GIZA PLATEAU MAPPING PROJECT

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Season 2017: The Old and the New

This year AERA team members busied themselves with the old and very new in research. I had the opportunity to return to some of my earliest work at the Sphinx, thanks to a grant from the American Research Center in Egypt (ARCE) Antiquities Endowment Fund (AEF) for the Sphinx Digital Database. This project will digitize, conserve, and make available as open source the archive from the 1979–1983 ARCE Sphinx Project, for which Dr. James Allen was project director and I was field director. My work at the Sphinx started three years earlier, in 1977, with Dr. Zahi Hawass, so that makes it exactly forty years ago.[1]

Search for Khufu

We launched a new initiative, directed by Mohsen Kamel and Ali Witsell, to explore the older layers of the Heit el-Ghurab ("Wall of the Crow," HeG) site. In some areas we have seen an older, different layout below what we have so far mapped, which dates to Khafre and Menkaure. We believe that the older phase settlement and infrastructure, which was razed and rebuilt, served Khufu's building of the Great Pyramid.

The discovery in 2013, and publication this year, of the *Journal of Merer*[2] piques our interest all the more in the early phase of Heit el-Ghurab. Pierre Tallet and a team from the Sorbonne and the French Institute in Cairo discovered the inscribed papyri at Wadi el-Jarf on the western Red Sea Coast, in a port facility used only in the time of Khufu. Merer was the leader of a crew that delivered limestone by boat from the eastern Tura quarries to the Great Pyramid of Khufu. Why would a record of stone deliveries at Giza be found at on the Red Sea coast? Perhaps because Merer's logbook belonged to his crew's portable dossier of jobs, which could have included tasks on the Red Sea coast (sailing to Sinai for copper?), or delivering stone from Tura to Giza. Some of the files apparently slipped out at the last closing of the Wadi el-Jarf storage galleries, which Khufu's engineers had cut into bedrock escarpments. The papyrus pieces lay between the huge blocks that closed one of the galleries.

Pierre Tallet's publication of Merer's Journal opens a window onto daily use of waterways around the HeG. It is possible that Merer stopped overnight on the shore of the very Fourth Dynasty settlement we have mapped, albeit, in its early phase. In his daily entries, Merer names places, and the *Heit el-Ghurab* site is possibly among them, under the name *Ankh Khufu* — "Live Khufu!" — determined with a *niwt* (town, village) sign.[3] It is practically certain that Merer and his men off-loaded somewhere between the Wall of the Crow and the Sphinx, for only here does the Giza Plateau dip invitingly down, close to the Nile floodplain. At the northern end of this natural gateway, a short distance east of the Sphinx and Sphinx Temple, several lines of evidence hint at a very deep canal basin, where boats could off-load and turn around in a waterway wide enough for two-way traffic.[4]

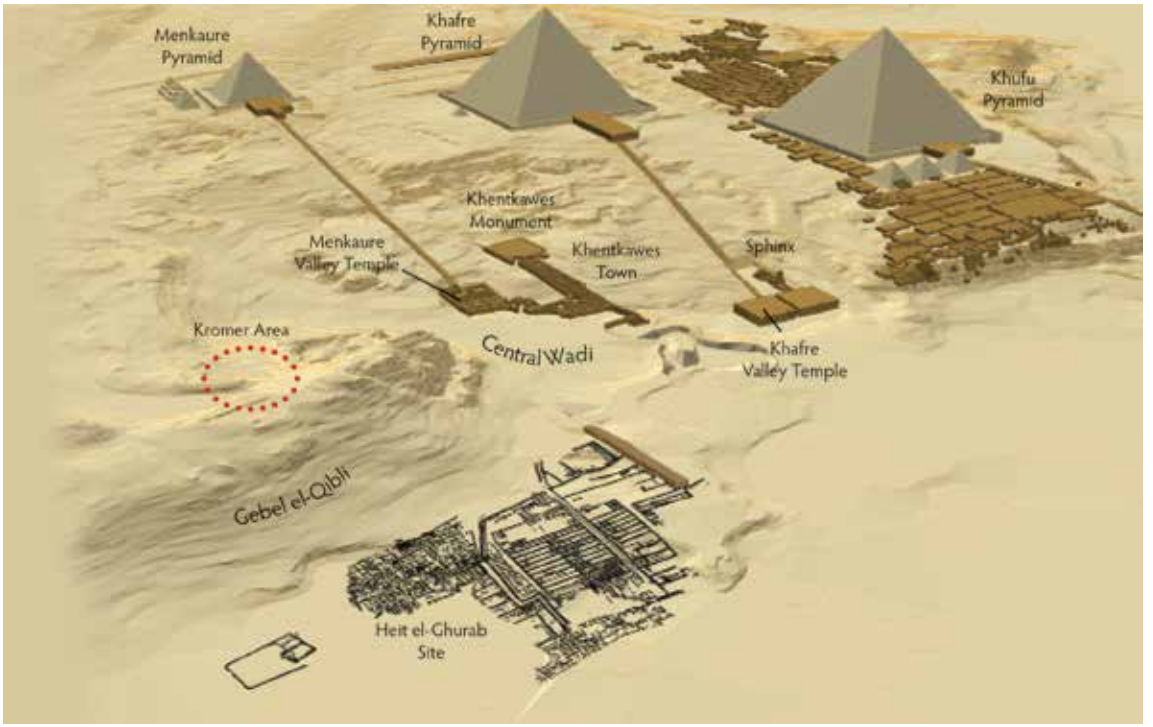


Figure 1. Model of the Giza Plateau with the Heit el-Ghurab site and Kromer excavation area

During spring 2017, Claire Malleson led a study season in our Giza Lab that included inventorying and analyzing material we had previously excavated from the early phase. This coming February–April (2018), we will further excavate parts of the early phase. We also plan to reinvestigate the site where in the early 1970s Karl Kromer investigated a massive dump of disarticulated settlement debris, up and over the Gebel el-Qibli, the escarpment that rises above the HeG on the west (fig. 1).[5] Kromer found sealings of Khufu and Khafre, but none of Menkaure. In the main phases of the HeG, we have sealings of Khafre (including at least one from the same seal as used for one of the Kromer dump sealings)[6] and Menkaure, but none of Khufu. So "Kromer's dump" may be debris from the dismantling of the early HeG.

Geoarchaeology of Sphinx and Sphinx Temple

This year I developed graphics and began to write up observations from the thirty-year-old ARCE Sphinx Project data. As part of that project, in 1980, I joined geologist Thomas Aigner, University of Tübingen, to carry out a study of the Sphinx and Sphinx Temple that combined geology and archaeology.

We believed that the Egyptians created the Sphinx and Khafre Valley and Sphinx Temples as part of a single quarry-construction sequence. From bedrock strata corresponding to the Sphinx head, they took megaliths for building the Khafre Valley Temple. As they quarried deeper, they cut a U-shaped ditch — leaving a core from which they sculpted the Sphinx — and removed blocks from these lower layers to build the Sphinx Temple (fig. 2).

We had intended to publish this work, but did not do so. And so we work thirty-seven years later to present the information. Here I summarize our method, broad conclusions, the

Figure 2. The Sphinx in its ditch, fronted by the Sphinx Temple (left) and the Khafre Valley Temple (right)

significance of this information for dating the Sphinx, and how revisiting this old study adds a piece to the picture puzzle of how the Egyptians built the Sphinx and Pyramids.

Mapping Stone by Stone

For the ARCE Sphinx Project, the German Archaeological Institute provided surveyor Ulrich Kapp and photogrammetry equipment to produce front and side elevations of the Sphinx. Between 1979 and 1983 I mapped the Sphinx and the two large temples stone by stone.

These temples are formed by gigantic limestone "core blocks," so-called because they make up the core of the temple walls, which were to be clad in granite or fine limestone. These blocks are so thick, many of them consist of three geological layers. The layers in many blocks match those that run through the bedrock of the Sphinx itself.[7]

As I moved about the Sphinx Temple in the first year of my work, I was struck by how the geological layers run continuously, in many places, from one block to another, as the layers must have run in the bedrock (figs. 3, 4). Those who moved these stones apparently did not have much chance to mix them up from quarry to temple wall. The Sphinx and its temple must have been part of the same quarry-construction sequence. If the huge core blocks could be "fingerprinted," they could be traced back to the quarry of the Sphinx. In 1980, I met Thomas Aigner who had the expertise to do this (fig. 5).

Figure 3. Sphinx and Sphinx Temple ruins; view to the northwest

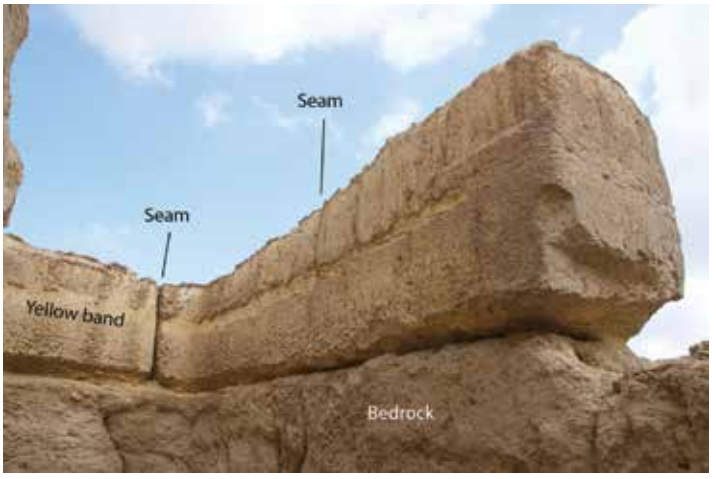


Figure 4. Core blocks (Type A) in the western side of the Sphinx Temple, cut from three geological layers, with a thin marl layer — the "yellow band" — running continuously through the middle of three blocks

Figure 5. Thomas Aigner and Ashraf Abd El-Aziz look at a large corral petrified in life position, in the eastern escarpment, Member I, around the corner from the Sphinx Amphitheater

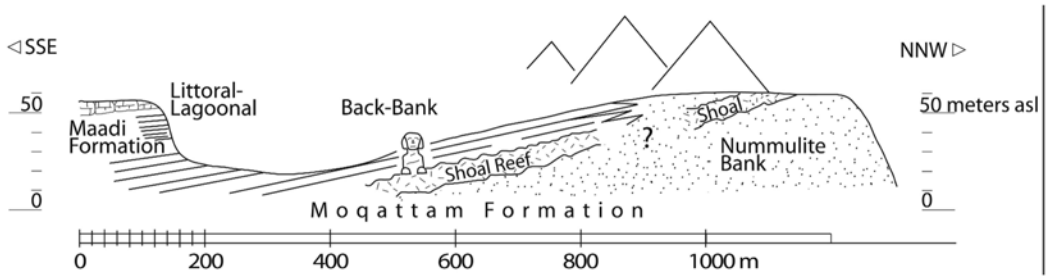


Figure 6. Thomas Aigner's schematic profile of the Giza Plateau, from north-northwest to south-southeast, showing principal geological layers of the Moqattam (Middle Eocene) and Maadi (Upper Eocene) Formations (figure: after Aigner 1983a, p. 363, fig. 11)

Seafloor Ecology Petrified

Aigner saw the Giza Plateau as sea floors, petrified and stacked into the bedrock layers from which pyramid builders quarried blocks, cut out tombs, and carved the Sphinx. He was interested in the "environment of sedimentation" tens of millions of years ago that produced the limestone.[8]

Here at Giza, the southern headwaters of a great sea, on its slow northward retreat into what became the Mediterranean, laid down silts and sediments that became the Egyptian tableland. Quarrymen fashioned the Sphinx out of the limestone bedrock at the low, southeastern base of the Pyramids Plateau. They knew well these bedrock layers, if not how the stone had originated millions of years earlier.

As the seawater retreated northward in the Eocene Epoch (65–38 million BP), a colossal bank of nummulites[9] built up beneath the waters at the northwestern side of the Giza Plateau (fig. 6). Down the long southeastern slope (in the direction of the Sphinx and the Central Field) in deeper water a sandbar developed, on which grew a shoal and coral reef. As the Eocene seawaters retreated north, the water protected by the sand bank became a muddy lagoon, inhabited by burrowing bivalves and sea urchins. A sequence accumulated, petrified as soft, yellow marly layers interspersed with harder beds.

The shallow waters of the lagoon laid down sediments that make up the layers running through the body of the Sphinx (Member II) (fig. 7). Turbulent waters churned up mud and silts, which petrified into softer layers. Calmer waters laid down more compact sedimentation, the harder layers. The Sphinx head is of harder bedrock (Member III) than the body, representing, again, calmer waters.

Tracing Core Blocks

When Aigner and I set about our Sphinx Temple core block study, he had already logged bedrock exposures on the Giza Plateau. Now he took the opportunity to look at the bedrock in the Sphinx itself.

In 1980 one could see much more of the Sphinx bedrock "core body" than today, although, even then, masonry veneer covered the bedrock Sphinx "core body" to a little more than half the height on the south and about a third the height on the north. The entire bedrock front was exposed. Today, masonry added since the 1980s covers much more of the lion body. The exposed bedrock has been covered with paste to stop flaking. However, the bedrock layers still

Figure 7. Lagoon layers, of Member II, in the south side of the Sphinx ditch (which forms the northern side of Khafre's causeway, connecting his valley temple and upper pyramid temple), with numbered beds of Members I and II. According to Aigner's model (see fig. 9), these layers derive from a back-bay lagoon along what became southeastern flank of the plateau, behind the nummulite embankment and corral reef, as the Eocene sea water retreated northward about 50 million years ago; view to the southeast

remain exposed on the sides of the Sphinx ditch — the U-shaped quarry cut by the Sphinx builders.

We could get up close to the bedrock surface on the Sphinx's northern flank by climbing up onto the ledge of masonry casing, which stepped up to the west and around the curve of the north haunch. From there, the masonry stepped down to a broader ledge at the curve of the rump. Or, one could climb up onto the top of the lion back and walk along it to the back of the head.

When he excavated the Sphinx in 1925–1926, Emile Baraize filled in the recesses that had eroded into the back of the head with cement. He covered the back of the neck with ceramic bricks, masonry, and more cement. Aigner and I could consult photographs he took before he did this work (fig. 8).

A large chunk of the Sphinx's nemes headdress, with the relief-carved pleating, lay behind the head. The piece came to light in 1978 when a hole in the top of the back was cleared of sand, modern cement, and ceramic

Figure 8. The back of the Sphinx head. Photo taken Sept. 25, 1925, before Baraize filled in the recesses and neck with ceramic bricks, limestone, and cement; view to the east (photo: Archive Lacau C I 006)

fragments that Baraize used in 1925–1926 to support the head. This has been called "Perring's Hole," after the engineer who worked with Howard Vyse in 1837.

Perring might have loosed the piece of the headdress when he tried to blast free his drill rods from a depth of 8.22 m. With this headdress piece, Aigner and I could examine closely the bedrock of one of the head layers, which were otherwise out of reach.

We examined each layer (or bed), giving each a number, bottom up. We marked bed numbers on photographs, old (fig. 8) and new (fig. 7), and on profiles of the Sphinx that Ulrich Kapp produced every 5 m with photogrammetry (fig. 9).[10] These beds weathered differentially — harder beds protrude and the softer beds recede — making it easy to mark the beds.

I marked the bed numbers on a master profile across the front of the Sphinx and the Sphinx ditch to either side. In figure 9, Aigner's schematic log of the Sphinx bedrock layers is on the left of the Sphinx. Aigner also charted the relative abundance of different fossils from former sea floors — urchins, oysters, sea stars, sponges, stromatolites, nummulites, and more.

Bed 8a, just below the neck, served as a good marker horizon and boundary between Members II and III. This "Operculind Pack Stone" featured a heavy concentration of fossils, especially *Operculina*.[11] Bed 8a thins (lenses) out on the Sphinx's back behind the head.

The biggest distinction is that between Member I and Member II. Member I is the very hard, gray reef formation, while the first bed of Member II, 2a, is one of the softest of the yellow marl-clay layers, in some places so soft you can crumble it with your finger tips. Member II beds are distinct in quality and fossils from Member III, but the boundary is not so stark as that between Members I and II. Aigner, following geologist K. Lal Gauri, who also contributed to the ARCE Sphinx Project,[12] distinguished the boundary between Members II and III as running just at the top of the back, toward the front, between Beds 7 and 8.

We designated the Sphinx head Bed 9, with subdivisions assigned on the basis of archival photos, taken before Emile Baraize added masonry veneer in 1925–1926 (fig. 8). The chunk of headdress from Perring's hole (see above) appeared to be "Operculind Wacke Stone" (fine-grained matrix with more than 10% fossils, abundantly *Operculina*).

The massive fine-grained bedrock of Beds 8–9 (Member III) made for good sculpting, with far more endurance than the soft-hard-soft sequence of Member II. This is why the Fourth Dynasty builders reserved Member III for the more exposed head. Details like the eyebrows have survived wind, rain, and sand for 4,500 years. But the Member II sequence was perfect for quarrying giant core blocks, because quarrymen could cut the bottoms and tops of the blocks along the clay-like yellow beds, and take out as many intervening beds as required (generally three) for the thickness of the block.

But from which beds exactly did they cut the core blocks? Would this tell us where they were in fashioning the Sphinx at the time they built the Sphinx Temple? Answering these questions required that we log each block.

Block-by-Block Came the Sphinx: Quarry and Construction Sequence

As Aigner examined each core block, I sketched its outlines onto the map that Herbert Ricke published in 1970[13] and gave each its own number, a total of 173 blocks (fig. 11). Aigner and I took notes on lithic qualities and fossils of each block and assigned each block to one of seven types: A through G. Later, I re-mapped each block of the entire Sphinx Temple and Khafre Valley Temple. Recently, to bring this work to publication, I color-coded the core blocks according to the types we assigned (fig. 11).

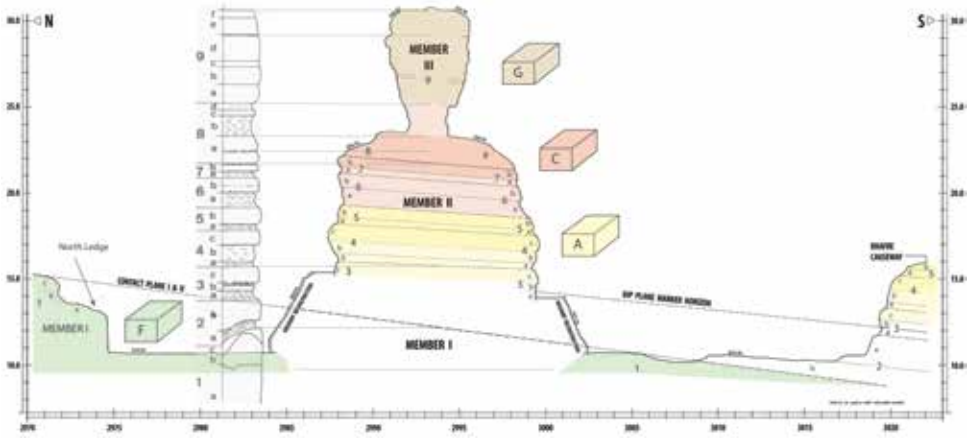


Figure 9. Profile across the front of the Sphinx and across the Sphinx ditch, with limestone beds numbered; color codes indicate source layers of large limestone core blocks in the Sphinx Temple (figure: Aigner's schematic profile of the limestone beds at the Sphinx)

Figure 10. North elevation of the Sphinx, produced with photogrammetry by Ulrich Kapp, with limestone bedrock beds indicated and labeled by Mark Lehner; the Sphinx faces east. Colors signify match of beds (layers) to core blocks in the Sphinx Temple and Khafre Valley Temple (see below)

Figure 11. The Sphinx Temple map with core blocks color-coded as to type:

Yellow = Type A core blocks
Orange = Type B
Red = Type C
Purple =Type D
Blue = Type E
Green = Type F
Beige = Type G
Gray = bedrock

Figure 12. Sphinx and Sphinx Temple core blocks (foreground); Type A blocks (labeled) derive from Beds 4b–c to 5a, "yellow band" = Bed 5a. Some Type A blocks may derive from Beds 3c to 4b–c, so the "yellow band" would be Bed 4a

Most of the Sphinx Temple core blocks are Type A, which I coded yellow. These "standard" Sphinx Temple core blocks consist of three layers: upper and lower hard massive layers, separated by a soft, yellow marl layer. For long stretches of temple wall, the "yellow band" runs continuously through separate blocks (fig. 4). With confidence, we can assign Type A blocks — the majority type in the Sphinx Temple — to beds that correspond to the lower chest of the Sphinx, mostly Beds 4b–c to 5b (figs. 9–13). Quarrymen could have taken some Type A blocks from Beds 3c to 4b. The "yellow band" running continuously through Type A temple blocks corresponds most often to Bed 5a, across the top of the prominent boss on the Sphinx chest (fig. 10), but could also be the same stratum as Bed 4a across the bottom of the boss.

If most of the Sphinx Temple blocks come from the lower Sphinx chest layers, the Sphinx statue must have risen unfinished in the solid mother rock, only from chest level when builders began the Sphinx Temple down on a terrace 2.5 m lower than the floor of the Sphinx. I designated the Sphinx floor as Terrace I and the lower floor Terrace II.

Builders could have exploited these same layers anywhere in the Sphinx Amphitheater — the greater quarry from the Khafre causeway to the cliff north of the modern road (fig. 14). Or, they might have taken the blocks from where the layers extended directly over the temple.[14] But then why did they not just cut the whole of the temple core walls directly from bedrock, as they did the lower parts of the back, western magazine walls (figs. 6, 7). We have evidence that they had already created Terrace 1 before the Sphinx was formed (see below).

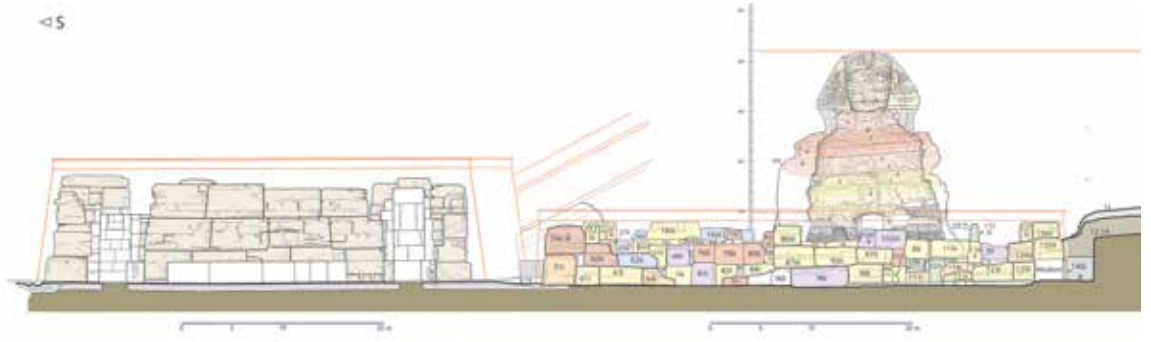


Figure 13. East elevation of the Khafre Valley Temple (after Hölscher 1912), Sphinx Temple (after Ricke 1970, pl. 2), and the Sphinx (from Ulrich Kapp photogrammetry) with core blocks and bedrock strata; Khafre Valley Temple core blocks are hypothesized to be Type G and to derive from Sphinx head layers

Type C blocks, coded red, came from layers near the top of Member II, layers of which are preserved in the top of the Sphinx chest and the base of its neck (figs. 9, 10, 13). They cluster near the front of the Sphinx Temple (fig. 11). We can imagine the quarry workers hewing the giant C blocks from layers that would become the lion's upper chest and top of the back. Gangs dragged those blocks to the eastern front of the Sphinx Temple. As quarry workers cut deeper, to the middle and lower Sphinx chest level, haulers and builders composed most of the core walls of the temple.

However, we must note that some Type C blocks rest upon Type A blocks (fig. 13), which we might not expect if Type C blocks were quarried and moved first. Did the quarrymen instead cut blocks in stepped fashion from more than one level, resulting in a mix of blocks from different strata? No. Huge quarry cuts that the workers left in the Giza Plateau suggest that they worked through the geological strata from top down. The C blocks on top of the A blocks are probably the result of rebuilding walls. Herbert Ricke noted how the builders deconstructed and then rebuilt the north and south walls of the Sphinx Temple, to expand the temple laterally so as to add pillared colonnades like those on the east and west.[15] In this operation, they could have scrambled some of the blocks out of the original quarry-construction sequence.

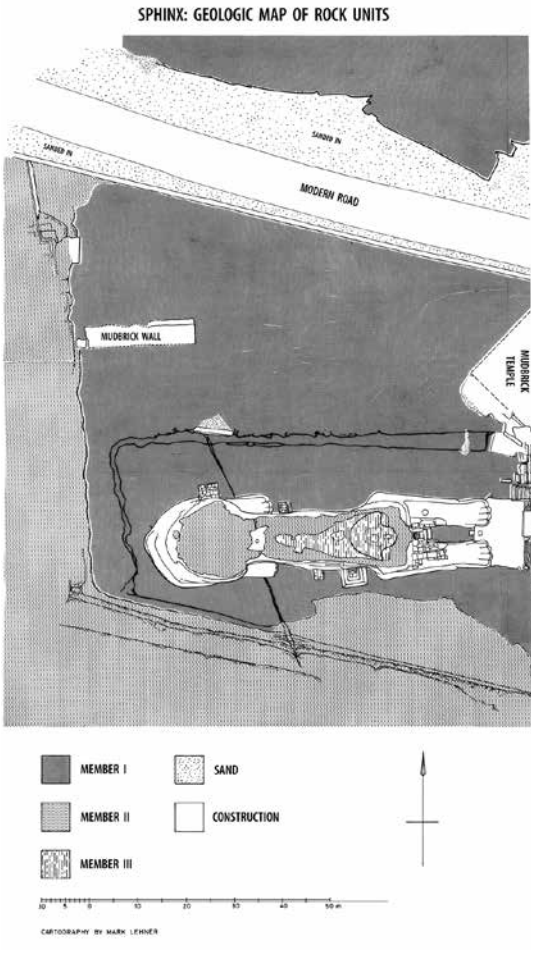
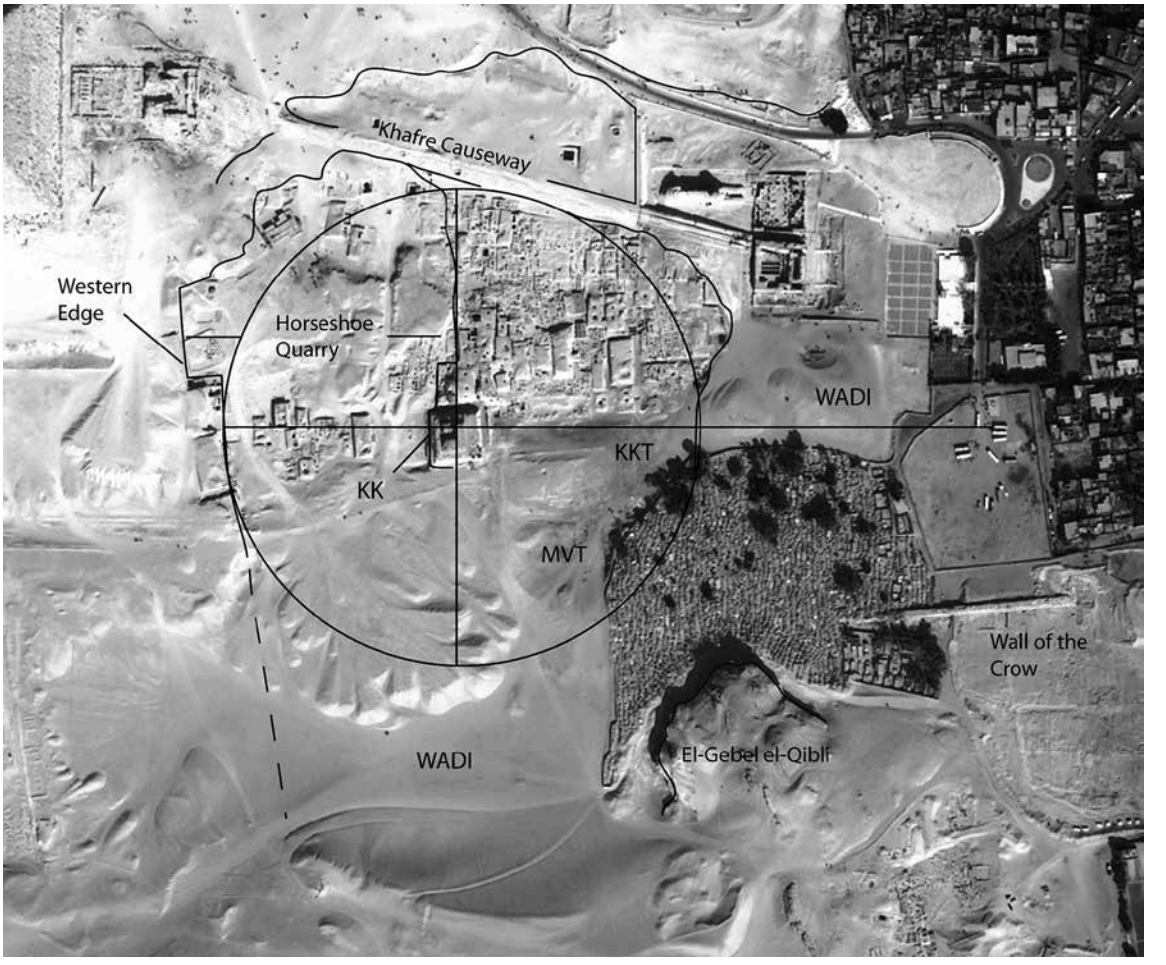


Figure 14. Map of Members I, II, and III exposed after quarrying to make the Sphinx Amphitheater, Sphinx, and Sphinx ditch, which isolated the lion body as an island of Member II and the Sphinx head as an island of Member III; the Sphinx head layers exist no where else in the immediate vicinity

Figure 15 (left). Distribution of Type B and D core blocks (orange and purple) within the Sphinx Temple

Figure 16 (below). The circle of Fourth Dynasty quarrying at the southeastern edge of the Giza Plateau. The Khentkawes I monument (KK) projects south at the approximate center. While never intended to be accurate, the radius of quarrying extends 200 m to the west, north, and east of the Khentkawes I monument. Quarry workers never exploited deeply the northeastern quadrant, between the Khentkawes monument and the Sphinx. People used the quarry blocks of this northeastern quadrant for mastabas and rock-cut tombs, starting in the late Fourth and mostly in the Fifth Dynasty



I note here that Type E blocks may derive from Bed 8a, and that Type F blocks came from the reef limestone of Member I. These types occur so infrequently in the Sphinx Temple that I will not deal with them further here. But they could both derive from within the Sphinx ditch.

Type B and D Blocks: Brought from Afar

Type B and D blocks show up at regular intervals within the core walls (fig. 15). They seem to have come from the quarries towards the Khentkawes Monument, southwest of the Sphinx, at the far end of a diagonal one can draw from the Sphinx across the northeastern quadrant of a greater circle of quarrying in the central field of the Giza Plateau (figs. 16, 17). The bedrock strata here are much higher than the Sphinx head layers, not in absolute elevation, rather in the sequence of the natural limestone strata.[16]

The spacing and fairly regular dispersal though the temple of Type B and D core blocks (fig. 15) could indicate two things: 1) The builders stockpiled these blocks and brought them into the walls whenever there was a hiatus in the quarrying, dragging, and placing of the regular A blocks; 2) because they quarried Type B and D blocks from much farther away, it took them much longer to haul the blocks to the temple site.

Figure 17. The quarry cut north of the Khentkawes Monument. All these beds, both the thick massive beds and the marly beds with many nummulites, lie higher in the stratification than the head of the Sphinx

Type G Blocks and the Temple Sequence

Already in 1910, when Uvo Hölscher excavated the valley temple, while the Sphinx Temple remained buried under sand and sediments 8 m high, he perceived that core blocks of Khafre Valley Temple came from the quarry that isolated the Sphinx block.[17] Our tentative match of Type G blocks in the valley temple to Sphinx head layers tends to reinforce this hypothesis.

Herbert Ricke (1970) on Sphinx and Sphinx Temple Sequence

Herbert Ricke also thought that workers began to create the Sphinx as they built Khafre's valley temple and causeway.[18] But our hypothetical temple sequence differs from Ricke's on the following point: He thought that as Khafre's workers quarried out the floor of the Sphinx ditch and then quarried 2.5 m deeper, down to Terrace 1, they used the blocks to build Khafre's Valley Temple and upper pyramid temple, and they next built the Sphinx Temple on the northern half of Terrace 1, which had remained empty.[19]

This belies Ricke's sequence: The match between the most common Type A ("yellow band") Sphinx Temple core blocks with the Member II layers (Beds 4–5) preserved in the lower Sphinx chest and in the sides of the Sphinx ditch. This and the continuity of the layers through long stretches of the Sphinx Temple wall, composed of multiple core blocks, suggests that builders did not stockpile the core blocks, but took them in sequence directly to the temple walls as quarrymen cut them from the Sphinx ditch.[20]

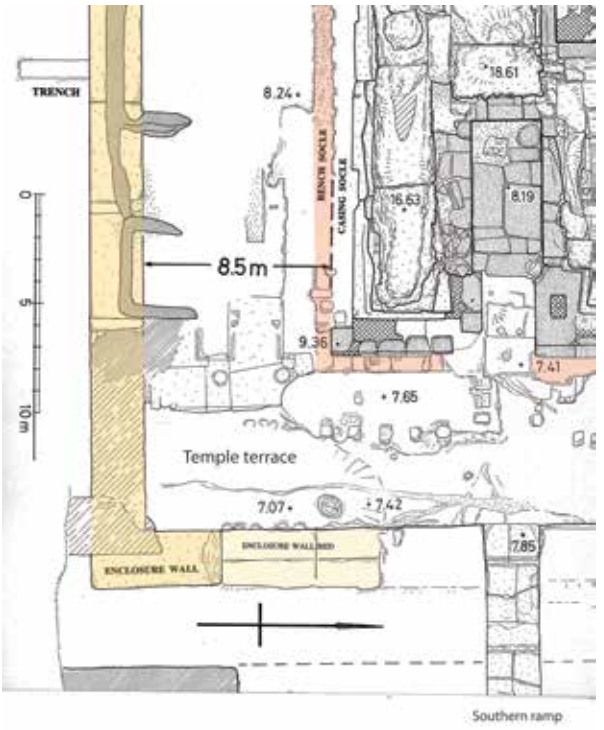
First Thing On Terrace 1: The Khafre Valley Temple

Ricke assumed the Sphinx was more or less complete before the Egyptians made the Sphinx Temple. He did not recognize that the Sphinx and its temple came into being as the same quarry-construction sequence. *But Ricke did recognize a major sequence that has gone all but forgotten in the debate about which king ordered up the Sphinx.*

Ricke described enclosure walls of enormous limestone blocks that flanked the valley temple. The southern enclosure wall still exists, composed of a single course of locally quarried monolithic limestone blocks. At its western end, two enormous blocks make a corner and attach to the back, southwestern corner of the valley temple. The end block is fitted over a small granite block that remains in situ from a low bench or curb, 75 cm wide, that ran along the base of the south, east, and north sides of the valley temple. Ricke recognized that Khafre's builders had finished the low bench, and probably the entire granite casing of the valley temple, before they added the enclosure wall of large limestone blocks.

From its run to the east, 8.5 m from the valley temple south wall, the southern enclosure wall turns 90 degrees at the edge of the bedrock terrace in front of the valley temple. Here a single large block remains (fig. 18). The rock floor is cut as an emplacement bed for an additional long block that must have been removed. The missing piece would have brought the wall 5 m shy of the southern stone entrance ramp.

In front of the opposite, northeast corner of the valley temple, I mapped the foundation bed of a matching wall (fig. 19). Builders sunk the foundation slightly into the bedrock. As on the south, the northern enclosure wall once ran parallel to the northern side of the valley temple and 8.5 m from its granite casing. The foundation bed is just under 2.6 m (5 cubits) wide, the same width as the southern enclosure wall. Again mirroring its southern counterpart, the foundation cutting of the north wall shows that it turned a corner to run along the edge of the terrace in front of the valley temple, similarly stopping just shy of 5 m from the northern stone entrance ramp.



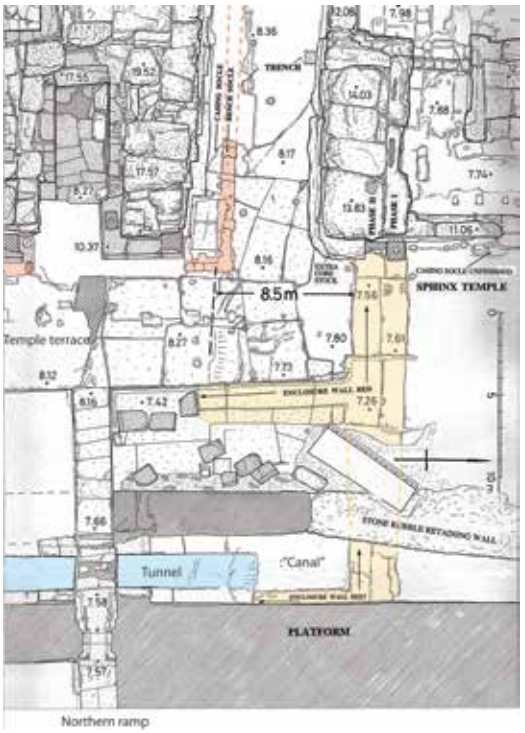


Figure 18 (left). The southeastern corner of the Khafre Valley Temple, with the turn of the southern enclosure wall (yellow) and the bed of a missing block that brought the wall just shy of 5 m from the southern entrance approach ramp. Spot heights are relative to an arbitrary datum set in 1978. Add 9.331 for meters above sea level. Highlighted in red: foundation for a small bench along the base of the southern and eastern temple walls, which were cased in granite, long missing

Figure 19 (right). The northeastern corner of the Khafre Valley Temple and southeastern corner of the Sphinx Temple. The turn of the foundation bed for an enclosure wall ends just shy of 5 m from the northern entrance ramp. The missing wall once ran 8.5 m from the granite casing of the Khafre Valley Temple, as does the southern wall (fig. 18). The wall bed appears to continue farther east, with an additional turn toward the south, but was covered under the mudbrick wall and platform of a later phase, contemporary with the approach ramps of the valley temple. The western mudbrick wall, which defines a corridor (or "canal") framing tunnels (blue) under the ramps, turns into a stone rubble retaining wall just east of the Sphinx Temple, which was under construction when work stopped. A broad mud-paved platform bounds the "canal" north of the northern ramp

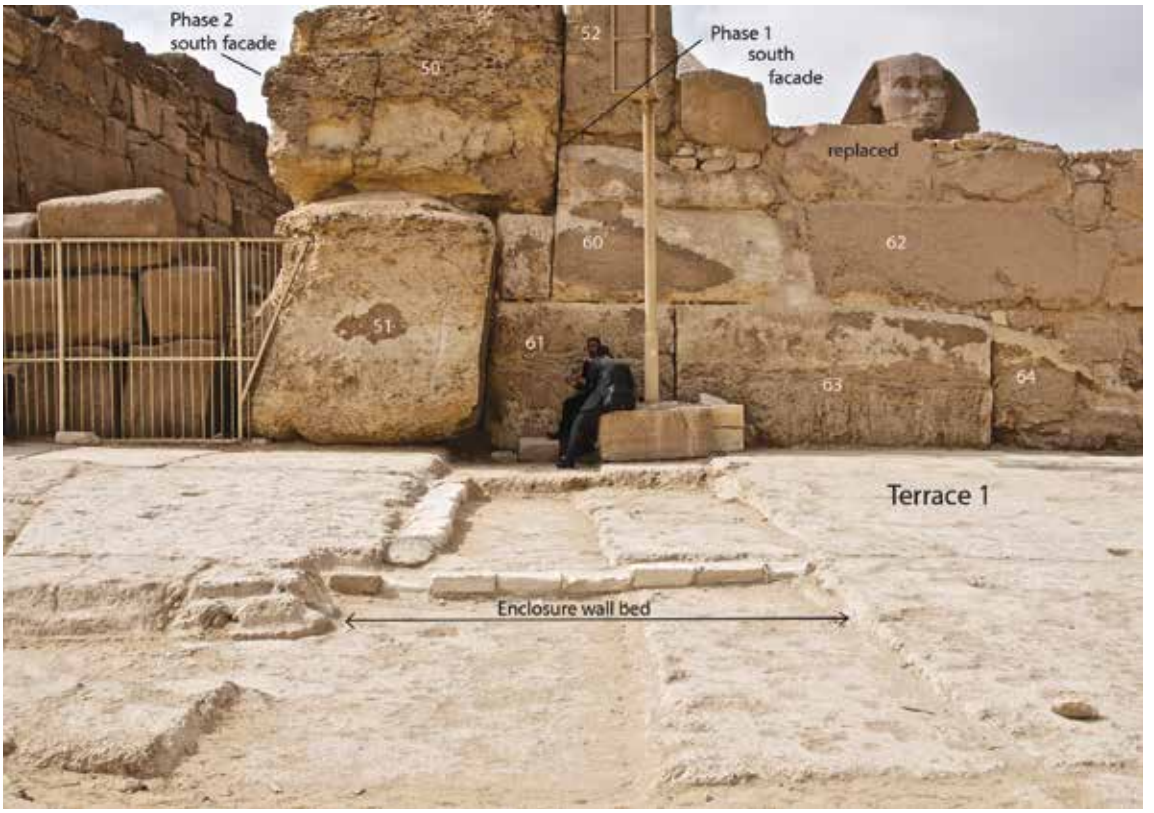


Figure 20. The bed of the northern enclosure wall of the Khafre Valley Temple, removed before Khafre's builders started the Sphinx Temple. The width of the bed, around 2.6 m (5 cubits), corresponds to the width of the southern enclosure wall and its bed. The builders left several blocks of the northern enclosure wall in place, including block 61, as part of the southern core wall of the Sphinx Temple

In a later stage of construction,[21] when the king's builders set to work on the Sphinx Temple, they removed most of the northern enclosure wall, but left in place some of its blocks, which they incorporated into the southern wall of the Sphinx Temple. The foundation trench, cut into bedrock, remains as a record of where the northern wall had once stood (fig. 20). Builders left the enclosure wall blocks in place across the entire southeast corner of the Sphinx Temple.

So, in summary, enclosure walls that flanked the valley temple, north and south, reached out to enclose the front corners, but left a wide space for the approach ramps and front terrace (fig. 21).[22]

The northern enclosure wall attached to the back end of the valley temple, 6 m east of the northwestern corner. As on the south, this connection is marked by a single surviving granite block of the low bench or curb that once ran along the base of the temple. Builders cut the large enclosure wall blocks to fit against and over the low bench, as we see on the south. The detail is important for showing that Khafre's valley temple stood complete, with its granite casing, when his builders added these enclosing walls.[23] Clearly, they launched into building the Sphinx Temple later still, after removing the northern enclosure wall.

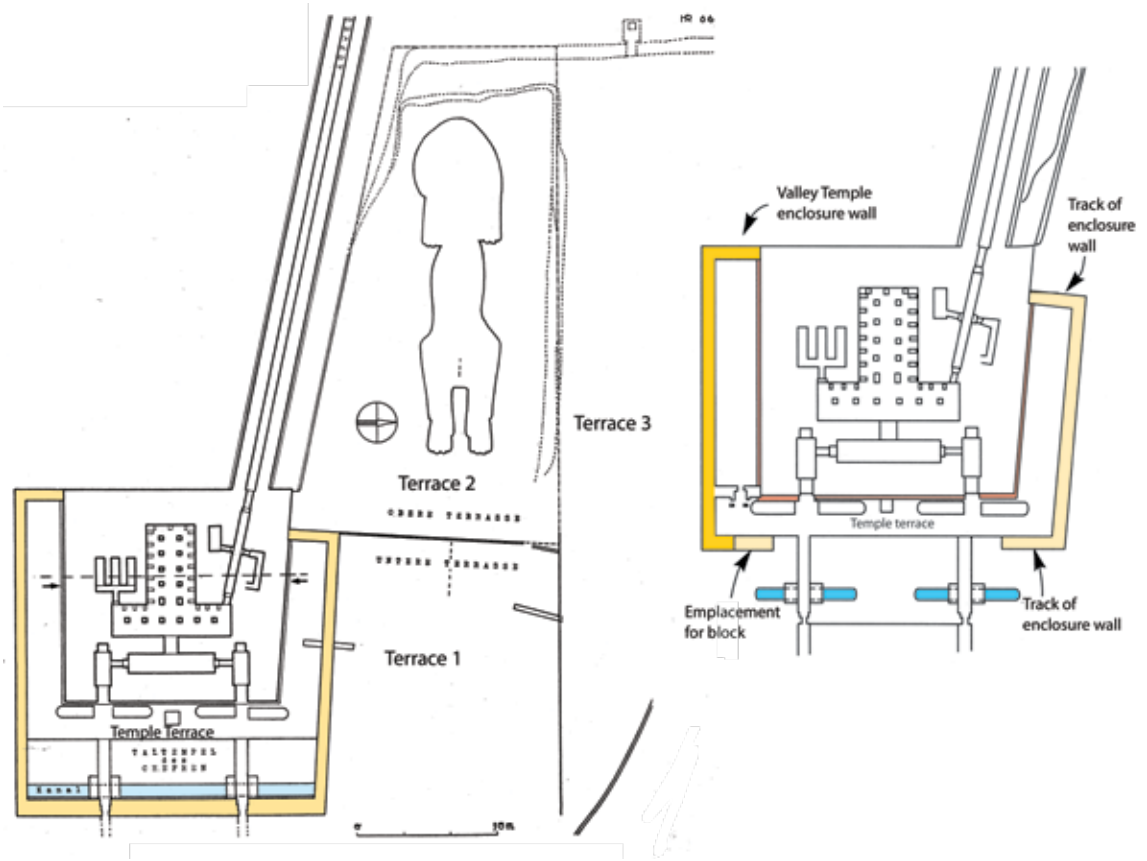


Figure 21. Ricke's schematic plan of the Sphinx, Terrace 1 before the Sphinx Temple was built, when Khafre Valley Temple included enclosure walls (left); early phase enclosure walls based on evidence mapped in 1993 (right) (see figs. 18–19)

How Much of the Sphinx was Done When Khafre Completed His Valley Temple?

How much of the Sphinx had Khafre's workers shaped when they finished his valley temple? They had reserved bedrock to carve the head, neck, and upper chest — just that part of the Sphinx above the top of Bed 5, the highest of the beds that produced Type A core blocks, from which most of the Sphinx Temple walls are composed (figs. 9, 10, 12, 13). They had probably started to shape the colossal statue down to this plane when the decision came down to build the Sphinx Temple in place of the northern enclosure wall.

At that point they began to gouge out the Sphinx ditch, taking Type A core blocks from Beds 5b down through 3c from within the ditch, and from where these layers extended out over Member I to the North Cliff within the greater Sphinx "Amphitheater" quarry (fig. 14). With one major modification — adding the north and south colonnades in a second phase[24] — the Sphinx Temple completely filled the northern part of Terrace 1, which had stood relatively empty except for the northern enclosure wall of the valley temple.

Khafre's workers started shaping the Sphinx as they built his valley temple. They were cutting the lower body out of its surrounding ditch as they made the Sphinx Temple, Khafre's last major addition to his pyramid complex. The builders did not finish. They left the Sphinx

Temple incomplete, without its exterior granite casing.[25] The quarrymen never finished cutting and straightening the Sphinx ditch. They left a testimony to their way of wasting unwanted rock on the North Ledge. They left a huge massif of Member I bedrock projecting to within a meter of the tail.[26]

Terrace 1: A Landing Platform?

Working on decades-old data is not unusual in Near Eastern archaeology. For me, work on this old data has yielded new insight in the light of more recent information. The core block study I carried out with Thomas Aigner in 1980, together with very new information from Wadi el-Jarf and the *Journal of Merer*, impacts an understanding of the landscape and waterscape at Giza in the time the pyramids and Sphinx were built.

From Wadi el-Jarf Papyrus B we know Merer's men hauled stones in Tura. Papyrus fragment BIV may document them hauling stones at Giza, in the *Ro-She Khufu* ("Entrance to the Basin of Khufu," a kind of port authority, perhaps). In what we have of his logbook, Merer mentions frequently loading stone in Tura, but off-loading only once.[27] Tallet infers that quarry workers assembled blocks at Tura in "loading bays," where Merer's men could fetch and load them onto their boat. In fact, Middle Kingdom builders' graffiti often refer to stones as "brought from the storage enclosure, delivered at the ramp."[28] At Giza, we might expect an "off-loading bay." Terrace 1 could have served this purpose.

I hypothesize that it was Khufu's quarry workers who emptied and leveled Terrace 1. They worked through the sequence, from Member III down through the Member II beds, and then they cut 2.5 m down into Member I. This left a vertical bedrock face, rising 22 m, from which Khafre's workers would carve the Sphinx. We see similar deep, vertical quarry faces in the Central Field West quarry and at the Khentkawes Monument (fig. 17). While shaping the Sphinx, Khafre built his valley temple and the Sphinx Temple on the terrace quarried out under Khufu as an off-loading platform.

Hard rock realities forced Merer to deliver his loads at the low, southeastern base of the Moqattam Formation, the Pyramid Plateau proper, somewhere between the Wall of the Crow and the area in front of the Sphinx. At the northern end of this natural gateway, some 60 m east of the Sphinx Temple, evidence hints at the western end of a very deep canal basin (fig. 22),[29] where boats could off-load and turn around in a waterway wide enough for two-way traffic.[30] The western end of this basin was the best place for Merer to off-load and have his blocks dragged up to the southeast corner of the Great Pyramid[31] — the closest he could get for the shortest possible drag-time, along the track of the modern asphalt road, which passes only 50 m north of the Sphinx.

This raises the possibility that Khufu's workers first opened the greater Sphinx ("amphitheater") quarry (fig. 14) by cutting a way through the escarpment on the northern side of this quarry (fig. 23). That would invite comment from the several scholars who would like to see Khufu as the one who conceived and created the Sphinx. However, the study of the Sphinx Temple core blocks reinforces Herbert Ricke's conclusion that Khafre finished the Sphinx, with as high a degree of probability as we can hope for, given current evidence.

I hope our work this year, with data old and new, contributes something to understanding how two of the world's most iconic ancient monuments, the Sphinx and the Great Pyramid, came into being, even as it raises new questions. And so the story evolves.

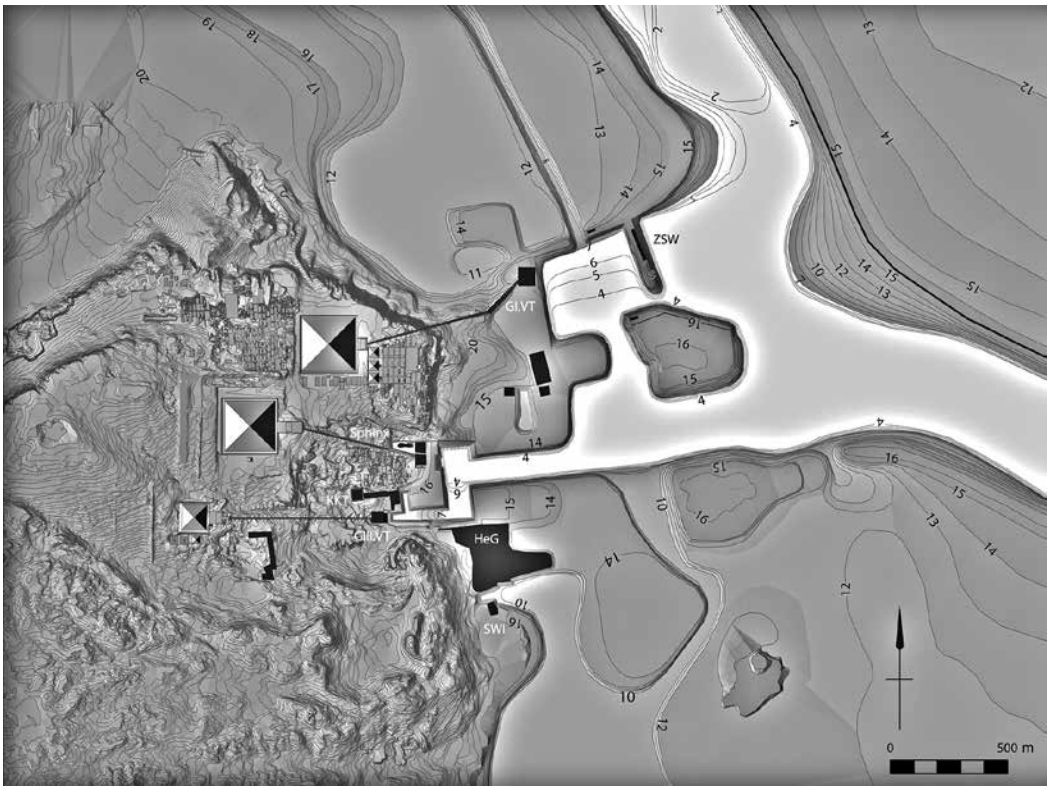


Figure 22. Reconstruction of Fourth Dynasty water transport infrastructure at Giza, with contour values in meters above sea level; white indicates low water level at 7 m asl; ZSW = Zaghloul Street Wall; HeG = Heit el-Ghurab site (map: Rebekah Miracle from AERA GIS, based on design by Mark Lehner)

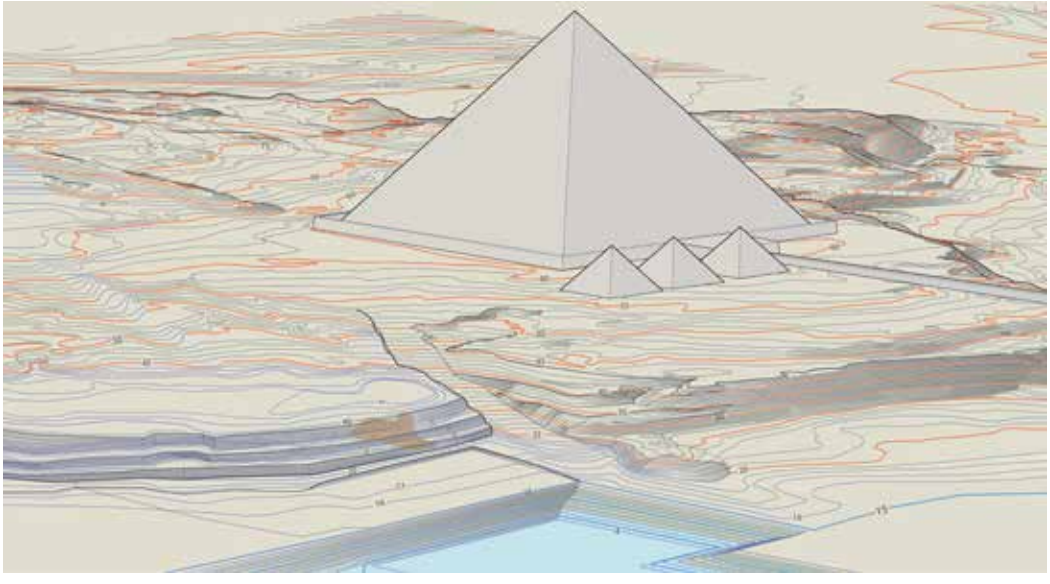


Figure 23. Reconstruction of the Giza Plateau eastern escarpment before the creation of the Sphinx, with a way cut to deliver material from the end of the central canal basin up to the Great Pyramid of Khufu

Notes

[1] At the time, James Allen was Assistant Director of ARCE. He is now Charles Edwin Wilbour Professor of Egyptology at Brown University. In addition to James Allen and Mark Lehner, the project included Ulrich Kapp (photogrammetry), Christiane Zivie-Coche (Egyptology), Attila Vass (survey), Susan Allen (survey), Peter Lacovara (survey), Cynthia Schartzer (archaeology, survey), K. Lal Gauri (geology), and Thomas Aigner (geology). I gratefully acknowledge the financial support the Edgar Cayce Foundation provided ARCE for the Sphinx Project.

[2] Tallet 2017.

[3] Tallet 2017, pp, 75–76.

[4] Lehner 2014; forthcoming.

[5] Kromer 1978.

[6] Nolan 2010, p. 155, Seal 1 with Khafre's name.

[7] Lehner 1980, pp. 14–15.

[8] Aigner 1981; 1982; 1983a; 1983b.

[9] *Nummulites gizehensis* are extinct unicellular plankton-like organisms that lived in the warm, shallow, tropical waters of the Eocene sea. They take their name from the Latin word for "coin" (*nummulus*) because each organism secreted a calcite shell in a coin-shaped spiral (https://en.wikipedia.org/wiki/Nummulite).

[10] Thomas Aigner first numbered the beds starting with Beds 1-a–b-c in Member I and continuing in numerical sequence up to Beds 9 a- in the head. Geologist K. Lal Gauri later asked that I designate the beds starting with number 1 as the lowest layer in Member II and continuing the numerical sequence with alternate soft, marly beds as sub Roman numeral "i" and the harder beds as sub Roman numeral "ii" in Member II, so 1i, 1 ii, 2i, 2ii, etc. This left the Sphinx head layers as 8-plus-letter rather than 9. I used Gauri's (1984, fig. 3a–c) numbering in most publications where Member II Sphinx beds are designated Lehner (1991; 1994); Hawass and Lehner (1994, pp. 46–47); Gauri, Sinai, and Bandyopadhyay (1995); and Gauri and Bandyupadhyay (1999, pp. 183–211) also use Gauri's bed numbers. For the Sphinx core block study and this article, I now revert to Aigner's numbering, since he and I surveyed the Sphinx Temple core blocks together, after I drew and numbered all the blocks, and because we referenced Aigner's bed designations in our notes and comments.

[11] *Operculina* is a genus of foraminifera, ocean-dwelling single-celled organisms with shells.

[12] Gauri 1981a; 1981b; 1984.

[13] Ricke 1970, plan 1. Ricke mapped the Sphinx Temple between 1965 and 1967. He included in his map all the details necessary to understand what the builders intended as their final result, but he did not outline each of the core blocks in his map. Using photogrammetry, he did draw most of the core blocks in his elevation views of the temple walls.

[14] As I noted in Lehner 1980, p. 15, where I suggested builders took blocks from bedrock layers above the Sphinx Temple (Terrace 1) for building the Khafre Valley Temple.

[15] Ricke 1970, pp. 16–20.

[16] Hawass and Lehner 1994, pp. 46–47. While I reviewed these observations with Aigner in 2010, they should be further tested, documented, and published with survey and photographs.

[17] Hölscher 1912, p. 19.

[18] Ricke 1970, p. 4.

[19] Ricke 1970, p. 34.

[20] Lehner 1980, pp. 14–17.

[21] At least three major construction phases can be distinguished for the Khafre Valley Temple, prior to the two major construction phases that Ricke already delineated for the Sphinx Temple. These should one day be explicated and published.

[22] I mapped what could be a continuation to the east of the bed of the northern enclosure wall. It passes under the mudbrick wall (see fig. 20). Like the more westerly segments on the north and south, the bed turns 90 degrees south, but this is not certain.

[23] The remaining building phase for the Khafre Valley Temple included the long limestone approach ramps, the pavement of the temple terrace and southern annex with its mudbrick magazines, and the massive mudbrick walls and platform framing the tunnels under the ramps east of the temple. Building phases of the Khafre Valley Temple have not yet been properly described.

[24] As Ricke 1970, pp. 16–29, outlined.

[25] Ricke 1970, p. 27.

[26] Lehner 2002; Ricke 1970, p. 4, recognized Khafre's workers did not finish cutting the North Ledge and west end of the Sphinx ditch.

[27] Tallet 2017, p. 77, fragment B22.

[28] Arnold 1990, e.g., pp. 77–78, nos. W27–28

[29] In the parlance of water transport infrastructure, a canal basin is "a waterway alongside or at the end of a canal, and wider than the canal, constructed to allow boats to moor or unload cargo without impeding the progress of other traffic, and to allow room for turning... For inland waterways, a land-locked harbor... often associated with wharves around its perimeter" (Wikipedia.org/wiki/Canal_basin; January 20, 2015).

[30] Lehner 2014; Figure 22 here is the result of my third attempt at reconstructing Fourth Dynasty waterways at Giza (see Lehner 1985; Ziegler 1999 for the first two attempts) based on vestiges of ancient features in the modern surface contours and more direct evidence that has come to light in the last thirty years, including Old Kingdom features encountered in excavation and sediments retrieved through deep core drillings. By contouring with values above sea level, using Fourth dynasty structures as benchmarks, I produced this bathymetric model of Fourth Dynasty water transport infrastructure. This year, I laid out the evidence and inferences that support this model in a forthcoming publication.

[31] Lehner 2013, p. 2; 2014, p. 20; Tallet 2017, pp. 84, 152.

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