.[54] Neith is the *nbt-nt-mḥtyt,* the "mistress of the northern (fifth Lower Egyptian) Neith nome," but other epithets link her to place names in both Upper and Lower Egypt, as well as the Fayum and even Punt.[55] Along with the numerous localities to which she is attached, she is *ḥryt jb t3 ḏsr* "who dwells in the Necropolis," and *ḥryt tp smyt* "chief of the desert," which could apply to Giza.[56] Neith oversees aspects of the inundation,[57] and has creator god and mothering/nurturing and resurrection abilities.[58] The Neith hieroglyph is written for *ḥmswt* (*Wb.* III, 95), which Faulkner calls the "feminine counterpart of the ka" in the Pyramid Texts,[59] and James P. Allen translates as "guardian forces."[60] Neith's warfare and hunting associations such as *nbt pḏwt psḏt* "mistress of the Nine Bows,"[61] and *ḳnt m swn=s,* "brave one with her arrow" are also well documented.[62] The epithet *wpt w3wt* "opener of the ways," may have more to do with leading the king into battle than assisting with the opening of the mouth ceremony.[63] Neith even incorporates some androgynous elements (*ḥmt jrt ṯ3y,* "the woman who is a man;" *ṯ3y jr ḥmt,* "the man who is a woman;" *ṯ3y jr ṯ3yw*, "the man who creates men."[64] Of potential relevance to G 7000 X, she is associated on a few epithets with thrones,[65] and in a funerary context, Neith is *nbt ḳrst,* "mistress of the burial."[66]

The standard upon which the Neith symbol rests displays nothing unusual on our chair. Sheets of gold foil with cutouts, and faience inlay elements, have both survived from the tomb to indicate the form of the Neith

[52] B. Lesko, *The Great Goddesses of Egypt* (Norman, 1999), 45–63, esp 48–49; B. Begelsbacher-Fischer, *Untersuchungen zur Götterwelt des Alten Reiches* (Göttingen, 1981), 111–20 (117, source list no. 641 for Hetepheres); C. Graves-Brown, *Dancing with Hathor. Women in Ancient Egypt* (London, 2010), 163–64.

[53] Graves-Brown, *Dancing with Hathor,* 164.

[54] C. Leitz, ed., *Lexikon der ägyptischen Götter und Götterbezeichnungen* (Leuven/Paris/Dudley, 2002/2003), vol. III, 510–17, and VIII, 265–74.

[55] W. Helck, *Die altägyptischen Gaue* (Wiesbaden, 1974), 158–63.

[56] For Neith at Giza in the Old Kingdom, see el-Sayed, *La déesse Neith de Sais,* 239–51; Hetepheres is Doc. 191, 266 and pl. IV.

[57] Leitz, *LGG* VIII, 268, D1.

[58] Leitz, *LGG* III, 511, function D (28= Merneptah sarcophagus, see K*RI* IV, 68–70, and J. Assmann, "Neith spricht als Mutter und Sarg (Interpretation und metrische Analyse der Sargdeckelinschrift des Merenptah)," *MDAIK* 28 (1972), 115–39; and Leitz, *LGG* VIII, E2.

[59] Utterance 273–74, §396; R. Faulkner, *Pyr.*, 80, 83 n. 6. I am grateful to Cynthia May Sheikholeslami for bringing the *ḥmswt* to my attention in this context.

[60] J. Allen, *The Ancient Egyptian Pyramid Texts* (Atlanta, 2005), 51 (180a): "… for Unis's kas are about him, his guardian forces are under his feet…;" see also Lesko, *The Great Goddesses,* 57–58.

[61] Leitz, *LGG* VIII, 267 and 270, I.1.

[62] Leitz, *LGG* VIII, 269, H1.

[63] Begelsbacher-Fischer, *Untersuchungung zur Götterwelt des Alten Reiches,* 112.

[64] Leitz, *LGG* VIII, 269, H5.

[65] Leitz, *LGG* III, 271, O8. *ḥmst ḥr nst=s m t3-šmʿw,* "who sits on her throne in Esna in Upper Egypt;" *ḥryt ḫndw m wsb n pt,* "who is upon the throne of the breadth of heaven;" *ḥryt st wrt,* "who is upon the great seat;" *ḏsrt st,* "whose seat is sacred;" *ḏsrt st m Jwnyt,* "whose seat is sacred in Esna." On comparisons between Hathor and Neith, see also el-Sayed, *La déesse Neith de Sais*, 142–43, Doc. 981, 607–608, with bibliography: "Hathor … mistress of the two seats of Neith."

[66] Leitz, *LGG* VIII, 273, U.2.

emblems (figs. 42–43).[67] The tall processional poll extends upward to end in a horizontal cross-piece, with a thicker, striated front section or platform, while a streamer billows off of it.[68] When the queen sat in the chair, her torso would have blocked the view of the Neith emblems on the front-facing side of the chair's back; and most likely few elites would have had a direct view of the additional Neith emblems on the back (assuming the chair was actually used at court during formal events, and was not constructed solely as a piece of funerary equipment). As noted above, either a horizontal cushion, a vertical one, or perhaps more likely both, seem required to offset the deep, square area of the seat, thereby forcing the queen's figure forward so that her knees might bend over the front edge of the chair. To quote today's furniture designers, admittedly regarding modern, not ancient (smaller), bodies: "The buttock-popliteal length governs the seat depth. This length, for 95 percent of both men and women, is 17 in. or 43.2 cm, or more. A seat depth not exceeding that should, therefore, accommodate a large majority of users." Note that by comparison the Hetepheres chair shows a whopping 66 cm or 26 inches in depth.[69]

On the back of the chair, the two Neith emblems are larger, and the most unusual elements are the double platforms on the standards, facing both inward and outward, along with the double streamers.[70] The pairs of arrows each face inwards, towards the center of the chair and each other, while the fletchings face outwards.

5.2 Beetles

We turn now to the actual items perched atop the divine standard. Over time, a striking evolution has taken place with these elements. In an excellent 1982 article, Stan Hendrickx argued that the Neith emblem was never associated with shields; and it is indeed true that holding a shield and bow and arrows simultaneously makes for a very unwieldy amount of weaponry.[71] Three different objects relate to Neith: the oldest is the crossed arrows, followed by the so-called bilobate object consisting of two ovals, and lastly the tied pair of bows (fig. 44). For our purposes, the two ovals are the key, as they appear on all six examples of the emblem on the Hetepheres chair. Rather than shields,[72] most scholars agree today that these grooved, connecting ovals represent the backs of the bilobate click beetles (*Agrypnus notodonta Latr*).[73] The shape devolves over time, losing its internal grooves in the Fifth Dynasty and becoming a broad oval in later periods.[74] We can find parallel examples as early as an Early Dynastic small gold beetle-shaped capsule with the Neith emblem inlaid in a "dark blue paste," from Reisner's excavations at Naga ed-Deir,[75] from the Abydos stela of Merneith, and also from the tag of Horus Aha showing

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[67] For a line drawing of the front of the chair back, with the four Neith emblems and surrounding ornamentation, see Smith, *HESPOK,* 147, fig. 58.

[68] See W. Simpson, "A Horus-of-Nekhen Statue of Amunhotpe III from Soleb," *BMFA* 69, no. 358 (1971), 160–61. For a Middle Kingdom parallel, a mirror handle showing the same form, see MFA 72.4470 (provenance not known), Manuelian, *Slab Stelae,* 155, fig. 229.

[69] See Panero and Zelnik, *Human Dimension & Interior Space. A Source Book of Design Reference Standards,* 57–67, 128.

[70] The standard hieroglyph (Gardiner R12, R13 with the Horus falcon, G26 with Thoth) is called by F. Griffith, *Hieroglyphs* (London, 1898), 58, with figs. 168, 175, a "hawk-perch, with two ornamental straight plumes at the back; at the end of the horizontal bar a peg passed through it, holding a food trough," For various discussions of aspects of the standard, see H. Fischer, *Varia Nova,* Egyptian Studies III (New York, 1996), 201–3, with fig. 13; R. Shalomi-Hen, *The Writing of the Gods. The Evolution of Divine Classifiers in the Old Kingdom* (Wiesbaden, 2006), 11–38.

[71] Hendrickx, "Two Protodynastic Objects in Brussels," 23–42.

[72] Helck, *Die altägyptischen Gaue,* 158.

[73] Hendrickx, "Two Protodynastic Objects in Brussels," 26, fig. 3; L. Keimer, "Pendeloques en forme d'insectes faisant partie de colliers égyptiens," *ASAE* 31 (1931), 150, pl. 3. For a look at beetles as a clue to Old Kingdom climate change (at Abusir), see M. Bárta and A. Bezdek, "Beetles and the Decline of the Old Kingdom: Climate Change in Ancient Egypt," in H. Vymazalová and M. Bárta, eds., *Chronology and Archaeology in Ancient Egypt (The Third Millennium B.C.). Proceedings of the Conference Held in Prague June 11–14, 2007* (Prague, 2008), 215–24.

[74] Hendrickx, "Two Protodynastic Objects in Brussels," 40.

[75] G. Reisner, *The Early Dynastic Cemeteries of Naga-ed-Dêr* I (Leipzig, 1908), 31, 143–44, pl. 6 no. 1, and pl. 9a. This object derives from Dyn. 1–2 tomb N 1532 (Cairo JE 35706 = CG 53821–2); see also E. Brovarski, "Naga ed-Deir," in *LdÄ* IV, 302 with n. 40l; A. Wilkinson, *Ancient Egyptian Jewellery* (London, 1971), 14, fig. 5. The other two gold amulets from this tomb, a bull and an oryx, are illustrated in color, ibid., 15, figs. 6–7; C. Aldred, *Jewels of the Pharaohs* (London, 1971), pl. 2.

a temple dedicated to the goddess.[76] An excellent example is found on the schist plaque or temple enclosure fragment in Brussels (E 6261) discussed by Hendrickx (fig. 45).[77] This piece shows not only the Neith emblems in the same form as on the Hetepheres chair, but additional oval click beetles immediately adjacent to them. From Giza, Selim Hassan discovered a Fourth Dynasty gold necklace composed of fifty beetles that was wrapped around the neck of the deceased.[78]

The question is, What is the relationship between the click beetles and the goddess Neith? Many scholars believed there was no clear solution here,[79] but Hendrickx has followed Kaplony's and el-Sayed's focus on Neith's important association with the inundation (*srnpt wḥm ʿnḫ r tr=f*, "who replenishes/rejuvenates the inundation waters in their time"[80]) as the connection between the goddess and the click beetle. Specifically, Hendrickx suggested that the beetle jumps to avoid the rising waters of the Nile. To connect the goddess further with sound, he has also called attention to the click or twang of arrows flying off the bow.[81]

I would like to take the Neith/beetle sound association one step further, to relate to concepts of clicking, locking, and sealing. The iconography of the click beetle appears in locations we might otherwise not expect, some of them even in Hetepheres's tomb, and on other contemporary royal monuments. For example, the beetle appears as a door latch in the cabin of the first Khufu boat, found in 1954.[82] It also forms the head of copper bolts or pins on Hetepheres's "bedroom" canopy, intended to lock the corner posts together. There are three beetle pins on each of the two front sides: one at the bottom, a second in the middle, and a third towards the top (fig. 46) All of these elements utilizing the beetle are related to clicking shut, or sealing.

This association might even bring us to a better understanding of door bolt *z/s* hieroglyph (Gardiner O34).[83] To my knowledge, the bulbous forms in the middle of the sign have yet to be explained. The more detailed versions of the hierogyph show the same grooves that we find on the Hetepheres chair Neith emblems, the bed canopy beetle pins, the Brussels shrine, and other examples (fig. 47).[84]

5.3 Sidelocks

It may be tempting to interpret the frieze of thirteen vertical elements above the four Neith emblems on the front of the chair back as royal or divine beards (fig. 48).[85] They show the same braiding and curled end as are found, for example, on the mask of Tutankhamun, right down to the color scheme.[86] Now it is true that one of

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[76] For the stela of Merneith, Egyptian Museum, Cairo JE 34450 see el-Sayed, *La déesse Neith de Sais,* 236, Doc. 108, pl. 3; for Horus Aha: Hendrickx, "Two Protodynastic Objects in Brussels," 31, fig. 6; W. Petrie, *Royal Tombs of the Earliest Dynasties* II (London, 1901), pl. X.2, and el-Sayed, *La déesse Neith de Sais,* 225–26, Doc. 73, pl. 1.

[77] Patch, *Dawn of Egyptian Art*, 150, cat. 124, Naqada III–Dynasty 1 (3300–2900 BC), graywacke, Brussels E 6261; Hendrickx, "Two Protodynastic Objects in Brussels," 28–32, pl. III.2; See also Patch, *Dawn of Egyptian Art*, 151, cat. 125, beetle-shaped beads, probably Naqada III–Dynasty 1 (3300–2900 BC), mineralized bone; MMA 16.7.59; 199, cat. 180, bowl with carved relief of an anthropomorphized beetle, Dyn. 1, reign of Den.

[78] Hassan, *Giza* 2: *1930–1931*, 149, pls. 49–50, 52 (G 8887 = mastaba of shaft 294, discovered in 1930; Egyptian Museum, Cairo, GEM 6184); Aldred, *Jewels of the Pharaohs*, pl. 5; Vilímková, *Egyptian Jewellery*, 17, pl. 6.

[79] Keimer, "Pendeloques en forme d'insectes," 173; Reisner and Smith, *Giza Necropolis* 2, 31: "…there is still a curious relationship, difficult to express, between these representations of the beetle and the Goddess of Sais," citing M. Murray, *The Museums Journal, London* 47 (1947), 37 (not seen).

[80] Leitz, *LGG* III, 269, (F2); Hendrickx, "Two Protodynastic Objects in Brussels," 41–42. See also S. Quirke, *Ancient Egyptian Religion* (New York, 1992), 51: "Still another expression of the waters out of which land emerged was Neit, a goddess whose main temple stood at Sais and whose role included the masculine territory of hunt and warfare; Neit as aggressive water formed the natural mother, in Egyptian expression, to the crocodile Sobek, a god revered particularly at dangerous riverbanks where the threat of crocodiles loomed especially large…."

[81] Hendrickx, "Two Protodynastic Objects in Brussels," 42.

[82] Jenkins, *The Boat beneath the Pyramid*, 15, fig. 6.

[83] Griffith, *Hieroglyphs,* 38–39, fig. 139.

[84] See the false doors with carved doorbolts from the Giza mastaba of Seshemnefer II (G 5080 = 2200): Tübingen Inv. Nr. 4, E. Brunner-Traut, *Die Grabkammer Seschemnofers III.* (Mainz, 1977), pl. 32, and N. Kanawati, *Tombs at Giza* II (Warminster, 2002), pl. 32; Hildesheim Inv. Nr. 1540, M. von Falck and B. Schmitz, *Das Alte Reich, Ägypten von den Anfängen zur Hochkultur* (Hildesheim, 2009), 74–75, cat. 14.

[85] See the beard on the creator god (Geb?) on a fragment from a Third Dynasty Djoser shrine at Heliopolis: *Egyptian Art in the Age of the Pyramids,* 175, cat. no. 7c. For this reference I am grateful to Florence Friedman.

[86] For the beard on the Tutankhamun mask, see I. Edwards, *Treasures of Tutankhamun* (New York, 1976), 134 and pl. 12; and Hawass,

Neith's epithets was *rwy=s m ṯ3y r3 ḥmt=s m ḥmt* "whose 2/3 are masculine and whose 1/3 is feminine,[87] But why would we find male beards on a chair designed for a queen and adorned with emblems of a goddess? Even the god Horus, whose falcons adorn the chair's arms, never appears in his mature form with a beard. Far more likely, then, these elements represent sidelocks associated with children and appearing most frequently in the wigs on coffins and statues of Middle Kingdom women. The feature that seems to clinch this argument is the circular element in the center of the curl at the bottom of each sidelock; this represents a spool, possibly of carnelian, around which the hair of the wig could be wound. It is not found on beards. Smith has gathered several parallels, and even speculates on a possible connection to a Libyan origin of the goddess Neith.[88] Should one want to associate the sidelocks with the Horus falcons on the Hetepheres chair arms, it is true that this deity sports a sidelock when represented as a youth, such as on cippi.[89]

5.4 Feathers and Floral Rosettes

The original excavators of G 7000 X deemed much of the ornamental decoration of the Hetepheres furniture to be "new" in the Egyptian repertoire.[90] This is not the case, however, with the flower pattern that appears on several pieces. Other scholars have already drawn connections between the "strongly stylized"[91] Hetepheres rosettes and the flowers appearing on diadems and fillets from the Old and Middle Kingdoms, among them the statue of Nofret from Meidum, diadems from Giza now in Cairo and Leipzig, and the exquisite diadem of Sit-hathor-iunet from Lahun.[92] With the Hetepheres rosettes, the four large, diagonal teardrop-shaped negative spaces between the four curving inlays seem to recall the cut-out spaces on Giza diadems that separate papyrus flowers.[93] There are either twenty-four or eighteen rosettes on Hetepheres's chair ii, depending on whether the interiors of the chair arms were actually decorated or not (we assumed that they were for our modern reproduction).[94] These appear between rows of vertical feathers, colored blue, with black midsection and black tip at the bottom, at regular intervals. Three rows of eight vertical feathers separate the three rosettes on the exterior horizontal pieces (see fig. 15 N) of the arm frames. The vertical arm rest supports (see fig. 15 K) have rows of five feathers (no rosettes). On the front-facing side of the chair's back (fig. 15 F), two groups of eleven feathers make up the outside left and right; then two groups of eight feathers separate the three rosettes. The top rail of the rear-facing side of the chair's back (fig. 15 M) shows four sections of ten feathers each between five floral rosettes. The vertical back rails (fig. 15 L) have five feathers in each row, and two rosettes each. It is interesting that the bottoms of all three back rails end, not in a rosette, but in a second row of five feathers.

Inside the Egyptian Museum, 240–41, 244.

[87] Leitz, *LGG* VIII, 269, H5.

[88] Smith, *HESPOK,* 147–48, fig. 58; Lesko, *The Great Goddesses of Egypt,* 47, 58; E. Terrace and H. Fischer, *Treasures of Egyptian Art from the Cairo Museum* (Boston, 1970), 73–76, cat. 14 (Queen Nofret); R. Freed, L. Berman, and D. Doxey, *Arts of Ancient Egypt* (Boston, 2003), 173 Hathor/Bat capital (MFA 89.555).

[89] See, for example, the Thirtieth Dynasty Metternich stela (MMA 50.85), Metropolitan Museum of Art, *The Metropolitan Museum of Art Guide* (New Haven, 2012), 57.

[90] Reisner and Smith, *Giza Necropolis* 2, 30.

[91] Smith, *HESPOK,* 146.

[92] Hawass, *Inside the Egyptian Museum,* 281, 284; Aldred, *Jewels of the Pharaohs,* 33–34, pls. 4 and 20; I fail to see the connection of Aldred's roundel drawing on p. 34 to the decorative elements from Hetepheres's tomb. See also Vilímková, *Egyptian Jewellery,* 16–17, pls. 5 and 14; D. Dunham, "An Egyptian Diadem of the Old Kingdom," *BMFA* 44, No. 255 (February 1946), 23–29. The MFA diadem, accession number 37.606a–b, from G 7143 at Giza, bears less of a relation to the Hetepheres rosettes since it contains a rising ankh sign flanked by two ibis birds. A color painting of this diadem appears in Dunham, "An Egyptian Diadem," 24, fig. 1; and see L. Keimer, "Interprétation de plusieurs représentations anciennes d'ibis," *CdE* 29, no. 58 (1954), 237–50; addendum in: *CdE* 30, no. 59 (1955), 46.

[93] Dunham, "An Egyptian Diadem," 27, figs. 7–8. S. Hassan, *Excavations at Giza* 2: *1930–1931* (Cairo, 1936), 149, pls. 49–51 (G 8887 = mastaba of shaft 294, discovered in 1930; Egyptian Museum, Cairo SR1 4873 = GEM 6184); M. Gauthier-Laurent, "Couronnes d'orfèvrerie à bandeau de soutien de l'Ancien Empire," *RdE* 8 (1951), 79–90; R. Krauspe, ed., *Das Ägyptische Museum der Universität Leipzig* (= Zaberns Bildbände zur Archäologie, Sonderhefte der Antiken Welt) (Mainz am Rhein, 1997), 47 (D 208, shaft 9, discovered in 1903; Leipzig ÄMU 2500).

[94] Reisner and Smith, *Giza Necropolis* 2, 30.

The patterns employ groups of five, eight, ten, and eleven feathers. We can contrast this with the footboard of Hetepheres's bed, which uses nine feathers in between each of three rosettes (fig. 49),[95] and the inlaid box, which uses seven feathers in between seven rosettes.[96] Both the curtain box and the walking stick case show feathers but no rosettes.[97]

6. Conclusions

We have summarized above the excavation history of tomb G 7000 X, and the meticulous recording that allowed us in recent years to explore fabricating the second chair of Queen Hetepheres. The experimentation and discovery process, from traditional archaeology to digital archaeology to a fabricated, real-world object, provided several benefits, not least of which was the opportunity to follow the ancient Egyptian construction methodology and to gain a closer look at the decorative iconography.

There are several ways to contextualize the corpus of Hetepheres's furniture. Questions include

- Did the queen use the furniture in daily life or commission them as part of her burial assemblage?
- Were some items made during the reign of Snefru and others under Khufu?
- Is there is a symbolic comparative significance to the iconography of the different pieces of Hetepheres's furniture?

For all these questions, the fact that we are dealing with thousands of tiny fragments and modern restorations hardly simplifies our interpretation. This is especially true for the daily life versus funerary equipment question, for the disintegration of the wood has obliterated any evidence of wear and tear from repeated use.

On the dating from one reign to the next, clearly several motifs recur across different pieces of furniture, such as the feather and rosette pattern on our chair ii, on the bed footboard, and on the inlaid box, although in different number sequences. These would seem to link all the furniture to the same royal workshop. We could look to the presence or absence of royal names on certain pieces. Snefru's name appears on the bed canopy and the curtain box. Khufu's name explicitly appears only on mud seal impressions from inside decayed wooden boxes and at the bottom of the pit.[98] Are we then to infer that items lacking the name of Snefru must date to Khufu's reign? This category would include the carrying chair, the inlaid box, the bracelet box, and our chair ii. But the ornament and decorative scheme selected for an object might take precedence over the presence or absence of a royal name, so this is a dangerous interpretation at best. In fact, we seek in vain for even a specific mention of Hetepheres I as the wife of Snefru. The only title naming Hetepheres as a *ḥmt nswt* comes from a sacred oil vessel lid in a private collection, a context unrelated to G 7000 X, and that could even refer to a different Hetepheres.[99] Vivienne Gae Callender has recently taken a very cautious approach to the genealogy:

> "It is quite certain that Hetep-heres I was buried near her son *after* the death of Sneferu (as the title of *king's mother* in her tomb demonstrates) and this may have taken place a number of years after the death of Sneferu. Whether or not she was ever married to him is an unknown factor; we must not automatically assume that she was. Not one item from that tomb links the names of King Sneferu and Hetep-heres I.

[95] G. Reisner, "The Household Furniture of Queen Hetep-heres I," *BMFA* 27, no. 164 (December 1929), 88, fig. 9. Note that Reisner and Smith, *Giza Necropolis* 2, fig. 33, lower left, shows an irregular pattern of nine, then ten feathers, but this must be a modern drawing error. For a line drawing, see Smith, *HESPOK*, 147, fig. 57.

[96] Reisner and Smith, *Giza Necropolis* 2, fig. 40.

[97] Reisner and Smith, *Giza Necropolis* 2, figs. 28a–b and 46.

[98] Reisner and Smith, *Giza Necropolis* 2, 48–59, fig. 47, pl. 43c; see also Reisner, "Hetep-Heres, Mother of Cheops," 31.

[99] P. Kaplony, *Kleine Beiträge zu den Inschriften der ägyptischen Frühzeit* (Wiesbaden, 1966), 21, 272, fig. 1114. Kaplony notes that Hetepheres is the earliest example of oils labeled on vessel lids; Reisner and Smith, *Giza Necropolis* 2, fig. 41. In fact, Peter Jánosi doubts Khufu was a son of Snefru: *Giza in der 4. Dynastie* (Vienna, 2005), 62, with reference to S. Roth, *Die Königsmütter des Alten Ägypten* (Wiesbaden, 2001), 69–81, esp. 72, and additional bibliography.

> Those few items of hers that are named do not mention Sneferu, even if Sneferu's name is present in her tomb."[100]

If the significant relationship was between Hetepheres and her son Khufu, rather than between Hetepheres and Snefru, then this would explain the proximity of G 7000 X to Khufu's pyramid complex, instead of an original location at Dahshur, as Reisner originally surmised.[101] And yet, the quality of the furniture is so exquisite that I find it difficult to follow Callender's suggestion that the "majority of the funerary equipment and the unwanted bric a brac of the previous reign would have been used in the burial."[102]

How should we parse the furniture items in a comparative schema in order to assess the iconography? Are there Upper Egyptian and Lower Egyptian elements to consider? Under the category of furniture representing the south we might list our chair ii (with the Horus falcons and their palmiform columns), the carrying chair (likewise with palmiform columns on the ends of the poles), and the inlaid box (with Min emblems). But here the pattern breaks down if we factor in the Neith emblems, most likely a northern feature, for chair ii. Northern elements may be found on chair i (with the three papyrus flower arms). Perhaps the two chairs should be seen in juxtaposition, with chair i emblematic of Hathor and our chair ii representative of the goddess Neith. Chair i places the queen between (arms of) papyrus, just as the Hathor cow was often traditionally portrayed."[103]

If Hetepheres's two chairs really were meant to stand in contrast with each other, despite the relative simplicity of one and the complex ornamentation of the other (as restored, of course), then we must take a closer look at the iconography of the queen's other pieces of furniture. Among them is the yet-to-be-fabricated elaborate inlaid box, with emblems of the god Min, rosettes and additional inscriptions (fig. 50).[104] The remarks above will hopefully serve as guideposts for future research that will either confirm or overturn some of the suggestions and conclusions drawn here. The last word has yet to be written on the tomb, its discovery, unique material record (figs. 50–51), and the ancient motivation behind one of the most intriguing archaeologial finds from any Egyptian cemetery or era.

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[100] Callender, *In Hathor's Image* I, 62–63.

[101] Reisner, "Hetep-Heres, Mother of Cheops," 31.

[102] Callender, *In Hathor's Image* I, 65: "All we can honestly say about her relationships is that she was the mother of Khufu, the grandmother of Hetep-heres II and Djedefre—and probably of Kawab, Khafukhufu I, Horbaf and Meresankh II and great-grandmother of Queen Meresankh III, but other relationships are uncertain."

[103] Lesko, *The Great Goddesses*, 85. For a suggestion that the seated image of Hetepheres sniffing a blossom could have adorned the back of Hetepheres's simpler chair I (see our color fig. 51), see Johnson, "The Mysterious Cache-Tomb of Fourth Dynasty Queen Hetepheres," 40, 49–50, cited by Eaton-Krauss, "Seats of Power. The Thrones of Tutankhamun," 31 = *Amarna Letters* 5 (2015), 175.

[104] Reisner and Smith, *Giza Necropolis* 2, 36–40, figs. 38, 40.

assistance with documents and footage relating to G 7000 X I am also indebted to Cat Warsi of the Griffith Institute, University of Oxford, and Benjamin Singleton, Moving Image Research Collections, University of South Carolina.

Research and Egyptological support came from the Giza Project staff at Harvard University: Rachel Aronin, Nicholas Picardo, and Jeremy Kisala. The installation of the chair exhibit in the Harvard Semitic Museum took place with assistance from Museum staff Joseph Greene, Adam Aja, Kristen Vagliardo, and Adam Middleton, and the design and exhibition expertise of staff from the Harvard Museums of Science and Culture: Jane Pickering (director), Janis Sacco, Sam Tager, and Tristan Rocher. The installation video was created by the author and Jennifer Berglund (Harvard Semitic Museum: http://bit.ly/2g89K9I, Youtube: http://bit.ly/2g89K9I). An educational video was also produced, in collaboration with our partners at Dassault Systèmes (http://bit.ly/2frzSe2). I thank Peter Lu for photographing the chair in the Harvard Semitic Museum with a PhaseOne IQ3 100-megapixel medium format back on an Arca Swiss technical camera (see fig. 40).

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Harvard University

Fig. 1. Aerial view of the Eastern Cemetery, looking southeast, with the location of G 7000 X indicated by white arrow. 10/7/2011. Courtesy of AirPano.com.

Fig. 2. G 7000 X, course I in stairway after removal of plaster fill, looking north. 02/20/1925, Photograph by Mohammedani Ibrahim (B5632). HU-MFA Expedition, courtesy MFA, Boston.

Fig. 3. G 7000 X, pit blocks at 24.8 meters from mouth, looking north. 03/07/1925. Photograph by Mohammedani Ibrahim (B5671A). HU-MFA Expedition, courtesy MFA, Boston.

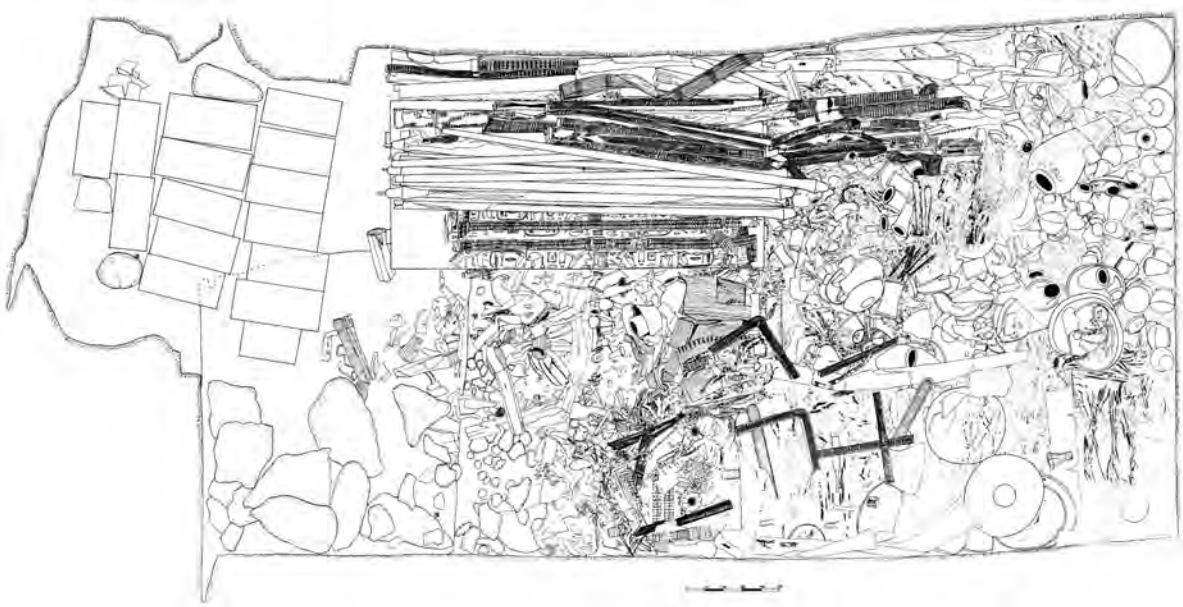


Fig. 4. G 7000 X, plan of chamber as found. Reisner and Smith, Giza Necropolis 2, fig. 19.

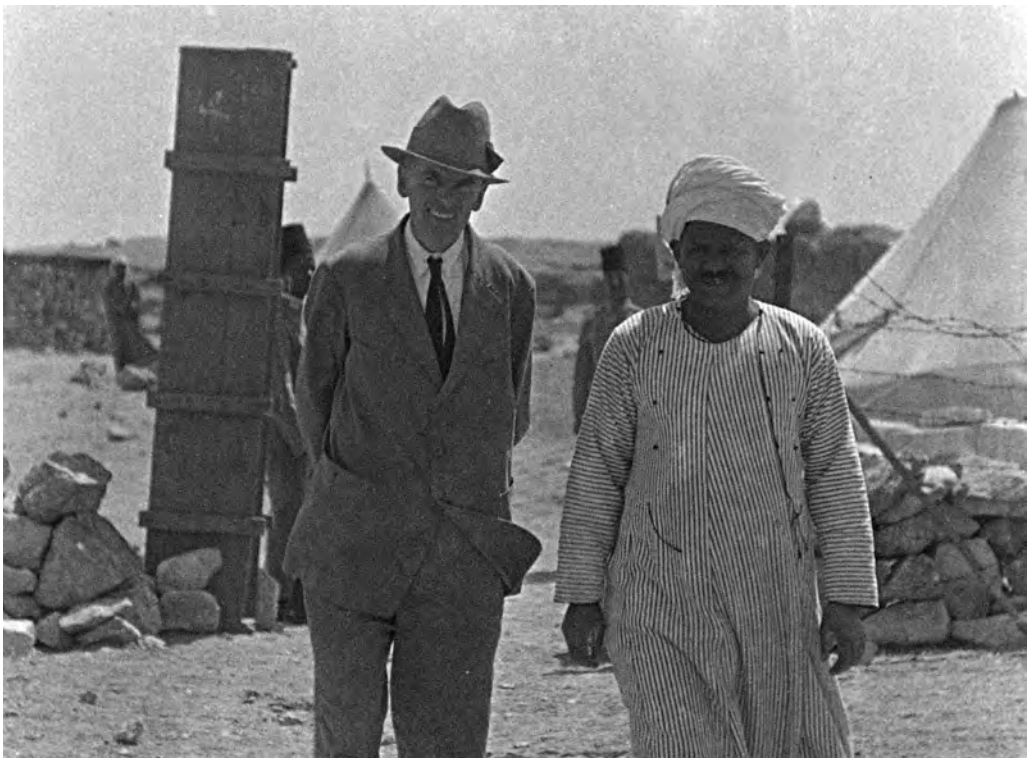


Fig. 5. Alan Rowe and Said Ahmed Said, in front of G 7000 X, pose for Fox news cameraman Ben Miggins, probably March 21, 1925, looking south. Courtesy Moving Image Research Collections, University of South Carolina.

Fig. 6. G 7000 X, plan of chamber as found; oil on canvas painting by Joseph Lindon Smith (1863–1950), 38.5 x 64 cm (15 3/16 × 25 3/16 in.). Anonymous gift; courtesy of the descendants of Joseph Lindon Smith, MFA 27.388. Photograph by the author.

Fig. 7. G 7000 X, general view of south deposit, looking northeast, before work commenced; fifth photo of the day, 09/25/1926. Photograph by Mustapha Abu el-Hamd (A4231). HU-MFA Expedition, courtesy MFA, Boston.

Fig. 8. G 7000 X, sealed sarcophagus (Cairo JE 51899) in cleared chamber, looking northeast, 02/27/1927. Photograph by Mohammedani Ibrahim (A4587). HU-MFA Expedition, courtesy MFA, Boston.

Fig. 9. Restored furniture of Queen Hetepheres, Egyptian Museum, Cairo. Photograph by Sandro Vannini.

Fig. 10. Modern reproductions of Hetepheres's furniture in the MFA, Boston: canopy (38.873), headrest (29.1859), chair i (38.957), curtain box (39.746), bed (29.1858) (SC63207). Courtesy MFA, Boston.

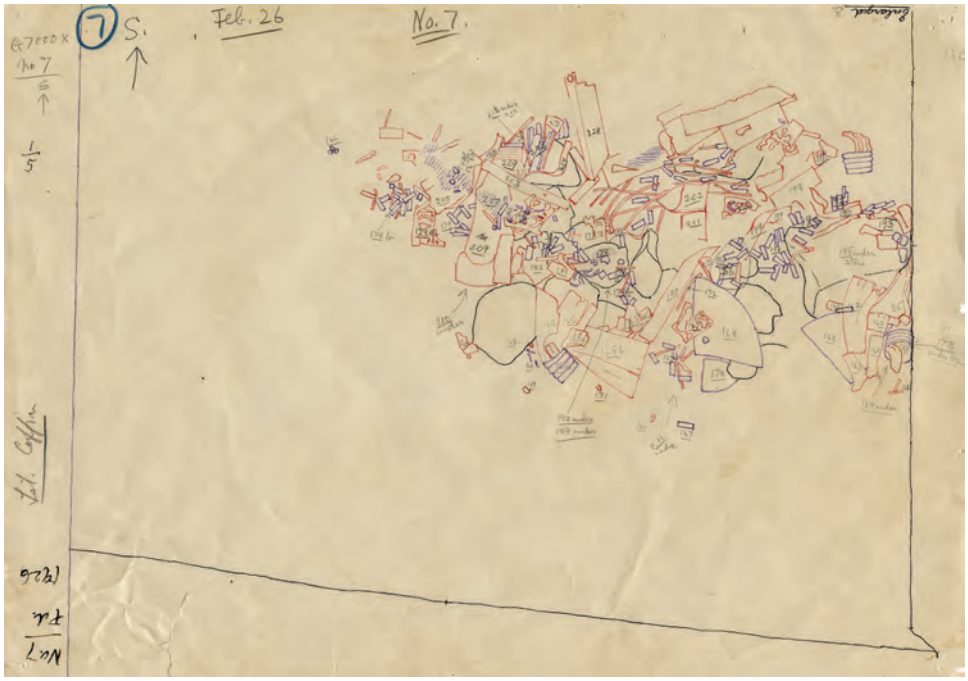


Fig. 11. G 7000 X, sample drawing of contents of the deposit, with gold objects in red ink, wood and other types of objects in purple, and stones and walls in black, 2/26/1926. HU-MFA Expedition Archives.

Fig. 12. G 7000 X, "view c" of strip adjoining lower pit on south, looking south, 02/15/1926. Photograph by Mustapha Abu el-Hamd (A3693). HU-MFA Expedition, courtesy MFA, Boston.

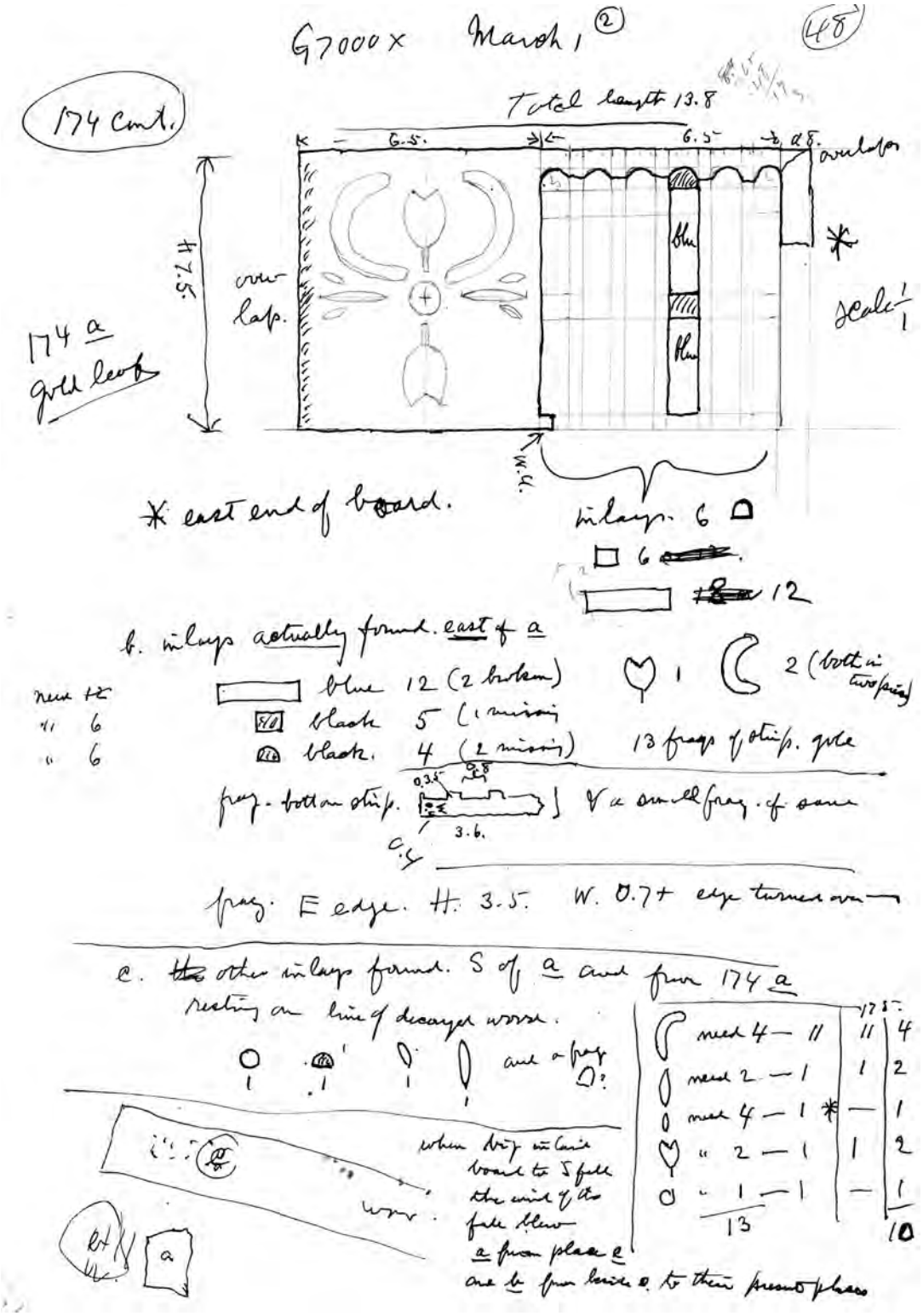


Fig. 13. Sample notes page, in Reisner's own hand, from the burial chamber of G 7000 X, March 1, 1926. HU-MFA Expedition Archives.

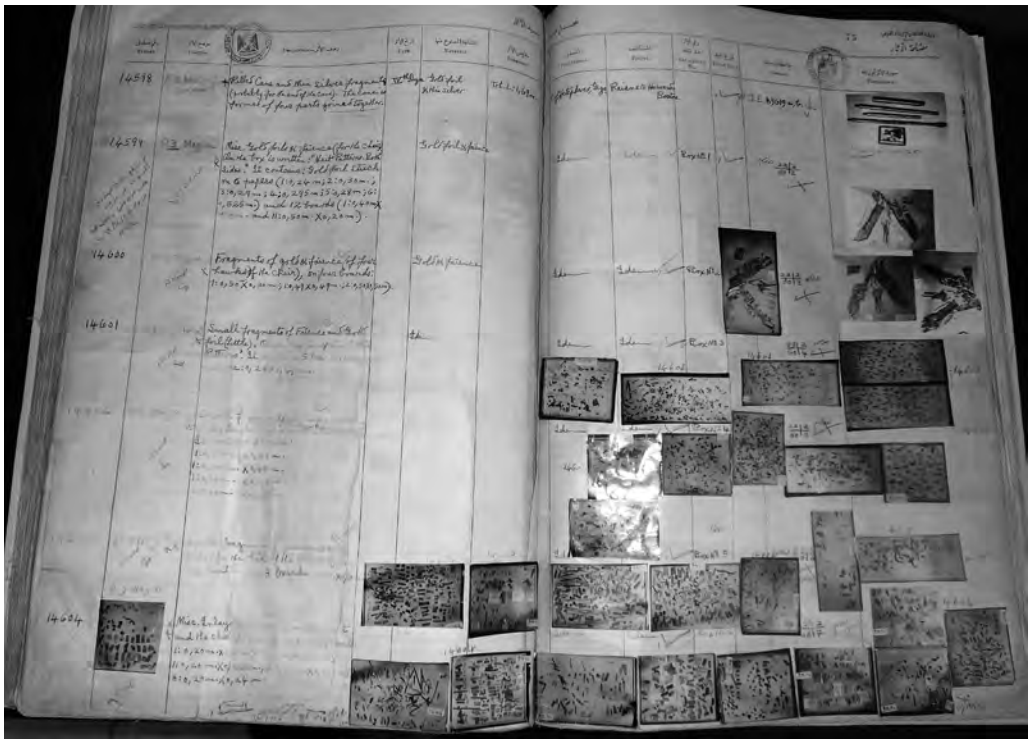


Fig. 14. Egyptian Museum, Cairo, sample view of Journal d'Entrée containing objects and photographs from G 7000 X. Courtesy Egyptian Museum, Cairo.

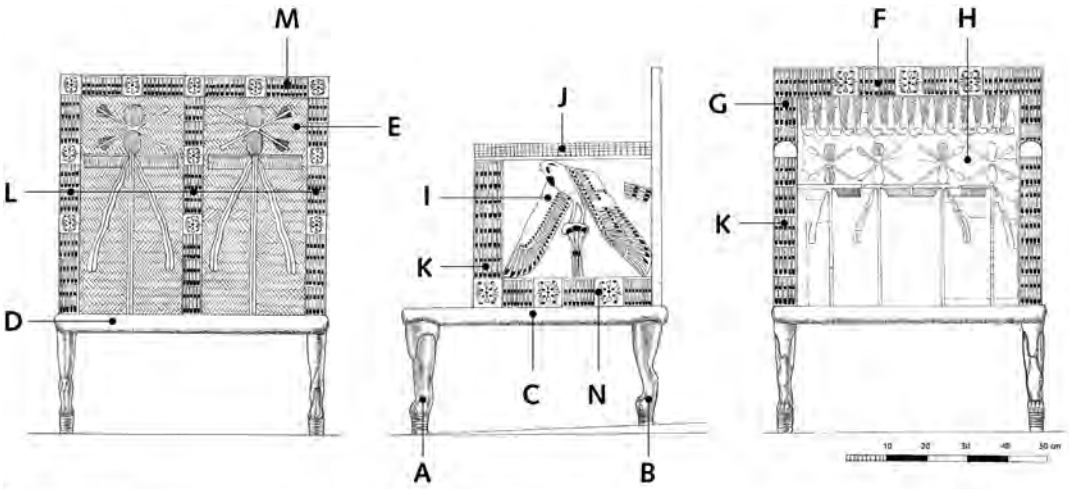


Fig. 15. Reconstruction scale drawing of chair ii of Hetepheres, with annotations by the author; after Reisner and Smith, Giza Necropolis 2, *fig. 32.*

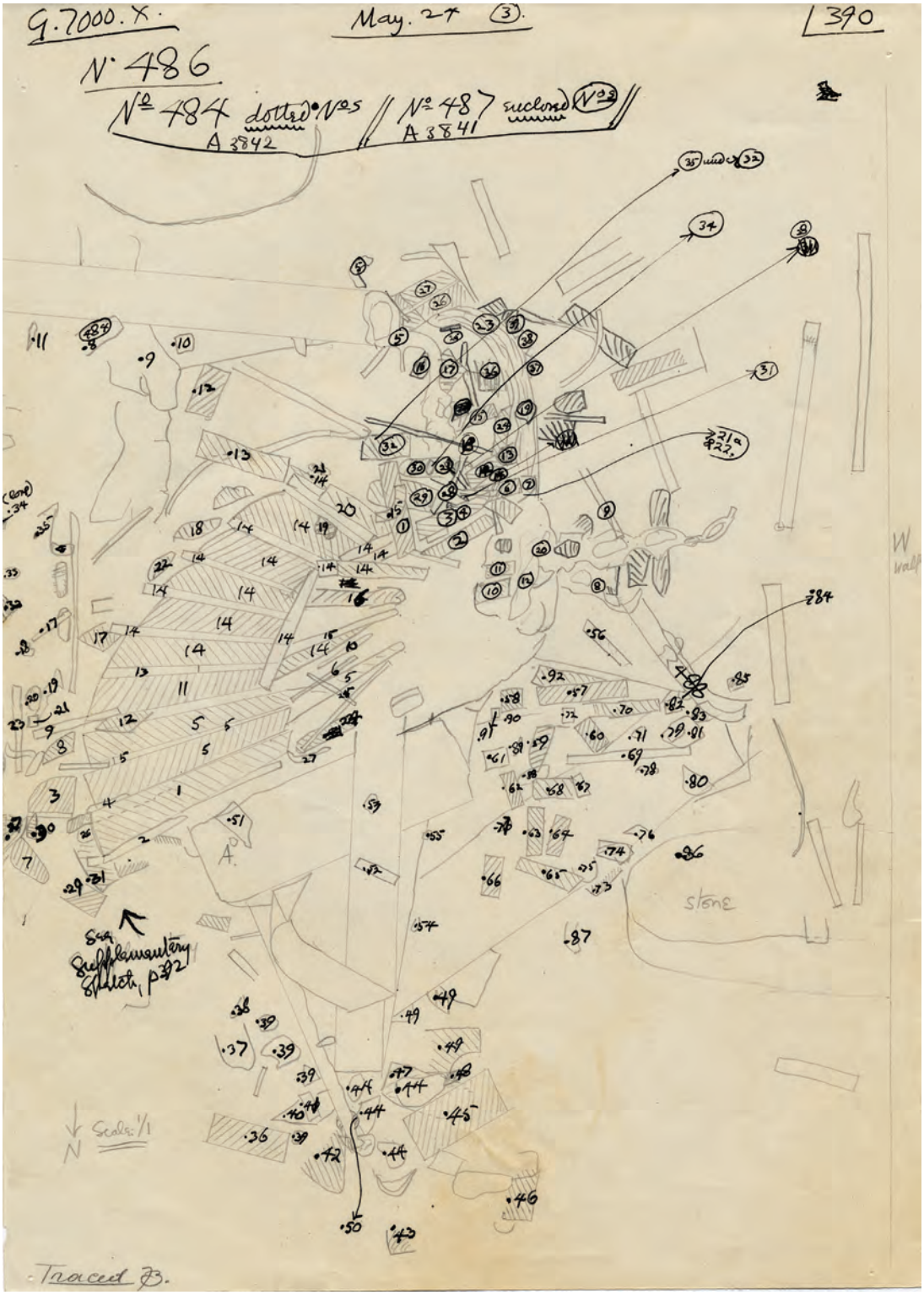


Fig 16. G 7000 X, sketch plan by Noel Wheeler of burial chamber deposit, showing wing fragments of the chair ii falcon arms; HU-MFA Expedition notes, 390, May 24, 1926.

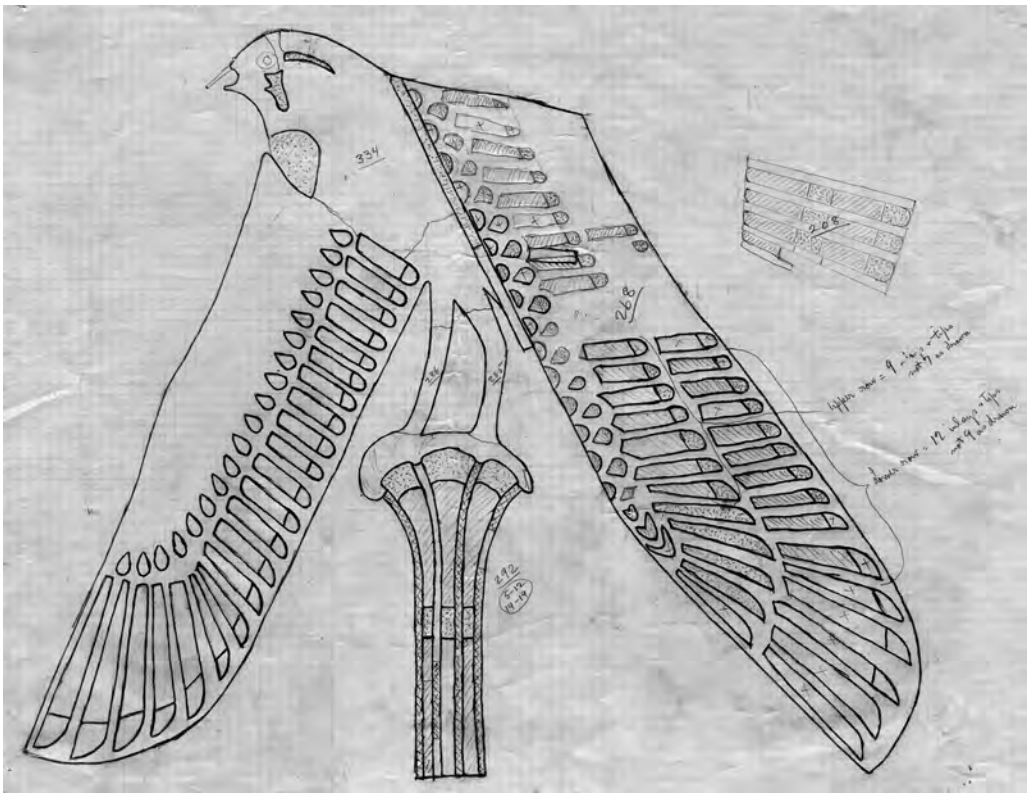


Fig 17. Original reconstruction drawing by Reisner's expedition staff of one of the falcon arms. HU-MFA Expedition Archives.

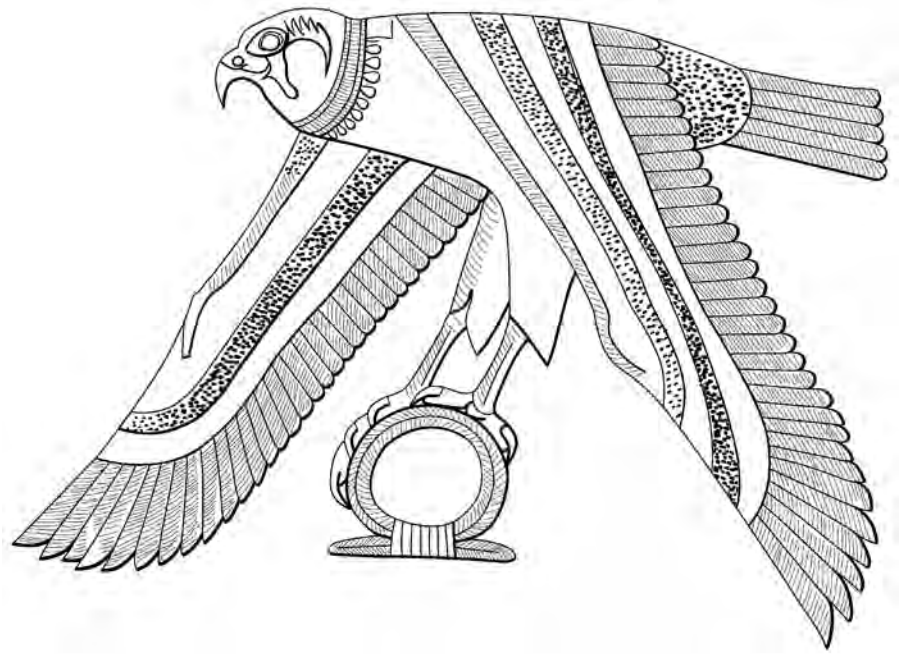


Fig. 18. Digital epigraphy of one of six falcons on the bed canopy of Hetepheres, top left side; Egyptian Museum, Cairo JE 57711. Uncollated drawing by Vera Jin, Harvard University.

Fig. 19. 3D model view down the shaft of G 7000 X and into the reconstructed burial chamber. Image by David Hopkins and Rus Gant. Courtesy the Giza Project, Harvard University, and Dassault Systèmes.

Fig. 20. 3D model view into the reconstructed burial chamber of G 7000 X. Image by David Hopkins and Rus Gant. Courtesy the Giza Project, Harvard University, and Dassault Systèmes.

Fig. 21. Chair ii of Hetepheres, 3D model and exploded view. Image by David Hopkins. Courtesy the Giza Project, Harvard University.

Fig. 22. Original ancient fragments of the falcons from the arms of Hetepheres's chair ii, Egyptian Museum, Cairo, part of SR 1/16599 to SR1/16610. Courtesy Egyptian Museum, Cairo.

Fig. 23. Original ancient fragments of the exterior bottom rails of the armrest of Hetepheres's chair ii (see fig. 15 N), Egyptian Museum, Cairo, part of SR 1/16599 to SR1/16610. Courtesy Egyptian Museum, Cairo.

Fig. 24. Small-scale 3D prints of both chairs i and ii from G 7000 X, prepared by Rus Gant and David Hopkins, Giza Project, Harvard University. Photograph by Rus Gant. Courtesy the Giza Project, Harvard University.

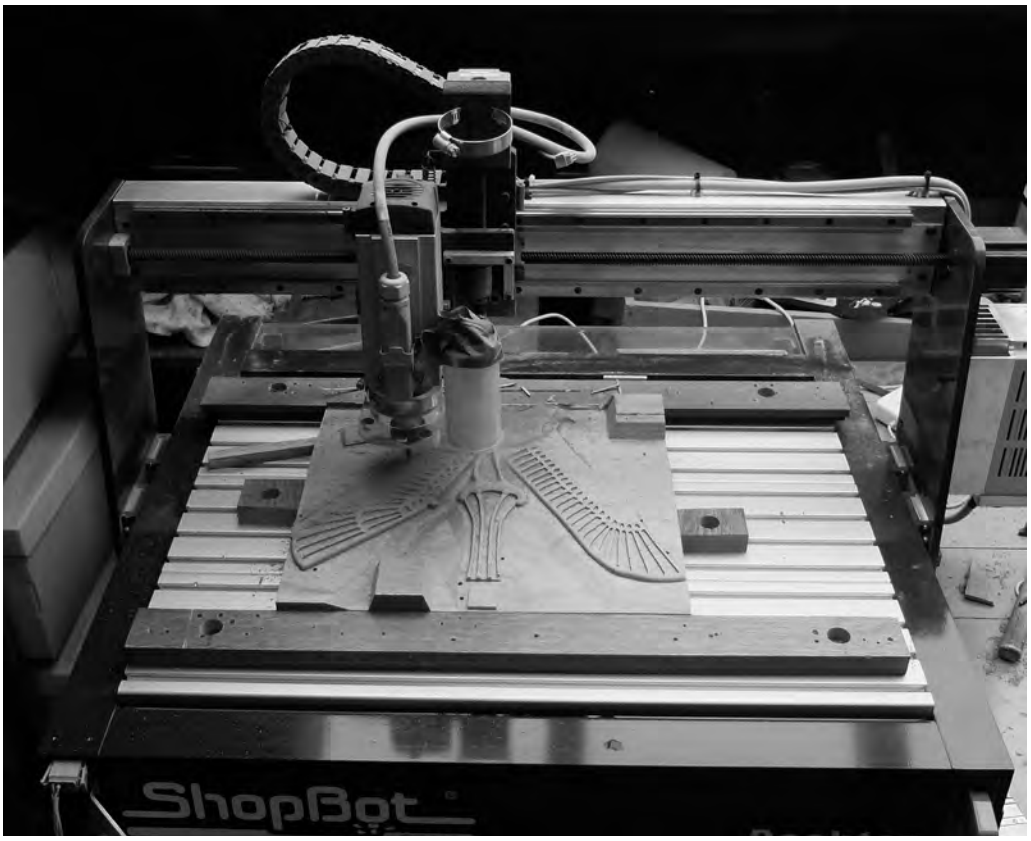


Fig. 25. Computer-controlled ShopBot Tools CNC router carving one of the modern falcon arms for Hetepheres's chair ii. Photograph by the author.

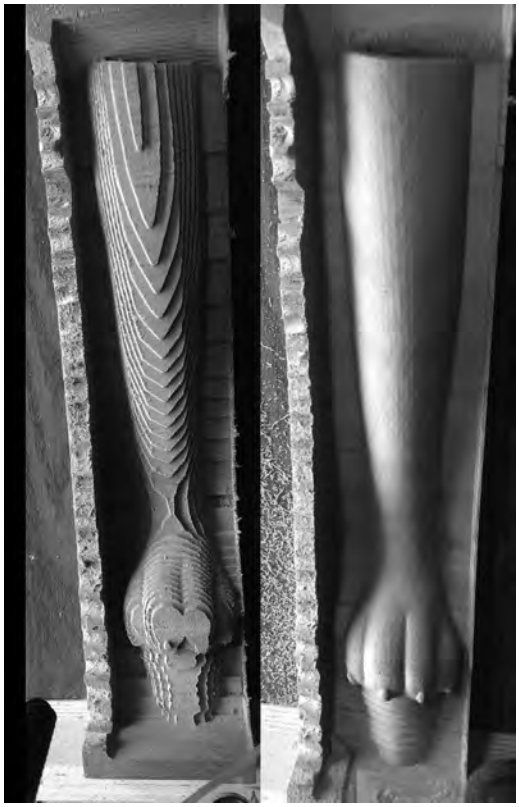


Fig. 26. Modern leonine legs from Hetepheres's chair ii at various stages of carving by the computer-controlled ShopBot Tools CNC router. Photo by Rus Gant.

Fig. 27. General view of all the modern wooden elements of Hetepheres's chair ii, prior to assembly. Photograph by the author.

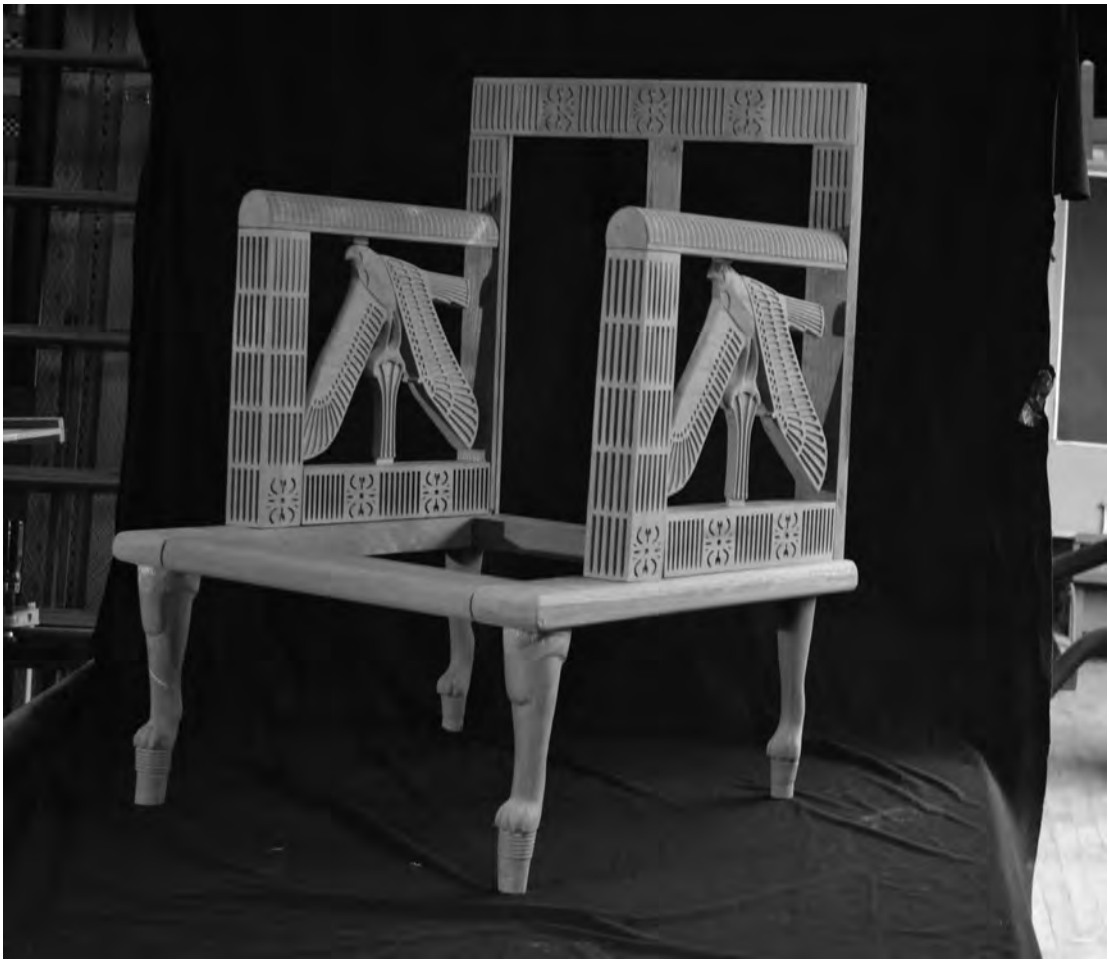


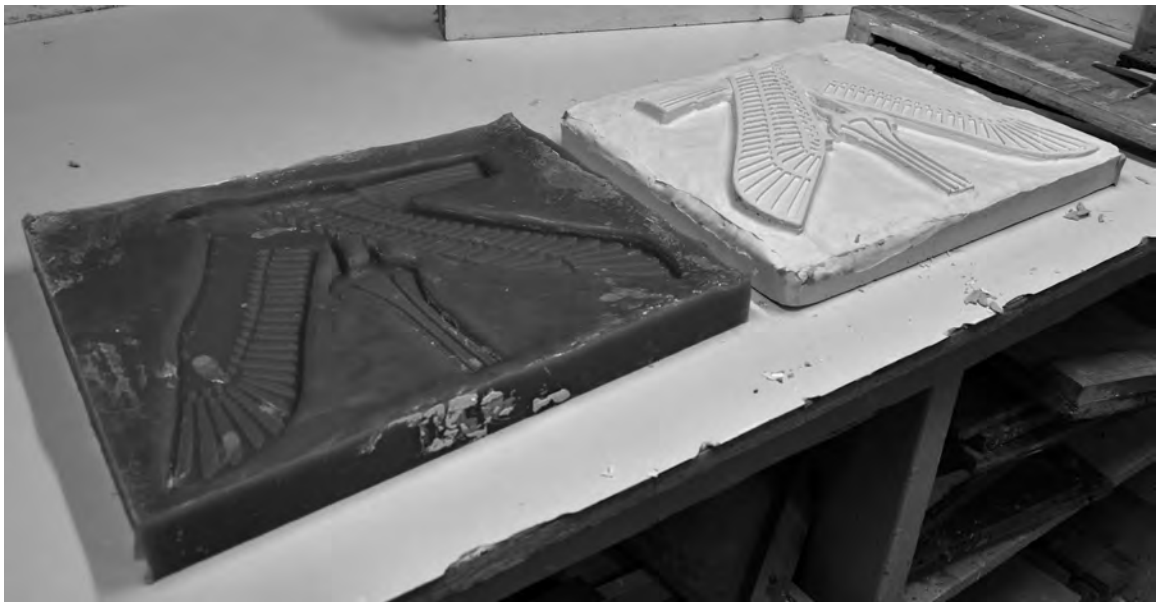
Fig. 28. Dry mount test assembly of all the modern wooden elements of Hetepheres's chair ii. Photograph by Rus Gant.

Fig. 29. Modern gilded wooden elements of Hetepheres's chair ii. Photograph by the author.

Fig. 30. Modern gilded falcon wing from one of the chair arms, prior to the inlay of faience tiles. Photograph by Rus Gant.

Fig. 31. Modern plaster-silica molds carved by computer-controlled ShopBot CNC router, filled with faience paste. Photograph by Rus Gant.

Fig. 32. Modern rubber and plaster-silica falcon arm molds for the chair. Photograph by Rus Gant.



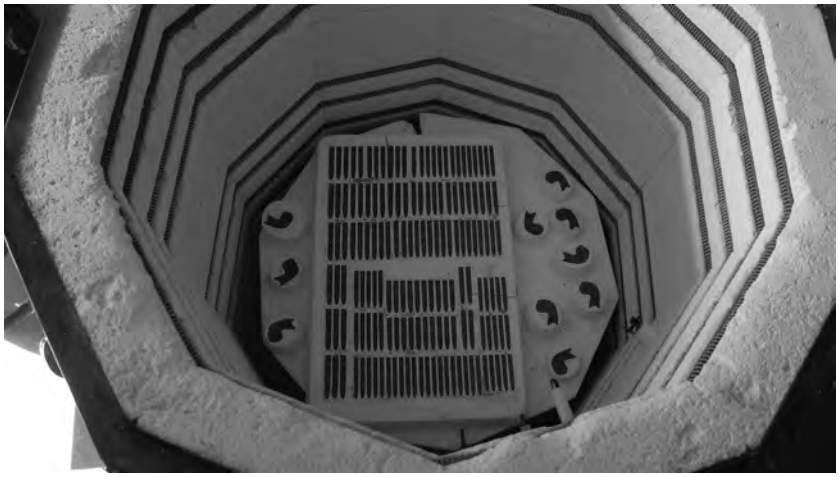


Fig. 33. Kiln firing of modern faience feather tiles, and sidelock elements for the back of the chair. Photograph by Rus Gant.

Fig. 34. Modern fired faience elements, both in their plaster-silica molds and after removal. Photographs by Rus Gant.

Fig. 35. Detail of the exterior side of the back of Hetepheres's modern chair ii with faience and Neith emblems. Photograph by the author.

Fig. 36. 1929 watercolor painting of Hetepheres's chair i (Cairo JE 53263; reproduction = MFA 38.957) by William A. Stewart. HU-MFA Expedition Archives (EG021372).

Fig. 37. Detail of seating cordage for Hetepheres's modern chair ii fabrication. Photograph by the author.

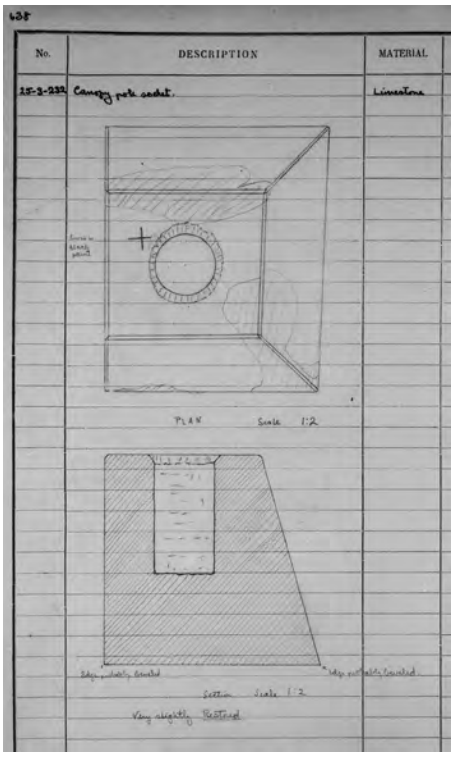


Fig. 39. HU-MFA Expedition Object Register 12, page 638, with drawing of limestone cone support 25-3-232 (mislabeled as canopy pole socket).

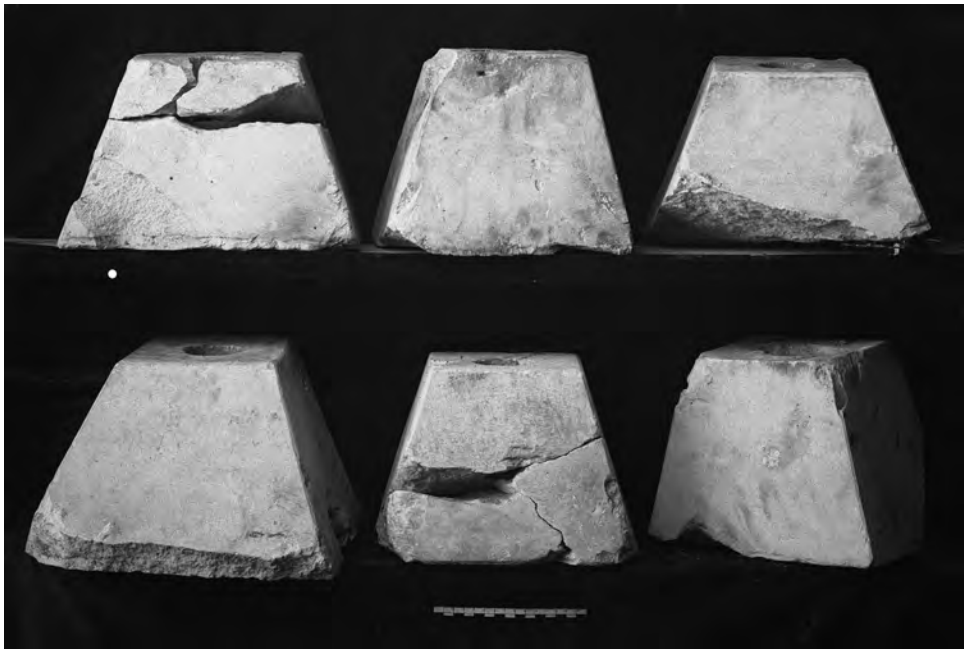
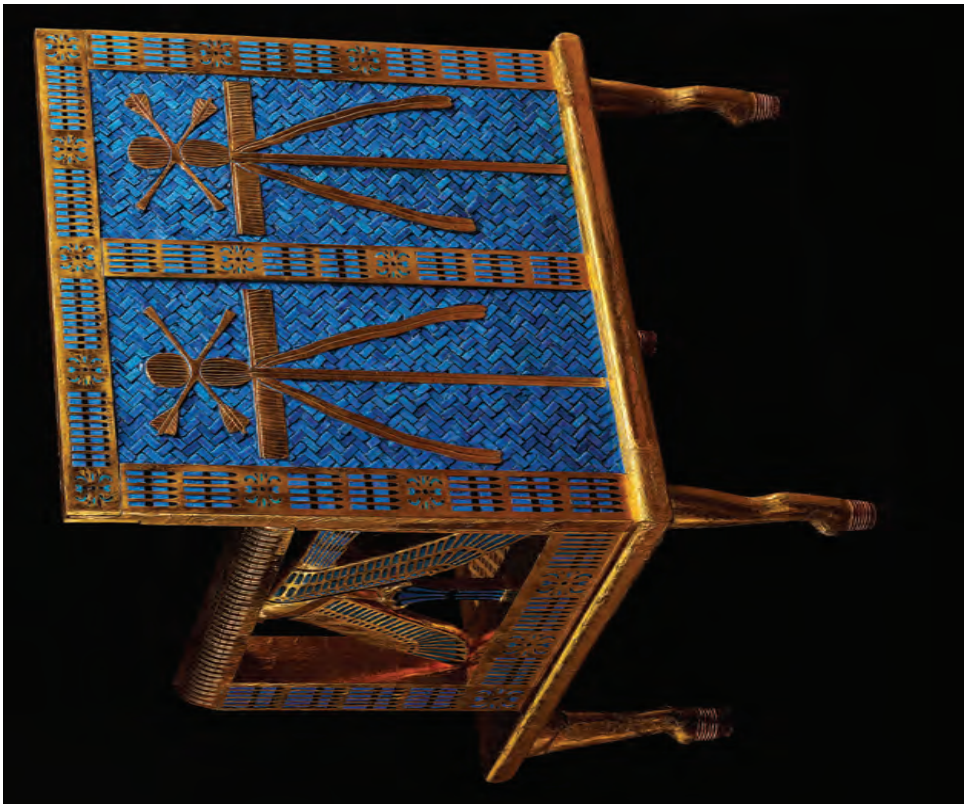


Fig. 38. Ancient limestone cone supports for Hetepheres's chair legs, from the shaft of G 7000 X, 06/27/1925. Photograph by Mohammedani Ibrahim (C10960). HU-MFA Expedition, courtesy MFA, Boston.



Figs. 40a–b. Two views of modern fabrication of chair ii of Hetepheres (Harvard Semitic Museum 2015.2.1); cedar, faience, gold foil, copper, and cordage. Photographs by Peter Lu, using a PhaseOne IQ3 100-megapixel medium format back on an Arca Swiss technical camera.

a

b

c

d

Figs. 41a–d. Four views of modern fabrication of chair ii of Hetepheres (Harvard Semitic Museum 2015.2.1). Photographs by Rus Gant.

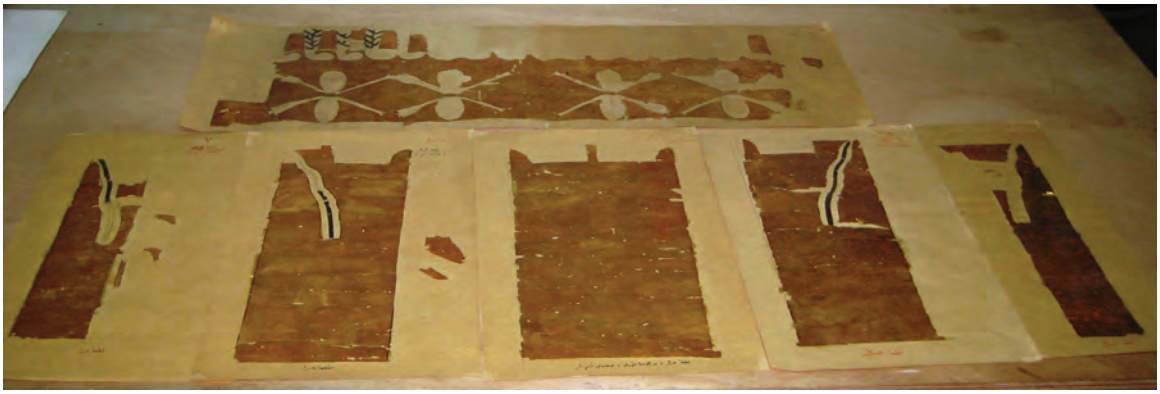


Fig. 42. Ancient gold foil "cut-outs" from the back of Hetepheres's chair ii, showing the Neith emblems. Egyptian Museum, Cairo, part of SR 1/16599 to SR1/16610. Photograph courtesy Egyptian Museum, Cairo.

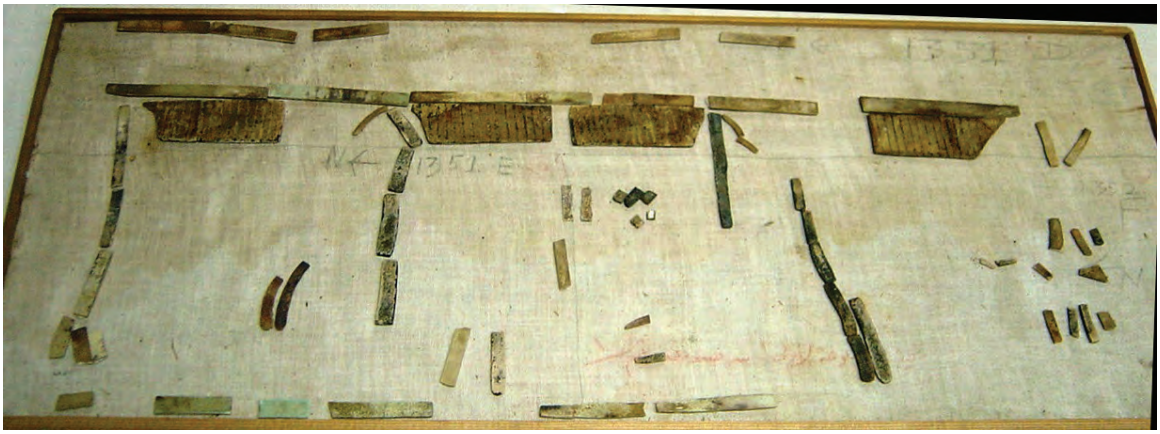


Fig. 43. Ancient faience platforms from the Neith emblems, from the back of Hetepheres's chair ii. Egyptian Museum, Cairo, part of SR 1/16599 to SR1/16610. Photograph courtesy Egyptian Museum, Cairo.

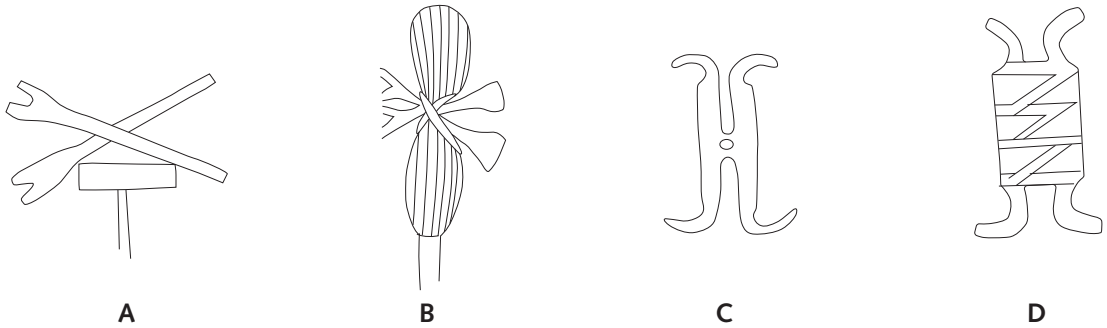


Fig. 44. Evolution of the Neith emblem, from the Protodynastic period to the Old Kingdom, after Hendrickx, "Two Protodynastic Objects in Brussels," 39, fig. 11. A = F. von Bissing, Re-Heiligtum, *7, no. 17. B = Brussels E.6261. C = W. Emery,* Great Tombs of the First Dynasty III *(London 1958), pl. 39. D = H. Wild,* Ti 3, La chapelle, *2e partie, pl. 164. Schematic redrawing by the author (not true facsimiles).*

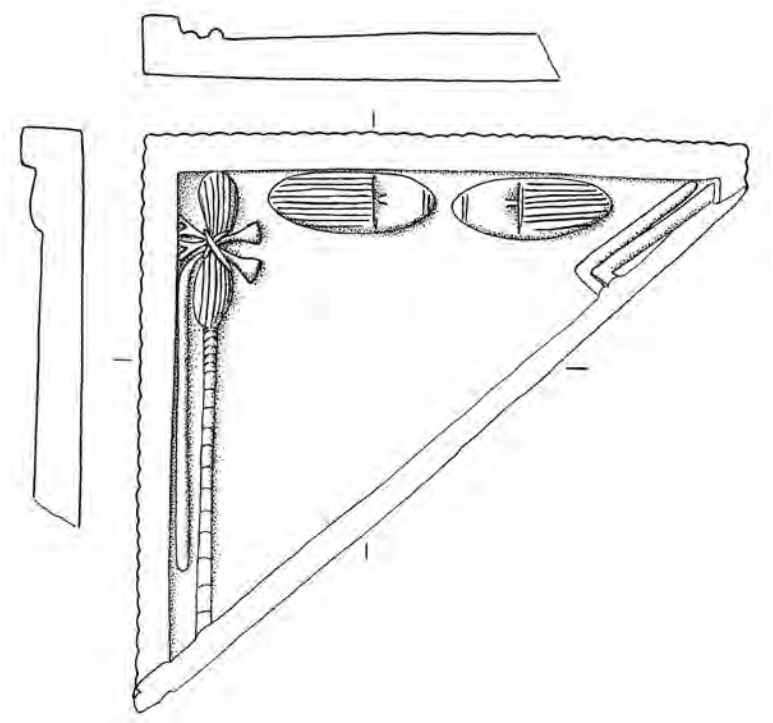


Fig. 45. Fragment of a rectangular palette, adorned with beetles and Neith emblems (Brussels E.6261), after Hendrickx, "Two Protodynastic Objects in Brussels," 28, fig. 5.

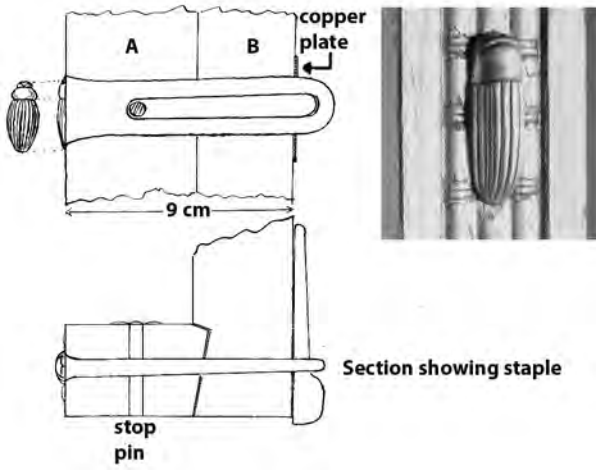


Fig. 46. Beetle-shaped pin, one of three on each side of Hetepheres's bed canopy; line drawing by W. Stewart, courtesy Griffith Institute, University of Oxford. Photograph detail by the author from modern reproduction in Boston (MFA 38.873).

Fig. 47. Detail of door bolt hieroglyphs z (Gardiner O34) and basket k, from the Fifth Dynasty mastaba chapel of Kayemnefret (MFA 04.1761). Photograph by Rus Gant.

Fig. 48. Ancient faience beetle and sidelock inlays, from the back of Hetepheres's chair ii, Egyptian Museum, Cairo, part of SR 1/16599 to SR1/16610. Photograph courtesy Egyptian Museum, Cairo.

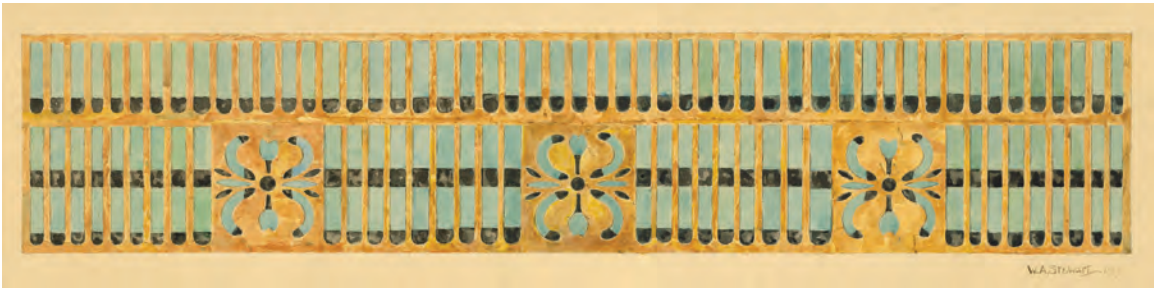


Fig. 49. 1929 modern watercolor painting by William A. Stewart of footboard from Hetepheres's bed (reconstruction = Cairo JE 53261; reproduction = MFA 29.1858), showing the color scheme for the feathers and floral rosettes. HU-MFA Expedition Archives (EG023583).

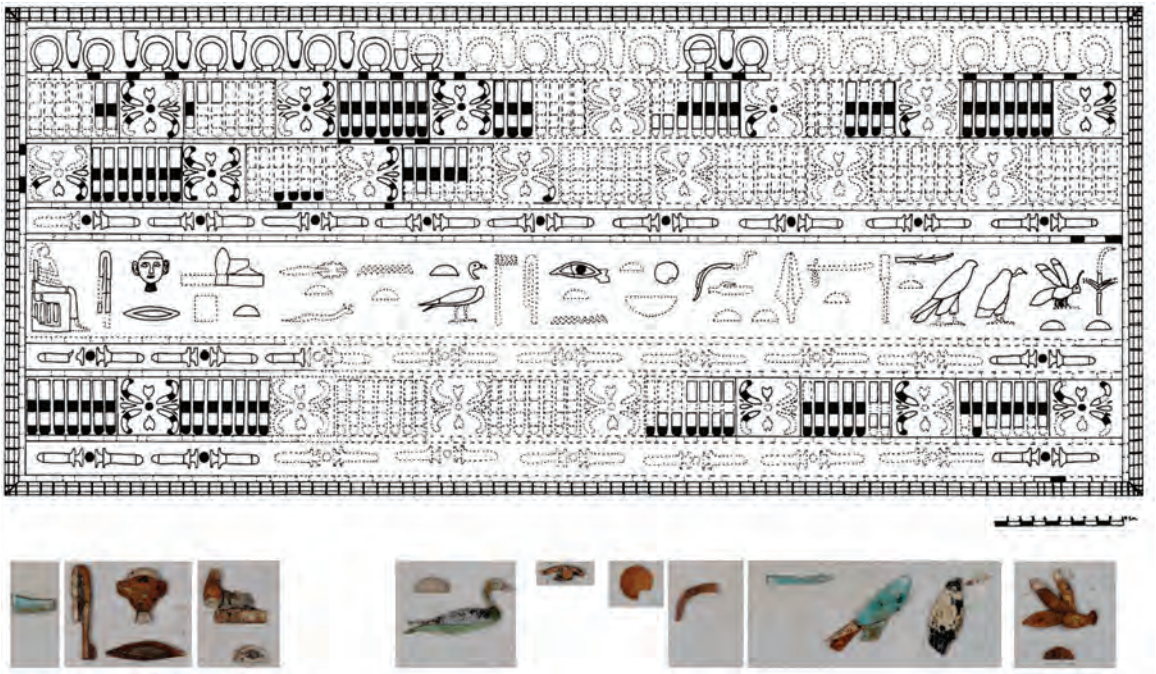


Fig. 50. Line drawing of the inlaid box from G 7000 X with a selection of the surviving ancient fragmentary hieroglyphs of Hetepheres, montaged by the author; Egyptian Museum, Cairo, part of SR 1/16599 to SR1/16610. Photograph courtesy Egyptian Museum, Cairo; compare Reisner and Smith, Giza Necropolis 2, *fig. 40 and pl. 35b.*

Fig. 51. Ancient seated figure of Hetepheres, Egyptian Museum, Cairo, SR 1/14609 = GEM 6191; Reisner and Smith, Giza Necropolis 2, *fig. 30 and pl. 14a, and photo courtesy Egyptian Museum, Cairo; montage by the author.*