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«aus der besonderen Fundsituation ... die Unterhaltung einer Menagerie ... sich als Erklärung ...» anbiete<sup>5</sup>. Für eine Lokalisierung der Menagerie kämen die noch nicht abschließend untersuchten Schichten des N-Bereichs von QI bzw. ein noch nicht erfaßter Gebäudekomplex in dessen Nähe in Frage.

Bei der ebenfalls vorläufig als Stratum B<sub>2</sub> zu bezeichnenden Bauschicht handelt es sich um Werkstätten und Kleinmagazine, die zumindest in Teilen – im nördlichen Bereich – von dem Thot-Heiligtum und den dazugehörigen Schreibstuben des Stratums B<sub>1</sub> überlagert werden. In diesen Werkstattsschichten wurden ausgedehnte Komplexe zur Metallver- und -bearbeitung anhand von Öfen und dem dazugehörigen Fundinventar wie Schmelztiegeln, Ofendüsen, Rohmaterialien u. a. m. nachgewiesen. – In weiteren Räumen ließen sich als Raumfunktionen Knochen- und Steinverarbeitung feststellen; auf die daneben zu erwartende Bearbeitung von Holz, Leder u. ä. kann zwar aus dem Werkzeuginventar geschlossen werden, sie ist jedoch wegen der Vergänglichkeit dieser Materialien nicht unmittelbar nachweisbar.

Wie oben erwähnt gelang 1984 die Wiederauffindung einer Sondage des kürzlich verstorbenen verehrten Kollegen Prof. Dr. Labib Habachi. Das seinerzeit von ihm freigelegte monolithische Kalksteinbecken von 3,0 × 3,0 m konnte dabei nicht nur freigelegt, sondern auch in einen architektonischen Zusammenhang gestellt werden, der in den kommenden Kampagnen näher untersucht werden soll. Bei ihm handelt es sich um einen Komplex von großzügigen Mauern aus luftgetrockneten Nilschlammziegeln und ebensolchem Pflaster. Auch dieses neue Grabungsareal QIII, das ca. 250 m südwestlich von QI gelegen ist und in das auch sonst durchgeführte Netz der Planquadrate einbezogen wurde, enthält zumindest zwei Bauschichten. – Das bei einer ersten Durchsicht festgestellte Keramikinventar läßt bei gleicher Datierung wie in den anderen Grabungsarealen auf eine andersartige Funktion der zu erwartenden Räumlichkeiten schließen.

Nach Abschluß der Arbeiten in QI und Fortführung der Arbeiten in QIII sind bei gleichzeitig intensivierten Oberflächenuntersuchungen erste gesicherte Aussagen über die Struktur dieses Teils der Stadtanlage zu erwarten.

E. B. Pusch

## Giza

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<sup>5</sup>) *Elefanten-, Löwen- und andere Tierknochen aus der Palastanlage der Ramessidenzeit bei Qantir im östlichen Nildelta*, in: *Studien an subfossilen Tierknochen aus Ägypten*. MÄS 40, München 1982, 136–143, Taf. 12, 13.

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#### 1.1. The ARCE Sphinx Project

At the close of its final season of December 1982 to January 1983, the Sphinx Project of the American Research Center in Egypt had completed most of its goals<sup>1</sup>. Thanks to the German Archaeological Institute in Cairo, 1:50 photogrammetric elevations of the Sphinx, done by Ulrich Kapp, are now in hand and at the disposal of the Egyptian Antiquities Organization. A detailed 1:50 plan of the statue and a 1:100 plan of the Khafre Sphinx and Valley Temples, were also finished. Smaller scale maps of the general area and larger scale studies of the masonry added to the rock core of the Sphinx will be included in the publication of the project results now being prepared. On the basis of the notes of Lacau and the more than 200 photographs of the Baraize excavation of the site, an attempt will be made to reconstruct the general stratigraphic sequence which was removed from the area. For the loan of the Archive of Lacau material we are grateful to Prof. Jean Yoyotte, and the Centre Wladimir Golenischeff. Contributions to the final report are being submitted by James Allen, Christiane Zivie, Jihan Ragai, Ulrich Kapp, K. Lal Gauri, Thomas Aigner, and Mark Lehner.

It was felt from the beginning of the project that the Sphinx could not be properly understood without understanding the geology of the rock from which it was formed. The contribution of the participating

<sup>1</sup>) M. Lehner, J. P. Allen und K. Lal Gauri, «The ARCE Sphinx Project: A Preliminary Report», *The ARCE Newsletter* 112 (Fall 1980), 3–33.

geologists went beyond purely descriptive value to offer insights into the *Baugeschichte* of the Sphinx and its associated temples. The geology, the expansion of our survey control network from the Sphinx to the three major Giza Pyramids, and certain incidental observations of alignments led us to a wider focus on the layout and development of the Giza Necropolis as a whole. I will relate some of the more salient configurations which led us to this wider focus, and sketch some working hypotheses that followed.

### 1.2. Geoarchaeology of the Sphinx

In a preliminary report<sup>2</sup> it was related that the Sphinx core was formed from three principle geological layers. These correspond to the principle parts of the statue: a hard layer at the base and through the lower terrace on which the Sphinx Temple was built, a softer layer from which the corebody was cut, and

nated, from bottom to top, Members I (former Bed 3), II, and III. These and subsidiary units were plotted in plans, elevations, and profiles of the statue. Each subsidiary bed – of which there are several in Member II of the body – was given a number. Samples were collected from these units from the quarried areas in the vicinity of the Sphinx. Gauri has conducted chemical and petrographic analyses of the samples, and is presently studying the permeability and porosity of these units<sup>4</sup>.

Thomas Aigner joined the Sphinx Project in the 1981–82 season after conducting a separate geological study of the Giza Plateau with an emphasis on the environment of sedimentation which produced the rock facies (Fig. 1)<sup>5</sup>. He sees the northern part of the Mokkattam Formation outcrop at Giza as a nummulitic bank exceeding 30 m in thickness. Against this, to the south, a shoal or reefal facies was laid down (Mem-

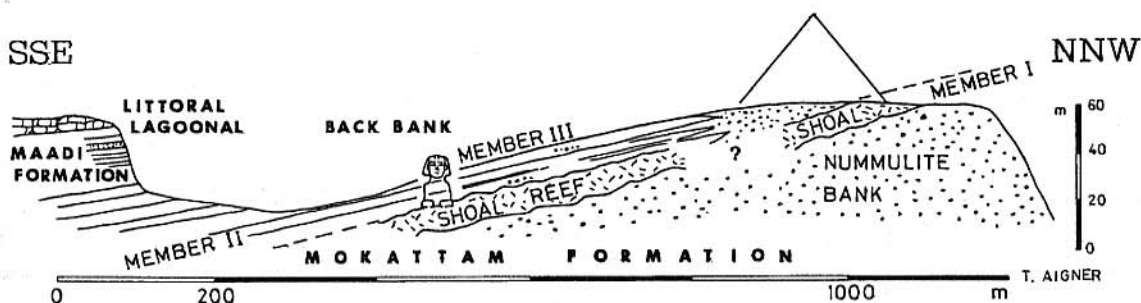


Fig. 1

another hard layer in which the head was sculpted. We labelled these beds 3, 2, and 1 respectively. During the 1980–81 season, Gauri directed geological mapping of the Sphinx area<sup>3</sup>. The principle layers were design-

ated, from bottom to top, Members I (former Bed 3), II, and III. These and subsidiary units were plotted in plans, elevations, and profiles of the statue. Each subsidiary bed – of which there are several in Member II of the body – was given a number. Samples were collected from these units from the quarried areas in the vicinity of the Sphinx. Gauri has conducted chemical and petrographic analyses of the samples, and is presently studying the permeability and porosity of these units<sup>4</sup>. Thomas Aigner joined the Sphinx Project in the 1981–82 season after conducting a separate geological study of the Giza Plateau with an emphasis on the environment of sedimentation which produced the rock facies (Fig. 1)<sup>5</sup>. He sees the northern part of the Mokkattam Formation outcrop at Giza as a nummulitic bank exceeding 30 m in thickness. Against this, to the south, a shoal or reefal facies was laid down (Mem-

<sup>2</sup>) Ibid., 12–13.

<sup>3</sup>) This will be published in a forthcoming article and Gauri's geology of the immediate Sphinx precinct will be one of the contributions to the final report on the Sphinx Project now in preparation.

<sup>4</sup>) K. Lal Gauri, «Deterioration of the Stone of the Great Sphinx», *ARCE Newsletter* 114 (Spring 1981), 35–47; «Selection of the Stone for the Restoration of the Sphinx», *ARCE Newsletter* 116 (Winter 1981–82), 35; «The Deterioration of Ancient Stone Structures in Egypt», *Prospection et sauvegarde des Antiquités de l'Égypte; Bibliothèque d'Étude* 88 (Cairo 1981), 13–15.

<sup>5</sup>) T. Aigner, «Fazies und Ereignis-Schichtung im Mittel- und Ober-Eozän von Ägypten», (Unpublished Diplom-Thesis, University of Tübingen, 174 pp., 1981); «Event Stratification in Nummulite Accumulations and in Shell Beds from the Eocene of Egypt», in G. Einsele and A. Seilacher (Eds.), *Cyclic and Event Stratification* (Springer-Verlag 1982), 248–62; «A Pliocene Cliff-line Around the Giza Pyramids Plateau, Egypt», *Paleogeography, Paleoclimatology, Paleoecology* 42 (1983), 313–22.

<sup>6</sup>) T. Aigner, «Facies and Origin of Nummulitic Build-ups: An Example from the Gize Pyramids Plateau (Middle Eocene, Egypt)», *N. Jb. Geol. Paläont. Abh.* 166: 3 (July 1983), 347–68.

<sup>7</sup>) T. Aigner, «Zur Geologie und Geoarchäologie des Pyramidenplateaus von Giza, Ägypten», *Natur und Museum* 112: 12 (December 1982), 377–88.

<sup>8</sup>) Lehner, Allen, and Gauri, «Preliminary Report», *NARCE* 112, 14–15.

<sup>9</sup>) Ibid.



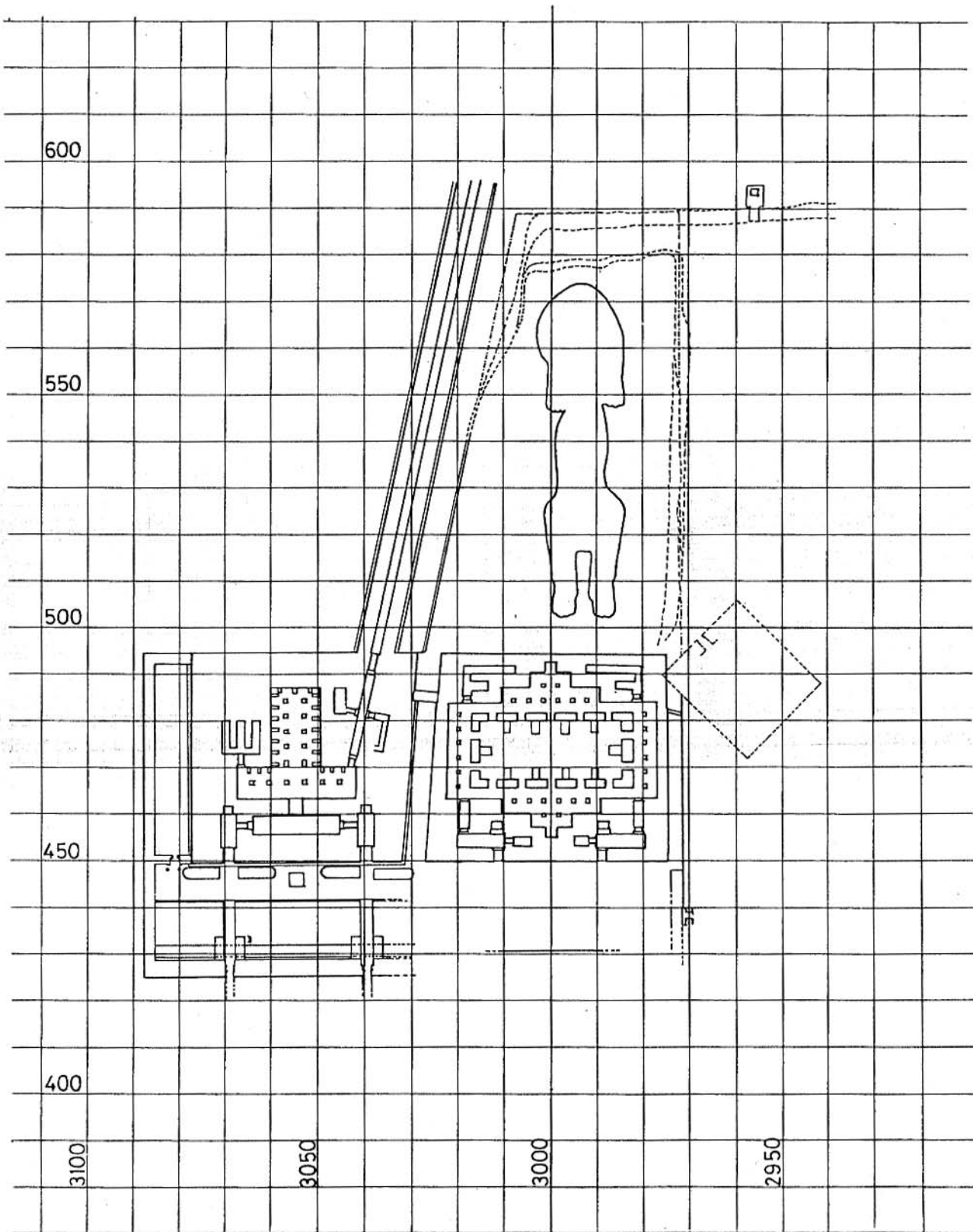


Fig. 3

Khafre Valley Temple were taken from the cut into Member I which created the lower terrace of the Sphinx complex was definitely nullified by Aigner's study. The Member I rock is hard, brittle, and fossiliferous which makes it less suited than Members II and III for extracting large core blocks. In Member II the limestone beds are intercalated with yellowish softer marly layers, along which the large temple blocks were extracted<sup>10</sup>. The more standard Sphinx Temple blocks were extracted along such a bed and show three limestone strata running through them, the middle being another «yellow band»<sup>11</sup>. It was found that the «structural stratigraphy» of the Sphinx Temple, and to some extent the Khafre Valley Temple, is generally inverse to the sedimentary stratification.

As a familiarity was gained with the geology at Giza, it was seen that the various units could be used as markers for the sources of other locally quarried stones which went into the pyramids and temples of Giza.

### 1.3. Sphinx-solar Alignments

Our interest was also drawn to the wider layout of the Giza Necropolis almost fortuitously by the positioning of our survey grid (Fig. 3). This was first determined on the basis of Ricke's reconstruction of the Sphinx and Khafre Valley Temples so that a grid center line (3000) running east-west corresponded to the axis of the Sphinx Temple.

Ricke and Schott<sup>12</sup> interpret the unique layout of this temple as follows: The cult niches on the east and west were for rituals dedicated to the rising and setting sun, the open court likewise conveys the solar character of the temple, the two pillars in front of each of the niches signify the arms and legs of the sky-goddess Nut, and the 24 pillars of the covered colonnades represented the 24 hours of the day and night. According to this scheme, the temple is a monument to the circuit of the sun and the hourly and daily cycles of time<sup>13</sup>.

Ricke noted that the axis of the temple is shifted 7.35 ms south of the axis of the Sphinx. While affirming that it appears to have been crucial for the temple to be exactly oriented east-west, he concluded that

<sup>10</sup>) Aigner, «Zur Geologie und Geoarchäologie», *Natur und Museum* 112: 12, 382–83, Abb. 6; cf. Goyon, «Les rangs d'assises de la grande pyramide», *Bulletin de l'Institut Français d'Archéologie Orientale* 78 (1978), 408–9.

<sup>11</sup>) Lehner, Allen, and Gauri, «Preliminary Report», *NARCE* 112: 12, 14.

<sup>12</sup>) H. Ricke, «Der Harmachistempel des Chefreden in Giseh», *Beiträge zur Ägyptischen Bauforschung und Altertumskunde* 10 (1970), 1–43; S. Schott, «Ägyptische Quellen zum Plan des Sphinxtempels», *BÄBA* 10 (1970), 49–79.

<sup>13</sup>) Ricke supports this interpretation with parallel scenes in the offering chapels of Hatshepsut and Thutmose III in Thebes; cf. E. Naville, *The Temple of Deir el-Bahri*, Vol. IV, Pls. CXIV–VI.

there was no thematic necessity for the Sphinx and the temple to align. The approximation of our east-west survey baseline 3000 to the temple axis (Fig. 3) called our attention to the following configuration. The axis, which we projected independently up the plateau with theodolites, points visually to the south side of the Khafre Pyramid where it terminates in the apparent horizon when viewed from the eastern niche of the temple (Fig. 4). Coming together at this point are the

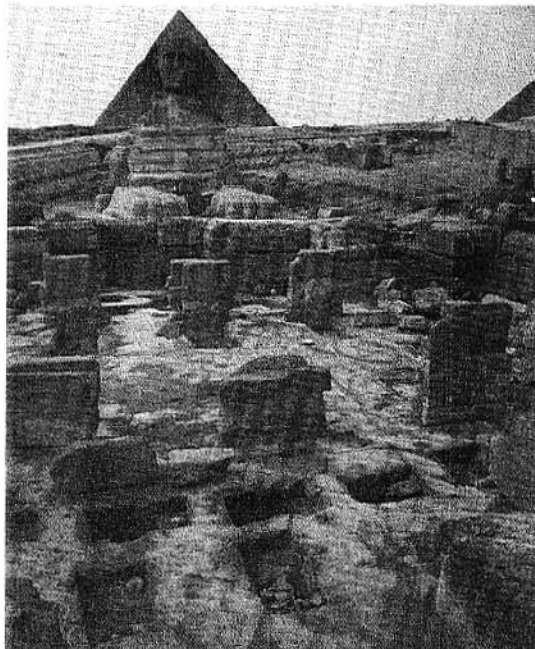


Fig. 4

side of the pyramid, the corner formed by the Khafre causeway and the Sphinx ditch, a notch carved in the bedrock at this corner<sup>14</sup>, and the south side of the Sphinx. It is at this point that the sun sets into the apparent horizon at the Equinoxes (Fig. 5, taken Sept. 21, 1980 two days before equinox). The ball of the sun sets more precisely into this corner when viewed from the top of the east colonnade (core wall) of the temple, from where there is a more unrestricted view of the apparent horizon. The general effect, when the temple was complete, would have been to have the sunlight pass over the top of the western colonnade, through the court, and into the eastern niche around the time of the Equinoxes<sup>15</sup>.

<sup>14</sup>) S. Hassan, *The Great Sphinx and Its Secrets: Excavations at Giza*, Vol. VIII (Cairo 1953), 161–62 reports that this is the end of a trench which runs the length of the Khafre causeway, 1.50 m deep and 2 m wide. He states that the trench is plugged with great granite blocks at the Sphinx end. I have not seen these granite blocks; they may be buried under the sand behind the patch of mudbrick wall filling the notch – part of the enclosure walls built by Thutmose IV.

<sup>15</sup>) In 1980 the axis of the Sphinx Temple was deter-

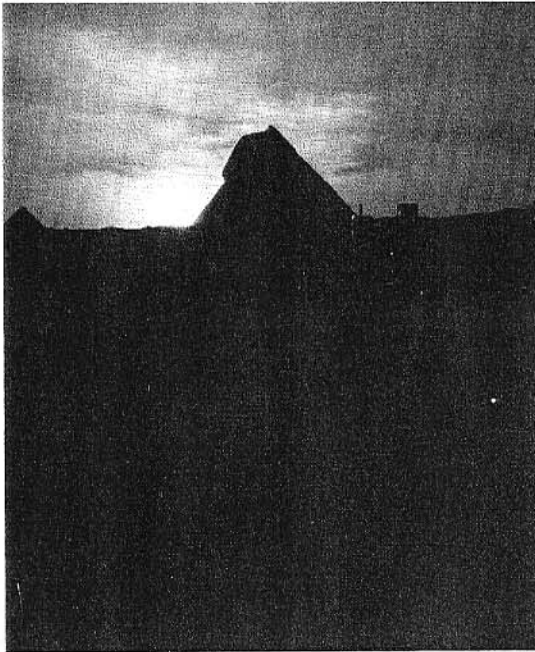


Fig. 5

An alignment of a wall or building axis to the Equinox or Solstice sunrise or sunset positions is not difficult to achieve. It is certainly within the surveying capabilities of the 4<sup>th</sup> Dynasty Egyptians who could orient the Great Pyramid to true north within 5'30" <sup>16</sup>. However, this kind of alignment, widely noted in other ancient cultures and studied by the sub-discipline of archaeoastronomy <sup>17</sup>, has not been widely

mined as best as possible by taking the center of the east and west niches, the pillar sockets before the niches, and the statue sockets in front of the court pillars (all core work and not finished masonry). This was projected up the plateau about 500 m where a point on this line was monumented on the modern cement roof protecting the tomb of Seshemnefer; see Hassan, *Excavations at Giza*, Vol. VI: 3, 201–6, Figs. 199, 204–5. It is this modern cement roof which forms the artificial horizon on this line as seen now from the east sanctuary of the Sphinx Temple. At the completion of the Khafre complex, the same line would hit the artificial horizon of the walls of the Khafre causeway. Clearly, if the apparent alignment with the sun was intentional, the intent was not to measure the Equinox from the temple sanctuary or axis, but to have the sunlight shine into the sanctuary when the sun was at its east–west rising and setting.

<sup>16</sup>) J. H. Cole, «Determination of the Exact Size and Orientation of the Great Pyramid of Giza», *Survey of Egypt Paper* No. 39 (Cairo 1925), 7.

<sup>17</sup>) A. F. Aveni, «Archaeoastronomy», in *Advances in Archaeological Method and Theory*, Vol. 4, ed. by M. B. Schiffer (New York 1981), 1–77.

documented in ancient Egyptian architecture. This may be, in part, due to the lack of recognizable documentation of such horizon phenomena on the part of the ancient Egyptian textual sources themselves <sup>18</sup>.

Another dramatic effect is created at sunset during the summer solstice as viewed, again, from the eastern niche of the Sphinx Temple. At this time, and from this vantage, the sun sets almost exactly midway between the Khufu and Khafre Pyramids, thus construing the image of the *akhet*, «horizon», hieroglyph on a scale of acres (Fig. 6a). The effect is, again, best seen from the

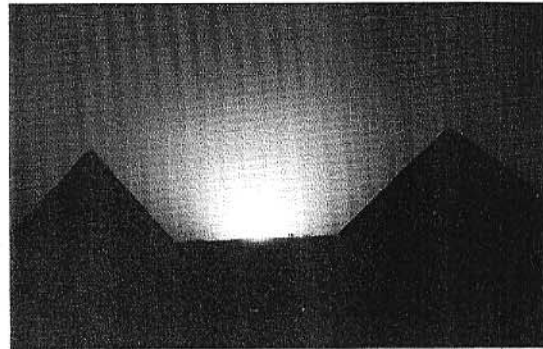


Fig. 6a

top of the Sphinx Temple colonnade, or an equivalent height to the east of the temple where the sand rises. At this height the Sphinx is merged into the silhouette of the Khafre Pyramid <sup>19</sup> (Fig. 6b). The image is actually



Fig. 6b

<sup>18</sup>) The astronomer Harkhebi in the early Ptolemaic Period referred, on a statue of himself, to «knowing the northing and the southing of the sun, announcing all its wonders . . . and appointing for them a time, he declares when they have occurred, coming at their times; who divides the hours for the two times (day and night) without going into error at night»; see O. Neugebauer and R. A. Parker, *Egyptian Astronomical Texts*; Vol. III, 213–16.

<sup>19</sup>) R. Anthes, «Was veranlaßte Chefren zum Bau des Tempels vor der Sphinx?» *BÄBA* 12 (1971), 47–58 argues that the Sphinx represents the king as Horus as the contributor of the offerings to Re taking place

to be appreciated from most any vantage out east of the Sphinx and Khafre Valley Temples. Even if coincidental, it is hard to imagine the Egyptians not seeing this ideogram. If somehow intentional, it ranks as an example of architectural illusionism on a grand, maybe the grandest, scale<sup>20</sup>. It is well known that the ancient name of the Great Pyramid was *akhet Khufu*, «the horizon of Khufu», a name which could later be used as a designation for the Giza Necropolis as a whole<sup>21</sup>.

In assessing whether the two solar-architectural configurations are intentional, it must again be emphasized that obtaining a line to the Equinox or Solstice sunset position is not a great difficulty. More to the point is the question of how the surveyed line could have been maintained as the bedrock formation was quarried away and reformed into the given monuments. The original top of the bedrock might once have been as high as the top of the Sphinx's head<sup>22</sup>, some

down in the court of the temple. Another effect of the southerly positioning of the Sphinx and its temple is that from the east sanctuary the silhouette of the Sphinx merges with that of the Second Pyramid at sunset. The pyramid could be identified with the body of the king; see A. Piankoff, *The Pyramid of Unas* (Princeton: 1968), 6 n. 4. Near the Equinox the merger of the two symbols of the king takes place as the sun floods the sanctuary of Re down in the temple.

<sup>20</sup> A. Badawy, «Illusionism in Egyptian Architecture», *Studies in Honor of John A. Wilson* (Chicago 1969), 15–23; cf. T. Dombart, «Der zweitürmige Tempel-Pylon altaegyptischer Baukunst und seine religiöse Symbolik», *Egyptian Religion I* (1933), 87–98. R. P. Hypher, «The Value of  $\pi$  and the Pyramids of Egypt: Intentional or Accidental?» *JSSEA*, Vol. VIII (Aug. 1978), 143–46 points out that the elevation of the sun at the moment it is due east and west on the Summer Solstice is 52.5°, very close to the slope of the pyramid face.

<sup>21</sup> C. Zivie, *Giza au deuxième millénaire*, *BdE* 70 (Cairo 1976), 34. It is interesting to compare this configuration on the summer solstice at Giza with «propagandistic» statements made by ancient Egyptian sculpture; see W. K. Simpson, «Egyptian Sculpture and Two-Dimensional Representation as Propaganda», *Journal of Egyptian Archaeology* 68 (1982), 266–71. Simpson speaks of «dealing with the syntax of the statue». H. Frankfort, *Kingship and the Gods* (Chicago 1948), 153 pointed out that the Step pyramid is «a three-dimensional form . . . of the hieroglyph for the (Primeval) Hill». The ancient Egyptians seem to have drawn little distinction between writing, sculpture, and monumental architecture. In the case of the *akhet* sign described at Giza on the summer solstice, either fortuitously or intentionally they wrote on the scale of acres.

<sup>22</sup> So thought G. A. Reisner, *A History of the Giza Necropolis*, Vol. I (Cambridge, Mass. 1942), 11. If so, a tremendous amount of stone has been artificially quarried from the area of the Sphinx and to the east.

22 ms above the floor of the lower terrace on which the Sphinx Temple is built. There is, further, a drop of more than 60 m from the original plateau surface west of the Khafre Pyramid to the terrace of the Sphinx Temple, a distance of about a kilometer<sup>23</sup>.

## 2. Ancient Layout and Survey Points

### 2.1. Structural Alignments

Early in the project we determined the actual alignment between the south side of the Khafre Pyramid and the Sphinx complex by projecting the former down the plateau with a theodolite. This line falls

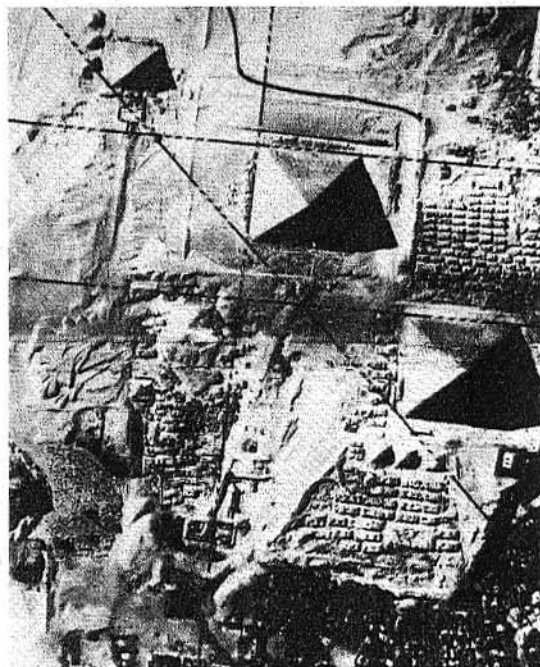


Fig. 7

along the south wall of the Sphinx Temple (Figs. 7, 8). The alignment of the temple axis and the south side of the pyramid is only an apparent and visually approxi-

We have not determined the extent to which the Sphinx head might have originally been a hummock or knoll. The same Member III stratum can be seen again in the knoll immediately north of the Khent-kawes tomb. It is not very likely that the Sphinx was fashioned from a yardang «that had already been streamlined by the wind»; as per Farouk el-Baz, «Desert Builders Knew A Good Thing When They Saw It», *Smithsonian* (April 1981), 116–22. Except for the head, the Sphinx is situated in an artificially created depression, unlike the geological forms to which it is compared by el-Baz. For another opinion see Rieke, «Harmachistempel», *BÄBA* 10, 42 n. 56.

<sup>23</sup> All such values herein are taken from the 1 : 5,000 photogrammetric maps of the Cairo area produced for the Ministry of Housing and Reconstruction.



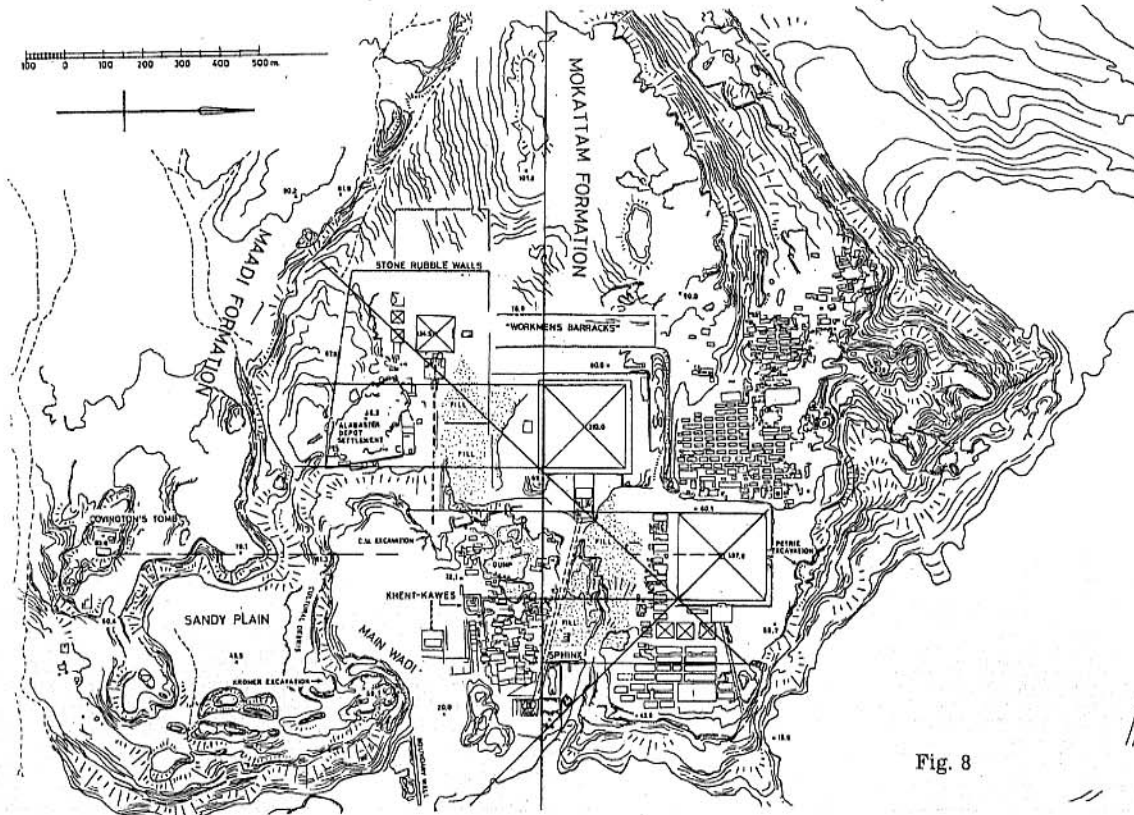


Fig. 8

mate configuration. Nevertheless Khafre's planners may have positioned his valley complex on this southerly alignment so that the equinoctial setting sun would not be obscured by the Sphinx nor by the pyramid.

Other alignments of the various structures at Giza became obvious. The most salient of these are shown on Figs. 7 and 8. The west side of Khufu's pyramid nearly aligns to the front of Khafre's Mortuary Temple, while the west side of Khafre's pyramid nearly aligns to the front of Men-kau-re's Mortuary Temple.

Fig. 8 is a form-line map based on the photogrammetrically produced 1:5,000 series of the general Cairo region. This shows that the two alignments to the mortuary temples are not so exact, although they are both off by the same amount (the outlines of the pyramids are those of the cores as they now stand without the casings). A great SW-NE diagonal cuts the diagonal of Men-kau-re's first queen's pyramid, touches the SE corner of his pyramid, cuts the diagonal of his Mortuary Temple, passes the SE corner of the Khafre Pyramid court, cuts the diagonal of the fore-temple of Khafre's Mortuary Temple, touches the SE corner of Khufu's Pyramid<sup>24</sup>, very nearly cuts the

diagonal of his first queen's pyramid, and ends in a large block of masonry built into the escarpment<sup>25</sup>.

This may be a mistake on the part of the journalist and «southwest» should read «southeast». According to the story, Goedicke feels the diagonal aims at Heliopolis and the sanctuary of the ben-ben stone. This NE-SW diagonal can also be seen in the general layout at Abusir where the pyramids of Ra'neferet, Neferirkare, Neuserre and even the mastaba tomb of Ptahshepses all approximately have their SE corners on line (with Neferirkare, like Khafre at Giza, slightly stepped back); see Borchardt, *Das Grabdenkmal des Königs SahuRe* (Leipzig 1910), Pl. i; Porter and Moss, *Bibliography* III. 1 (1974), Pl. XXXVII. At Saqqara the Pyramids of Teti, Userkaf, Zoser, Unas and Sekhemkhet are arrayed on an approximate NE-SW diagonal. The following points align: NW corner of Teti, SE corner of Userkaf, SE corner of Zoser, diagonal of Unas, NW corner of Sekhemkhet; see J. P. Lauer, Saqqara, *The Royal Cemetery of Memphis* (London 1976), map.

<sup>25</sup> G. Goyon, «Quelques observations effectuées autour de la Pyramide de Kheops», BIFAO 67 (1969), 77-9, fig. 4, Pl. IXa-b; *Le Secret des Bâisseurs des Grandes Pyramides Kheops* (Paris 1977), 231-33, where the feature is seen as a dumping platform. Cf. M. Lehner, *The Pyramid Tomb of Queen Hetep-heres I and the Satellite Pyramid of Khufu* (DAIK Sonderchriften, forthcoming), n. 4.

<sup>24</sup> C. Brown, «A Theory on the Pyramids, Hopkins Professor Tells Why They Were Put There», *The Washington Post* (November 30, 1983), C8, relates that according to Goedicke «a line could be drawn from the southwestern corners of the three Giza Pyramids».

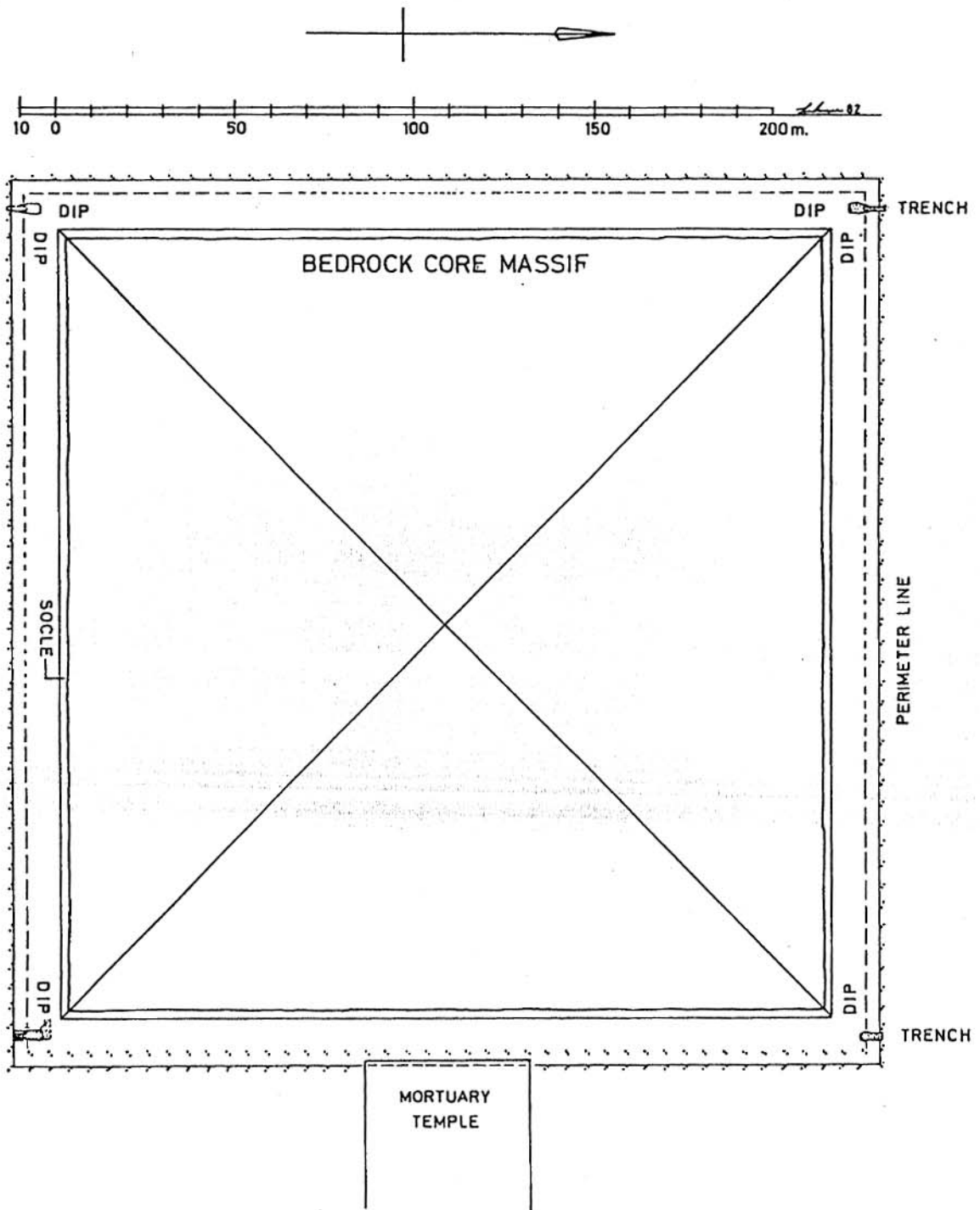


Fig. 9

Also aligned are the west side of the Khent-kawes superstructure<sup>26</sup> with the east side of Khufu's Pyramid, and, on a longer distance, the axis of the Khufu Pyramid with the stone platform located immediately to the east of Covington's 3<sup>rd</sup> Dynasty mastaba tomb<sup>27</sup>.

## 2.2. Layout of the Pyramids: Ancient Survey Points

It seemed reasonable that the kind of surveying which may have achieved these alignments, or indeed, that which laid out the pyramid should have left traces, especially when the layout was upon the cleared bedrock floor. Such traces may have been identified in some patterned cuttings in the courts of the two largest Giza pyramids.

Around the Khafre Pyramid there are distinct lines of small holes (30–40 cm in diameter) at roughly 10 cubit spacings, parallel to the base of the pyramid on all four sides (Fig. 9). The most distinct of these lines occurs along the line of the outer edge of the enclosure wall, 13.5 ms from the pyramid base, where the holes occur in staggered pairs. Another line of holes, less regular than the first, occurs along the line of the inner side of the enclosure wall<sup>28</sup>. At the four corners of the

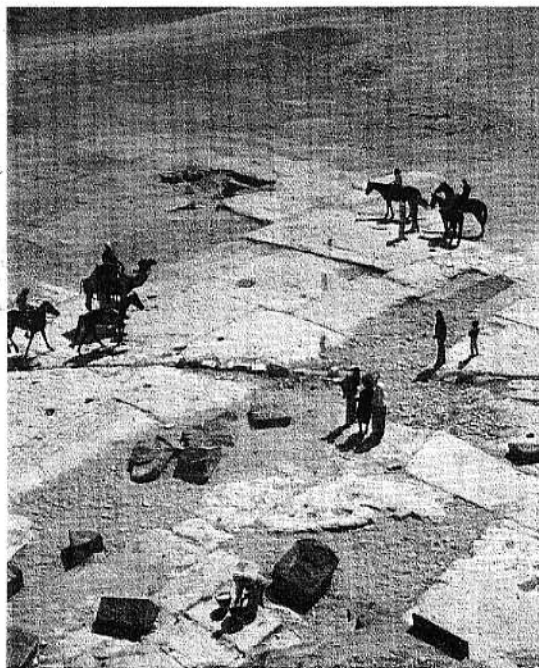


Fig. 10

<sup>26</sup>) B. Porter, R. Moss, E. Burney and J. Malek, *Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs, and Paintings*, Vol. III, Part I (Oxford 1974), 288–89.

<sup>27</sup>) W. M. F. Petrie, *Gizeh and Rifeh* (London 1907), 7.

<sup>28</sup>) The objection that these could be merely for scaf-

pyramid court, spanning the distance between the two lines of holes (or the width of the conclusion wall), are trenches, 6 m long, the ends of which face into the court and are on line with the diagonals of the pyramid. In Fig. 10 the trench at the SE corner, filled with sand, is just in front of the standing man and boy. Also evident is a series of notches cut into the rock floor, extending the line of the pyramid diagonal. Just to the left of these is a larger round hole (in front of the camel) at the point at which the great diagonal line, mentioned above, crosses the Khafre Pyramid court.

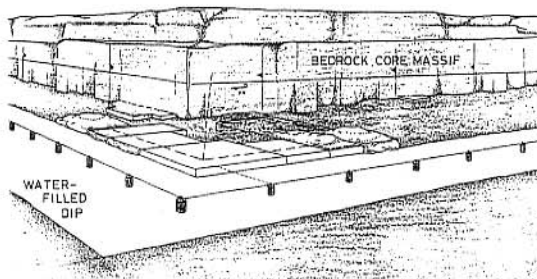


Fig. 11

Although some of these features were noted by Maragioglio and Rinaldi<sup>29</sup>, the possibility that they are traces of the original survey and layout of the pyramid was missed, except for a brief note by Goyon<sup>30</sup>. It appears that the holes describe a great layout square for determining by offset measures the baseline of the pyramid. Since at the Khafre Pyramid this baseline is only a cut in the foot of the lowest casing course of granite<sup>31</sup>, an outside datum or reference system was required, and this is represented in the features described.

Around the base of the Great Pyramid there is also a square described by a series of holes, here only 3 m from the foundation platform, and spaced, on the average, at 7 cubits. Like the holes at the Khafre Pyramid, these may have been fitted with posts in which pins allowed a taut and levelled line to be carried around the entire perimeter of the pyramid. From this line the base of the pyramid could have been accurately deter-

mined. Similar holes can be seen spaced about every ten cubits running down the axis of the Khafre causeway, where they would not have functioned as scaffold sockets. Those holes around the Khufu Pyramid do not correspond with the line of the enclosure wall. See M. Lehner, «Some Observations on the Layout of the Khufu and Khafre Pyramids», *Journal of the American Research Center in Egypt* 20 (1983, in press).

<sup>29</sup>) V. Maragioglio and C. Rinaldi, *L'Architettura delle Piramidi Menfite V: Le Piramidi di Zedefrà e di Chefren* (Rapallo 1966), 72–4.

<sup>30</sup>) Goyon, «Quelques Observations», BIFAO 67, 73 n. 3.

<sup>31</sup>) Maragioglio and Rinaldi, *Le Piramidi di Zedefrà e di Chefren*, Tv. 6, Figs. 2–7.

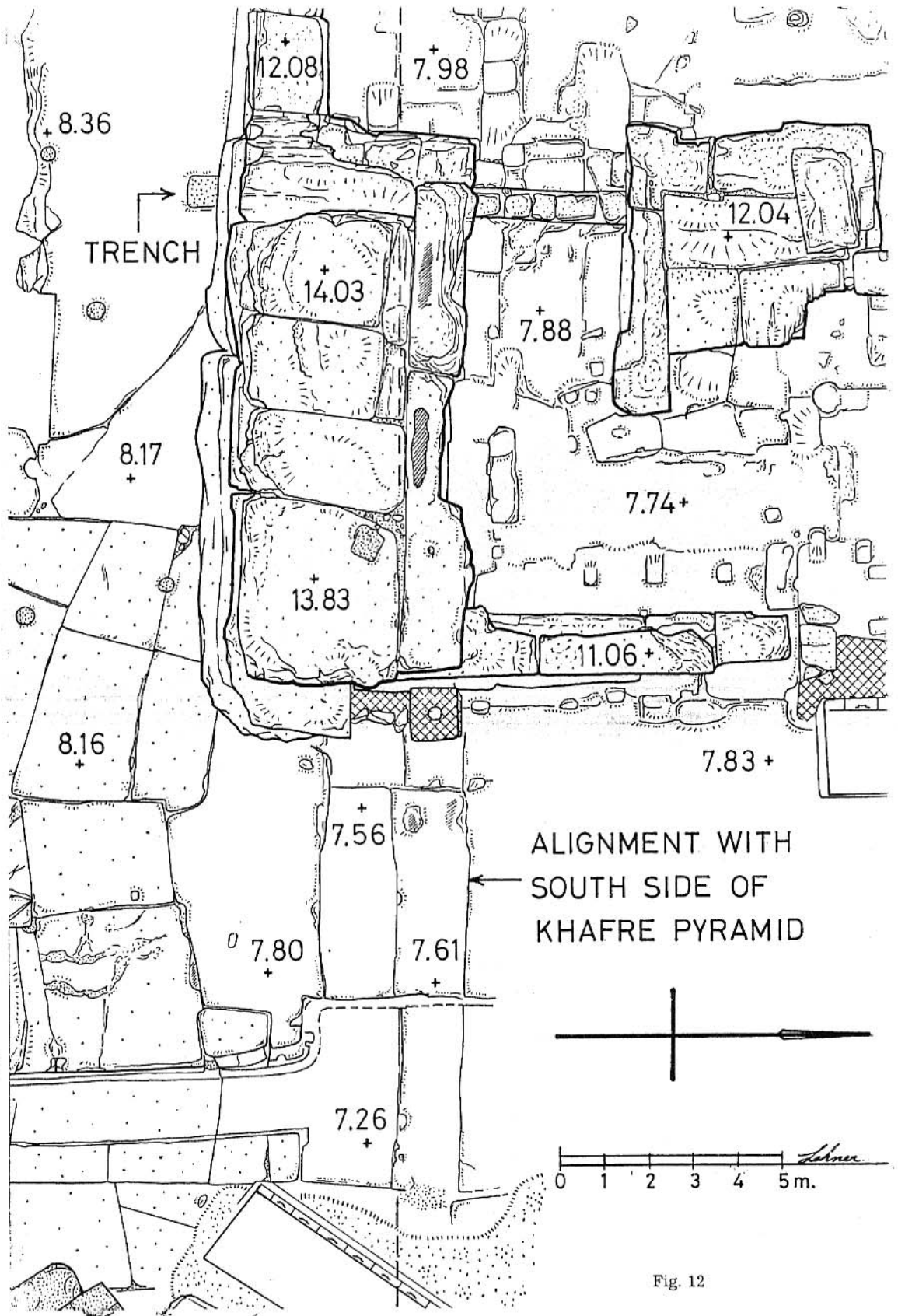


Fig. 12

mined on a level plane by means of traditional offset measures (Fig. 11). Again, these features were noted at the Khufu Pyramid by Maragioglio and Rinaldi<sup>32</sup> and, on the east side, by Goyon<sup>33</sup>, who surmised their function in the pyramid layout. A more complete description and an attempt to reconstruct the ancient survey is given elsewhere<sup>34</sup>.

### 2.3. Sphinx-Khafre Pyramid Alignment Markers

The features in the Khufu and Khafre Pyramid courts prompted a search for any possible survey markers which would indicate the alignment between the south sides of the Sphinx Temple and the Khafre Pyramid. The line of the south base of the pyramid, extended down the plateau, falls on a prominent seam running through the massive corework of the SW corner of the temple. Since the south wall of the Sphinx Temple is angled slightly SE-NW, this puts the line of the pyramid base at the inner side of the Temple wall at the SE corner, and on the north side of a rock-cut trench or socle just in front of this corner (Fig. 12). Ricke saw the trench as marking an enclosure wall for the Valley Temple. According to his reconstruction, this wall was removed when the Sphinx Temple was built<sup>35</sup>.

On the basis of the seam running through the corework of all four corners of the Sphinx Temple, Ricke concluded that this marked the outside of the walls of the temple in its first building phase<sup>36</sup>. The north and south colonnades of the temple (with the additional 12 pillars making up the total of 24 for the colonnades), were added after the interior of the temple had been largely finished with granite sheathing. For the addition, the middle part of the north and south walls were pushed back, and great limestone core blocks were added to the outside corners of the temple, which were never finished off. The alignment with the south side of the Khafre Pyramid, therefore, falls on the outside line of the original south wall of the Sphinx Temple at the SW corner in its first building phase.

A long and narrow trench runs just under the south wall of the Sphinx Temple, about 12 m west of its SE corner (Fig. 12). Ricke interpreted this as a drain which served the lower terrace before the erection of the Sphinx Temple<sup>37</sup>. However, it does not seem to lead to any point significant for this purpose, and its south end is cut vertically, rather than at a gradient which

one would expect if it was a drain. Could such trenches, like those at the corners of the Khafre Pyramid, have been used as «leads» for dropping down a control or reference point as bedrock is being quarried away at a place where an alignment was desired<sup>38</sup>? If the extremely long east-west alignment was indeed more than fortuitous, and if it was oriented to the east-west line of the equinoctial sunrise-sunset, it seemed reasonable to expect some kind of back-sight marker at the highest point of the formation to the west of the Khafre Pyramid. We located another rock-cut trench at this point, and apparently on line with the south side of the Khafre Pyramid (Fig. 13). Its exact position has yet to be mapped.

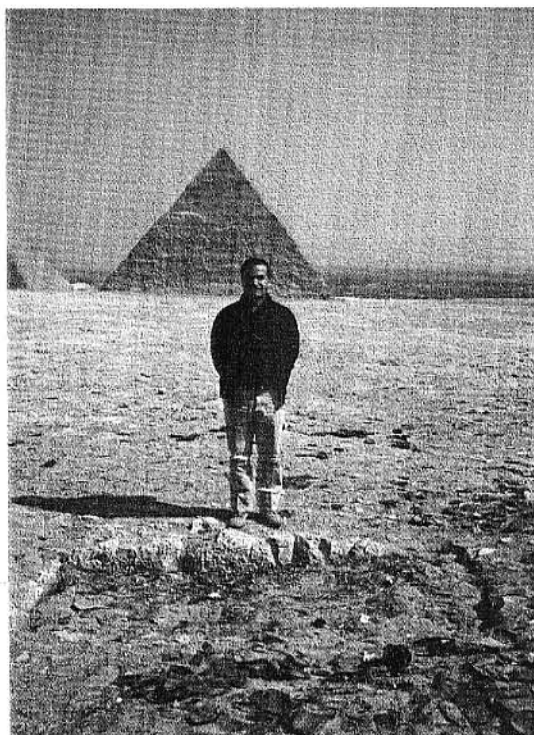


Fig. 13

### 3. Giza Plateau Mapping Project

In future seasons we would like to survey the Giza Plateau with the primary goal of producing a topo-

<sup>32</sup>) Maragioglio and Rinaldi, *L'Architettura IV: La Grande Piramide di Cheope* (Rapallo 1965), 66-7.

<sup>33</sup>) Goyon, «Quelques Observations», BIFAO 67, 73 n. 3.

<sup>34</sup>) M. Lehner, «Some Observations», JARCE 20 (in press).

<sup>35</sup>) Ricke, «Harmachistempel», BÄBA 10, 3-6, Abb. 2.

<sup>36</sup>) Ibid., 16-20.

<sup>37</sup>) Ibid., 15.

<sup>38</sup>) On the west side of the so-called «Trial Passages» north of Queen's Pyramid GI-a there is a long trench which appears to mark the axis of a pyramid superstructure intended for the passages, which model those in the Great Pyramid; see Petrie, *Pyramids and Temples of Gizeh* (London 1883), 15-16, Pl. II; Lehner, *Pyramid Tomb of Hetep-heres* (forthcoming); Maragioglio and Rinaldi, *La Grande Piramide di Cheope*, 70-1.

graphic map at scale 1 : 1,000. The photogrammetrically surveyed 1 : 5,000 maps of the Cairo area are a real boon for analyzing the Giza Pyramids plateau, but insufficient for certain kinds of interpretation. The map is seen as a tool for a functional, spatial, and ecological study of the building of the Giza Necropolis, in addition to its purely descriptive value. It will be possible to check for the accuracy of the apparent alignments mentioned here. Other general questions might also be resolved with good topographic data, geological study, and some common sense in a contextual approach to the Giza Pyramids site. The proposed topographic map of Giza would identify ancient and modern dumps, settlement debris, exposed bedrock, filled-in quarries, the secondary stone-rubble walls which district the necropolis, and any artificial features which may pertain to the ancient survey control networks.

It is surprising how much of the discussion about how the pyramids were built takes little consideration of the topographical circumstances of any given pyramid. One should look for certain basic items: a suitable (nearby?) quarry, the debris from the removal of the ramp, the staging area for workmen and supplies, the easiest access to the construction site. The ramp may have equalled two-thirds the volume of the pyramid<sup>39</sup> and the workers must have numbered in the thousands, if not the 100,000 mentioned by Herodotus. Archaeologically, it is not possible that they disappeared from the pyramid sites without a trace.

#### 4. Development of the Giza Necropolis

##### 4.1. Layout of the Khufu Pyramid Project

Looking at the Khufu Pyramid within its context, it is fairly certain that the main supply ramp did not ascend from the west, since there is no ancient quarry within reasonable distance in that direction<sup>40</sup> and, more pertinent, Khufu's court cemetery was under construction there during his reign, perhaps as early as his year 5<sup>41</sup>. Likewise, the supply ramp probably did not ascend to the pyramid from the east, since Khufu also began the Eastern Cemetery (G7000), perhaps as early as year 15<sup>42</sup>, when one would expect that the ramp would be servicing construction on the upper parts of the pyramid. There is no appreciable advantage to having the main ramp on the north. The escarpment is at its steepest there and no quarry occurs to the north<sup>43</sup>.

<sup>39</sup>) G. Haeny (personal communication).

<sup>40</sup>) There is a sizable quarry about 1.1 kilometers south of the Khufu Pyramid along the road to the Fayum. I am not sure of its date. Between it and the Pyramid lies the Western Cemetery, begun early in Khufu's reign.

<sup>41</sup>) Reisner, *Giza Necropolis I*, 83-4.

<sup>42</sup>) *Ibid.*, 72.

<sup>43</sup>) Reisner (*Ibid.*, 10-19) opened his voluminous study with a chapter on topography at Giza in which he attempted to point out the various quarries. He

Given these considerations, the only side of the Pyramid available for the major supply ramp is on the south. Geological trace analysis of the stone can offer important clues in determining the source of the stone. Meanwhile, going on the basis that a major part, if not all, of the core stone must have been quarried locally<sup>44</sup>,

maintained that the north and east faces of the cliff near the Khufu Pyramid have been quarried back. Although this needs more study, it appears to us that these rock faces were not much exploited for building stone, for the reason that this rock, forming the nummulite bank (Fig. 1) is not suitable for extracting building stone like that from Members II and III which are exposed along the south part of the formation. Except for those in the Central Field and SE of the Men-kau-re Pyramid, the several quarries Reisner identifies probably fed the construction of the mastaba cemeteries. Reisner did not correlate his typologies of cemetery features and their chronological order with the quarry and construction sequence which produced the pyramids. He identified differing qualities of limestone in the core constructions at Giza, but not in geological terms.

<sup>44</sup>) On this point we have to contend with the study of R. Klemm and D. Klemm, *Die Steine der Pharaonen* (Munich 1981), 12-20. According to the results, core stone for the Men-kau-re Pyramid derives from the quarries immediately to the SE of this pyramid. The agreement between the analysis and the Egyptological expectations is seen as a corroboration of their method, which gives somewhat unusual results for the Khufu Pyramid. The study indicates that core material for this pyramid is of heterogeneous origin, deriving from quarries ranging from the Cairo area to Assyut (stone from the Khafre Pyramid is traced to the quarries at Maasara). Stones are traced to quarries based upon chemical analysis for 21 elements. Correlation is graphed in triangular diagrams arraying the distribution of the samples according to the presence of three elements per graph. Each graph, therefore, arrays only one-seventh of the available information. Given the serious ramifications of quarries throughout the Nile Valley feeding the Khufu Pyramid project, some questions come to mind: Upon what basis were samples selected from various parts of a given pyramid or quarry? Were all the quarries at Giza sampled? From which geological layer in the quarries were the samples taken, in other words, with what degree of stratigraphic control was the sampling carried out? Would the chemical trace analysis of different geological layers in the Giza quarries show a greater or lesser match with the blocks of the pyramids or other quarries in Egypt? The claim of heterogeneous origins for the core stone of the Giza Pyramids (or only that of Khufu?) certainly deserves more investigation. Meanwhile, even if some core stone does derive from quarries on the east bank and in Upper Egypt, much of it must have been quarried locally at Giza, and the observations about the general layout of the work given here would not be seriously altered.

there should be some patterning to the cultural changes in the topography that would indicate the order of quarry and construction. Directly south of the Khufu Pyramid there is a large basin which was created by quarrying in the western part of the Central Field (Fig. 7). The east and west sides of the Khufu Pyramid, if extended to the south, align to the sides of this quarry (Fig. 8). Whereas the eastern part of the Central Field shows a labyrinth of tombs, very few are located in the western part. Those that are situated at the south edge of the basin date from the time of Khafre or later<sup>45</sup>. Nebemakhet (LG 86), Sekhemkare (LG 89), and Neuserre, children of Khafre, and Persephone (LG 88), wife of Khafre, made rock-cut tombs in the cliff formed by the west side of this quarry<sup>46</sup>. The reason there are not more tombs in the floor of this

lines of anciently dumped construction debris, in the form of chips of stone, are quite clear. The mound has been trenched, no doubt as a check for tombs, without revealing any further development of the cemetery.

One would expect this basin to have been the major quarry for the Khufu Pyramid<sup>47</sup>, and the debris to be the remains of the ramp. Having chosen the position for the pyramid, the builders took the most direct course, cutting stone out of the plateau along the south and transporting it up the slope of the rock formation to the north.

The southern part of the Giza Plateau is bounded by a great wadi formed because of the dip of the Mokattam Formation from the NW to the SE where it meets the base of the Maadi Formation (Figs. 1, 14). The wadi probably became, in Khufu's time, the main

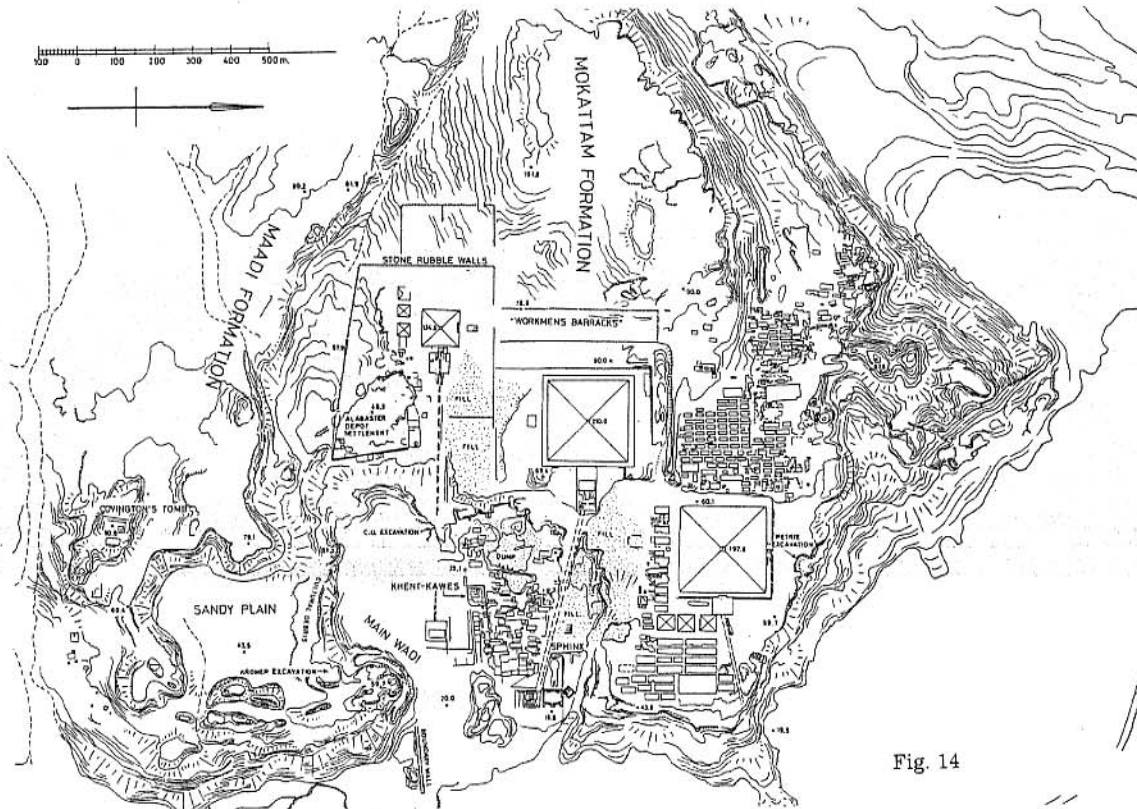


Fig. 14

basin is the great mound of debris found here (Figs. 7, 8). In sections where this has been cut through, tip

access to the construction site and the route for the introduction of nonlocal materials (alabaster, granite, Turah-quality limestone). Such an arrangement of-

<sup>45</sup>) Porter and Moss, *Bibliography* III. 1, 239-43.

<sup>46</sup>) *Ibid.*, 230-33. More toward the southern mouth of the basin, Babaf, another of Khafre's sons, has his mastaba tomb, see Hassan, *Excavations* VII, 7-11. The mastaba immediately to the west of Babaf's was considered by Hassan to belong to a «Daughter of Khephren, *ibid.*, 1-5. Closer to the Khent-kawes superstructure is the tomb of Yunre' who is called «Elders son of his body of Khephren . . .», Porter and Moss, *Bibliog-*

*raphy* III. 1, 243. Those claiming parentage of Khafre who built in this area seem to be circumventing the great dump in the location of their tombs.

<sup>47</sup>) I want to thank John Swanson, American University in Cairo, who first suggested the quarry and approach from the south during a visit to the site. I have benefited from many discussions with Dr. Swanson about the layout of the pyramids.

ferred several advantages. The access to the site was flanked on the immediate south by the high rocky outcrop of the Maadi Formation – the knoll which towers above the modern cemeteries south of the

of the pyramid at an angle of  $14^{\circ} 37' 30''$ . Dr. Gerhard Haeny offered some enlightening calculations which he has worked out. Most of the stone of the pyramids, hence most of the work, was at the lowest

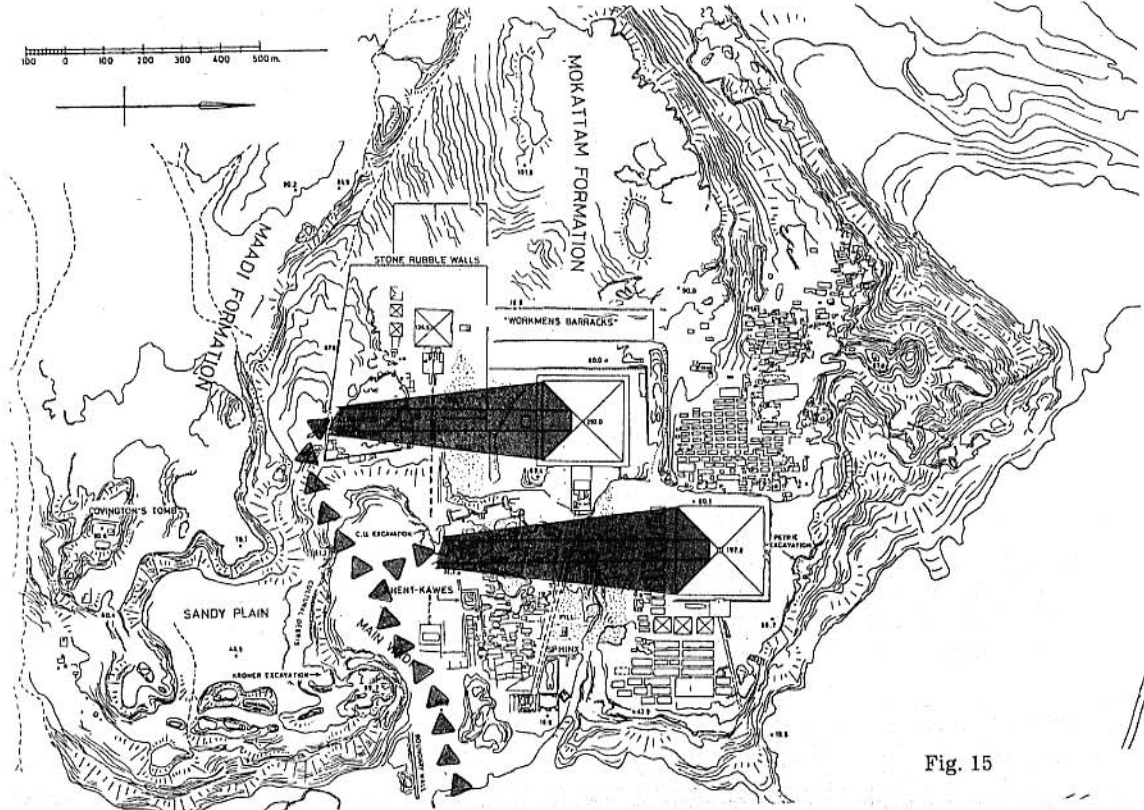


Fig. 15

Sphinx. This afforded a good point to oversee and regulate the flow of workmen and materials. The wadi led right to the foot of the great supply ramp during its final stages of servicing the pyramid project (Fig. 15)<sup>48</sup>.

Space here does not permit a thorough review and reevaluation of the many variations proposed for the main construction ramp. Whether the ramp sloped up to the higher parts of the pyramid as a straight access, or only to the lower or middle part of the pyramid from where it ascended as a series of ramps parallel to the pyramid faces, the main access must have been from the south. It should be pointed out that the 1 : 5,000 map of the area shows the top of the pyramid, as now preserved, to be 197.8 m above sea level, while the Central Field quarry floor has an elevation of 32.1 on its southern limit. From near the top of the pyramid to this point there is about 630 m, which would allow a ramp to slope from the quarry floor to the current top

levels. At one-sixth the pyramid's height, the pyramid contained 42% of its mass. At two-thirds its height, it contained 96% of its mass. Dr. Haeny estimated that the ramp would have to have been three times the length of the pyramid. From a point at about two thirds the height of Khufu's Pyramid to the south edge of the Central Field basin quarry there is a distance of about 635 m (a little less than the length of the pyramid times 3), and a difference in height of 119.8 m. This could be spanned by a ramp with a slope of  $10^{\circ} 41' 02''$ . The last one-third of the pyramid could have been built with a steeper ramp extension, or other means, since less bulk had to be transported<sup>49</sup>.

A great deal of stone has also been quarried from the area north of the Khafre causeway to cemetery GIS along the south side of the Great Pyramid. It is possible that the Khufu quarry began here during the initial stages. When the extracted stone would not have to be dragged up so steep a gradient, it could be

<sup>48</sup>) Something very close to this arrangement was visualized by B. T. Sporry and A. Tadema, *Pyramide en Faro* (Haarlem 1982), Fig. 8, although the artist's reconstruction is not quite to scale and the ramp looks steeper than would be functional.

<sup>49</sup>) See M. Isler, «Ancient Egyptian Methods of Raising Weights», *JARCE* 13 (1976), 34–7 for a proposal on how the Egyptians could have raised stone blocks to the higher parts of the pyramid using counterweights.



exploited nearer to the pyramid<sup>50</sup>. However, the Khafre causeway is founded upon a bridge of bedrock separating this quarry from the quarry in the west part of the Central Field. It seems unlikely that Khufu would have reserved this rock for his successor's causeway, and so the more northerly quarry may have been exploited by Khafre.

This area, south of the Khufu Pyramid and west of the Sphinx, is filled with the same kind of stone rubble debris as that which forms the great mound in the west part of the Central Field. When looking for the remains of the pyramid construction ramps, we should, perhaps, look no further than the patterning of such debris. One problem is whether this would be stable enough to form a ramp, even if shored up by forming walls of stone debris bonded with *tafl* mortar. It is often assumed that the ramp would have had some kind of balking or shoring of mudbrick. Archaeologically, there is a real problem with this view. Given the amount of mudbrick that would have been required, it seems inconceivable that the ramp could have been dismantled and all the mudbrick carted away without leaving a trace. In all the trenching and excavation at Giza, and in all the exposed deposits on the surface, there are no large grey or black stains that would signify the dumping site of the quantity of mudbrick necessary to shore up the ramps.

It appears as though, at the completion of the project, Khufu's workers disposed of enormous quantities of debris by filling in the great basins caused by their quarrying. From Petrie's observations<sup>51</sup> we also know that they dumped over the north edge of the plateau (Fig. 14). Petrie estimated that the debris dumped to the north and south of the pyramid was equal to more than half the bulk of the pyramid, that to the north was stratified and contained pottery, wood fragments, charcoal, and string of the workmen. The great dump of debris in the western part of the Central Field is probably one factor which prompted Khafre's children, wanting to be close to the pyramid of their father, to prepare rock-cut tombs in the western edge of the quarry. When Debehen had his tomb in this cliff personally commissioned by Men-kau-re, the king first ordered that the rubbish be cleared from the site<sup>52</sup>.

As for the question of whether the quarry offered enough stone to make up the bulk of the pyramid core, good topographic data will allow the original contours of the area to be approximately restored by interpola-

tion. The amount of stone extracted can be compared with the total volume of the pyramid core.

## 4.2. Layout and Development of the Khafre Pyramid Project

### 4.2.1. Pyramid

When it came time to build Khafre's Pyramid, the alignments with Khufu's Pyramid may have been consciously and carefully chosen as the layout lines were surveyed. At the same time, the design of the necropolis, from one complex to the next, was not so much a premediated pattern laid down from the very beginning of Khufu's reign, as an organic development in which some thematic considerations may have been accommodated to certain geological and topographical constraints.

One such constraint is that, given the general *dip* direction of the Mokkatam Formation from the NW to the SE (at about 6 degrees), the *strike* – any line perpendicular to the dip direction on which points will be roughly at the same elevation – runs roughly from the NE to the SW. This may be part of the reason for Khafre and Men-kau-re building on the great diagonal to Khufu's Pyramid. Even with the difference in size from the pyramid of Men-kau-re to that of Khafre, the desire seems to have been to found the bases of the pyramids at about the same level. As it developed, with Khafre cutting down about 10 m into the bedrock at the NW corner of his court, there is a difference in elevation of about 10 m from the base of Khufu to Khafre, while Khafre and Men-kau-re are at about the same elevation.

Khafre's team probably wanted to continue the same work patterns developed during the Khufu project. Since the time of the photograph of Fig. 7, more excavation to the south of Khafre's Pyramid and SE of Men-kau-re's Pyramid has indicated another large basin that looks to be the result of quarrying. Again, the west and east sides of the Khafre Pyramid align to the west and east limits of this basin (Fig. 8). Another reason that Khafre's Pyramid was situated to the SW of Khufu's was that Khafre had to avoid Khufu's quarry, now having been deeply exploited and utilized as a cemetery on its fringe. Khafre also had to get in line with a good patch of readily exploitable stone along the low southern edge of the Mokkatam Formation outcrop. As with the Khufu quarry, an additional advantage to exploiting stone here was the natural dip from south-southeast to north-northwest, which facilitated moving the major bulk of the material in the early stages of the project.

Again, in Khafre's working situation we find a great quantity of stone construction debris dumped in overlapping tip lines within the basin quarry, as well as to the north of the later Men-kau-re causeway. Both Men-kau-re and Khafre had to build up their causeways partially out of huge locally quarried stone blocks so as to bridge the quarries of their predecessors. In both cases the cemeteries developed in the quarries south of the causeways.

<sup>50</sup>) This, of course, is creating a deeper surface which would eventually have to be bridged by the supply ramp. The alternative is that stone was quarried from the far reaches of the ramp from the very beginning of the project. In this case the ramp would immediately cover exploitable stone en route to the pyramid. The workers had to manage with disadvantages either way.

<sup>51</sup>) Petrie, *Pyramids and Temples of Gizeh*, 85.

<sup>52</sup>) A. Badawy, «Philological Evidence About Methods of Construction in Ancient Egypt», *Annales du Service des Antiquités de l'Égypte*. LIV (1954), 53.

#### 4.2.2. Cult Layout and Valley Complex

Khafre had an additional opportunity in terms of exploitable bedrock and this may be part of the explanation for the development of the Sphinx and its associated temple. Since Khufu largely quarried directly to the south of his pyramid, there was left a triangular area of bedrock that was not so deeply worked on the east of his quarry. The hypotenuse of this triangle runs from the Khent-kawes tomb to the head of the Sphinx, and the base from Khent-kawes to the Khafre causeway on the north (Fig. 8). This takes in the eastern part of the Central Field, excavated from 1929 to 1937 by Salim Hassan for Cairo University<sup>53</sup>. On Hassan's final map, or on an aerial photograph (Fig. 7), this area shows as a tightly spaced, semi-organized cluster of mastaba-like tombs with intermediate intrusive tomb shafts. Yet, as opposed to the true mastaba fields west and east of Khufu's Pyramid, these «mastabas» were first and foremost huge rectangles of bedrock, defined by quarry channels which loosely gridded off the area to be quarried before the rock was deeply exploited.

During the geological survey of our 1981–82 season, we called these rectangles «quarry cubes», and we gave each one a number for easy reference to geological logs, samples, etc. The base of the tomb of Khent-kawes is the largest of these quarry cubes. One reason Khent-kawes aligns to the east side of Khufu's Pyramid is that this great cube of bedrock was on the easternmost fringe of the Khufu quarry. Yet, to some extent, as with the bedrock that became the Sphinx, the Khent-kawes cube looks to have been purposefully reserved.

Khafre had at his disposal an outcrop of unexploited bedrock at the SE corner of the formation. Only to this extent did his planners seize on an outcrop of rock for fashioning the Sphinx – rather the entire Sphinx and Valley complex. At the far eastern angle of this triangular outcrop, the position of the Sphinx, its terraces, and the alignment of its temple appear to have been carefully surveyed, and the rock for the Sphinx head and upper rim of the corebody carefully reserved. The suggestion is that the Sphinx, the Sphinx Temple, and the Khafre Valley Temple are situated where they are because 1. there was an outcrop of the thickly bedded Member II and Member III stone here which could be reserved for the Sphinx and exploited for the large core blocks for the temples, and 2. the shift to the south of the Khafre Pyramid axis allowed an alignment to the rising and setting of the sun at its due east and west positions – the Equinox. The former explanation presents the physical constraints – the «challenge of architecture», – while the latter hint at thematic functions of the Sphinx complex, namely an important advance in the solar cult under Khafre's reign. The ideological statement of the monuments may have been partially forethought, and partially *ad hoc* as the physical constraints were accommodated. It may, for

<sup>53</sup>) Hassan, *Excavations*, Vols I–IX (Cairo 1932–60).

example, have been seen that by locating the Sphinx and Valley complex at this point, the sun at its most northerly setting describes the *akhet* ideogram on the scale of acres. One wonders to what extent such dramatic configurations, perhaps somewhat fortuitous, themselves inspired and advanced the solar cult themes, rather than the reverse.

The eastern part of the Central Field was never as deeply quarried as the western part because Khafre's main quarry was due south of his pyramid. Hence the quarry cubes were preserved. Once the pyramid superstructure was nearing completion, work would have shifted to the cult layout – the Mortuary and Valley Temples, the Sphinx and its temple. The major axis of work now shifted to the east side of the pyramid. As Ricke pointed out, the Sphinx, these temples, and the numbers of hard-stone statues of the king, presented in themselves an enormous undertaking. It is to be noted that the quarry cubes in a crescent shaped area from the east edge of the Central Field to the south side of the Khafre causeway are, while apparent, more worked away than those closer to the Khent-kawes cube. Ricke thought that the multi-tonned blocks for Khafre's Mortuary Temple and Valley Temple derived from the quarry which fashioned the Sphinx<sup>54</sup>. The quarry cubes in the crescent shaped area were probably also exploited at this time for these temples. One can still see, within the Central Field, places where the channels which subdivide these cubes have isolated a block of about the size of those in Khafre's temples (Fig. 16).



Fig. 16

#### 4.3. Harbour for the Introduction of Non-local Material

The granite and Turah-quality limestone for the pyramid casing were brought up the main wadi and to the foot of the southern supply ramp, as had been the case with Khufu's project. The causeway itself would

<sup>54</sup>) Ricke, «Harmachistempel», BÄBA 10, 42 n. 56, excluded the idea that the blocks of the Sphinx Temple derive from the Sphinx cavity. This would upset his view that the Sphinx had been fashioned, and its lower terrace in use, before the Sphinx Temple had been decided upon.

only have served as an access route for the stone of the temples. By this time Khafre probably had the use of a deep rock-cut revetment forming a harbour or quay to the front of the Sphinx and Valley Temples. In 1980 Zahi Hawass conducted excavations 36 m east of the Sphinx Temple and hit the levelled bedrock (Member I) terrace under 3 m of deposit. A few months later the Institute of Underground Water of the Ministry of Irrigation did a core drilling 20 m further to the east and penetrated 16 m of deposit before hitting a hard surface<sup>55</sup>. Within this 20 m there might lie the kind of rock-cut revetment predicted by Butzer as fronting the mortuary complexes of the Old Kingdom. He pointed out that the depth of flood waters of less than 1.5 m would have been «insufficient for systematic navigation by heavily loaded barges, quite apart from the fact that the flood surge has a duration of only four to six weeks»<sup>56</sup>. As Goyon suggested<sup>57</sup>, the large wall built of monolithic blocks 320 m to the south of the Sphinx Temple may have served as the southern boundary of the harbour (Figs. 7, 15). This wall defines the southern limit of the mouth of the main wadi which had been the principle access route for non-local materials from the beginning of Khufu's complex. One would suppose that barges bearing granite blocks as heavy as those which roof the King's Chamber in Khufu's Pyramid would have docked at some point near the mouth of the wadi. The wall, therefore, may have already been built in Khufu's reign as the boundary of a revetted harbour. Since there is a gateway built into the wall, the water would not have lapped up against the wall, but might have filled a basin which began some decameters to the north. The wall would then mark the southern boundary of either the land or the water approach to the great construction site. Khafre may have extended the harbour northwards as a docking for the barges bringing the granite for his pyramid temples.

#### 4.4. Sphinx Precinct as a Khufu Quarry?

One different view of the quarry-construction sequence must be discussed in answer to the suggestion

<sup>55</sup>) Z. Hawass and M. Lehner, «Excavations in the Area of the Great Sphinx», unpublished manuscript, 20-4.

<sup>56</sup>) K. W. Butzer, *Early Hydraulic Civilization in Egypt* (Chicago 1976), 45-6.

<sup>57</sup>) G. Goyon, «Les ports des pyramides et le grand canal de Memphis, *Revue d'Égyptologie* 23, 137-53; *Le Secret des Bâtisseurs*, 26, Fig. 2; 136, Fig. 42; 137-9, Fig. 43. See, for the large wall, Reisner, *Giza Necropolis I*, 26; O. R. Rostem, «Bridges in Ancient Egypt; With a Report On A Newly Discovered Bridge From the Old Kingdom, Giza», *ASAE XLVIII* (1948), 161; Hassan, *Excavations IV*, 42, reported finding a pavement upon a bed of rubble in trenches dug at the south side of the wall; R. Stadelmann, «La Ville de Pyramide à l'Ancien Empire», *RdE* 33 (1981), 72 sees the wall as having been built in the reign of Khafre to delimit the necropolis on the south.

that the Sphinx may have been created before Khafre's reign by Djedfere<sup>58</sup>, or even Khufu<sup>59</sup>.

The Sphinx does show some alignments with elements of Khufu's layout. The NW-SE diagonal of Khufu's Pyramid aligns to the NE corner of the Sphinx Temple (Fig. 8). The front of the Sphinx Temple (and also the Khafre Valley Temple) is roughly on line with the eastern limit of the Eastern Cemetery, though this marks a later expansion of that field. The west edge of the Sphinx cavity aligns to street G7200 in the Eastern Cemetery, and to the large block of masonry laid in at the edge of the escarpment at the NE end of the great diagonal to which the SE corners of the three main pyramids are aligned (Fig. 8).

One advantage for Khufu to begin quarrying in the Sphinx area is that the direction of a supply ramp from here to his pyramid would have been even more on line with the dip direction of the limestone formation. This would facilitate moving the stone up a gradual slope to the worksite. This ramp would not have been perpendicular to the face of the pyramid, and therefore might best ascend the pyramid during construction by wrapping around the superstructure in some way (Fig. 17)<sup>60</sup>.

A basic problem with this view is that it leaves unresolved the pattern of quarrying at Giza. Someone had to be using the huge basin quarry directly south of the Khufu Pyramid. It is unlikely that this was exploited for Khafre's Pyramid. The ascent from the Central Field quarry to his Pyramid directly to the NW is simply too steep for efficient delivery of material. Khufu could have bifurcated his ramp and exploited stone for his pyramid from both the Central Field basin quarry and that in the Sphinx area (Fig. 17). However, there seems little reason for leaving the cubed eastern part of the Central Field unexploited.

Given the way in which the Sphinx and its temple are situated with respect to Khafre's Pyramid, the Sphinx was more than just an afterthought created from a chunk of bedrock left by Khufu's quarrymen<sup>61</sup>. Bedrock for the Sphinx looks to have been carefully reserved in a quarry cut especially to create it. If the alignment between the south side of the Khafre Pyramid and the Sphinx and its temple is intentional, it seems more likely that Khafre had the Sphinx aligned to his pyramid, rather than that he aligned his pyramid to an already sculpted Sphinx.

<sup>58</sup>) Goyon, *Le Secret des Bâtisseurs*, 108.

<sup>59</sup>) Stadelmann (personal communication and forthcoming).

<sup>60</sup>) It could be argued that cemeteries G4000 and G2100 were begun in the reign of Khufu (Reisner, *Giza Necropolis I*, 83-4) as far as 140 m west of the king's pyramid just so the ramp could pass between the cemetery and the pyramid as it made its ascent up the superstructure (Fig. 17). Later when the ramp was removed, the Cemetery en Echelon filled this space.

<sup>61</sup>) Reisner, *Giza Necropolis I*, 26.

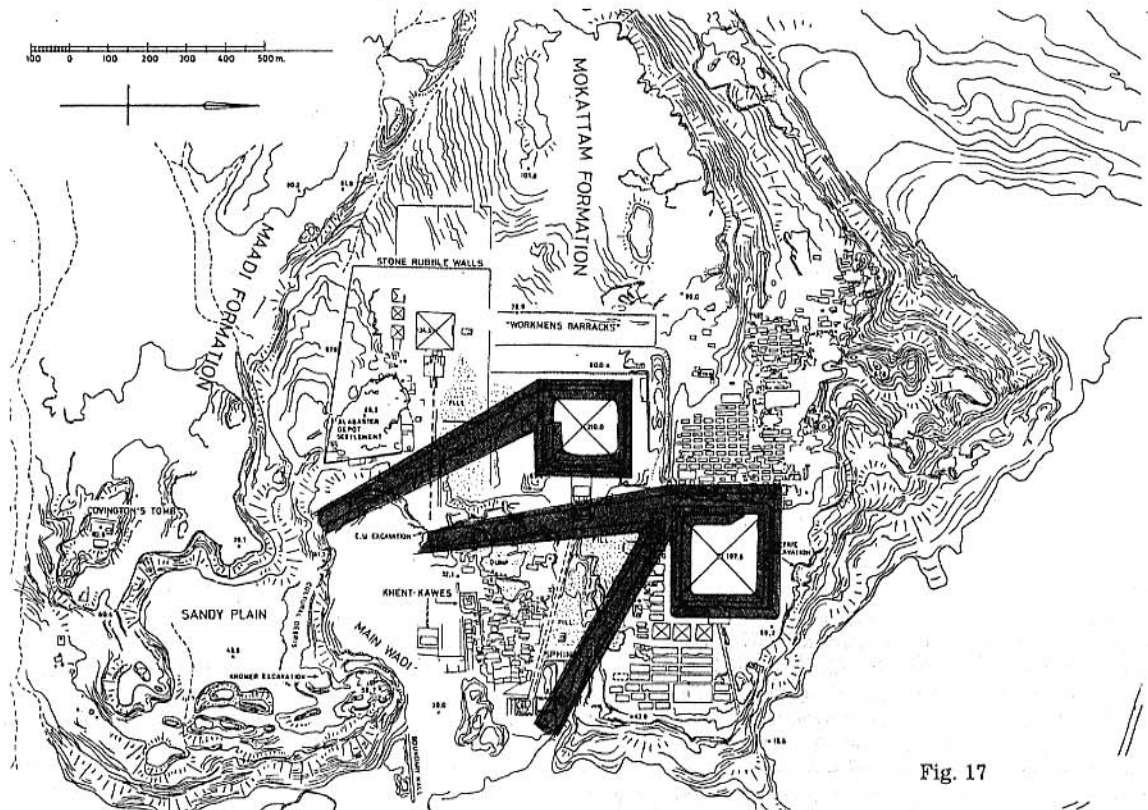


Fig. 17

#### 4.5. Men-kau-re Pyramid and Quarries

When Men-kau-re began his pyramid he continued the great NE-SW diagonal alignment. By now this diagonal was also parallel to the main quarries which extended from the Sphinx about one kilometer to the SW. It may be that continuing this line had a thematic imperative as well, for the fact that Men-kau-re's pyramid was situated with its SE corner on the great diagonal meant that this complex was right at the edge of the Khafre quarry and nearing the south-southwest limit of the Mokkatam exposure. Men-kau-re placed three subsidiary pyramids along the south side of his own pyramid. Although the western two of these subsidiary pyramids were left incomplete, all three must have been begun while work was yet in progress on the main pyramid, since it was also not completed.

Therefore, it appears as though the main access ramp for the Men-kau-re Pyramid must have been from the east, SE, much as Dows Dunham has reconstructed<sup>62</sup>. The Cairo University excavations have uncovered a striking portion of a terraced quarry at about the place where the cliff marking the west limit of the Khufu quarry runs under the path of the Men-kau-re causeway (Fig. 14)<sup>63</sup>. On the south side of the

line of the causeway it appears as though Men-kau-re's crews were extracting blocks for the pyramid, working along the fringes of the Khufu and Khafre quarries. In the quarry immediately southeast of, and below the Men-kau-re Mortuary Temple, there are to be seen wedge cuttings and removal channels delimiting blocks the size of the core blocks of the Mortuary Temple. Here, it was an extremely steep ascent from the quarry to the temple. These large blocks might have more easily been dragged down to the Valley Temple, which had only just been laid out with a first course of large blocks at the time stonework stopped on Men-kau-re's complex.

#### 5. The Settlement Archaeology of the Giza Pyramids

The work patterns so far construed may make more understandable and predictable the distribution of settlements and settlement debris at Giza, where we should expect great quantities of such deposits considering the number of men which must have been em-

cerinus Pyramid Complex», *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo*, 30, I (1974), 140 n. 9. This is far enough east from the Men-kau-re Pyramid so as to lessen the rise from the quarry to the work site. It is a very steep drop from the pyramid to the quarries directly SE of it.

<sup>62</sup>) D. Dunham, «Building an Egyptian Pyramid», *Archaeology* Vol. 9, No. 3 (1956), 159-65.

<sup>63</sup>) Abdel-Aziz Saleh, «Excavations Around My-

ployed on the Giza Pyramids at least four times the number of years Tell el-Amarna hosted Akhenaten's city.

### 5.1. Kromer Excavations

Kromer<sup>64</sup> excavated a large dump of settlement debris located just behind the salient outcrop of the Maadi Formation which rises as a knoll above the entrance to the main wadi (Fig. 14). The dump is some 30 m higher than the wadi floor and is situated on a slope of about 8 degrees toward the west-northwest. The cultural debris covers an area of 12.5 acres and was accumulated to a thickness of 6.5 m. Kromer hypothesized that a workmens' community which served the Khufu and Khafre complexes had to be razed for building Men-kau-re's complex. The debris was transported nearly a kilometer to be dumped on the slope overlooking the wadi. Although the excavations, conducted from 1971-75, are now largely sanded in, part of the lower section can still be seen to contain mud, mudbrick debris, quantities of sherd, ash, and bone. This kind of debris is capped at the east and south part of the section by a more sandy deposit of limestone chips, forming a very thick upper layer.

Butzer, in a critique of the excavations<sup>65</sup>, points out that there are at least five major stratigraphic units in the section as published, but not clearly identified, by Kromer. The lowest two of these are separated from the third by a major erosional break. Butzer pointed out that «by inference it would have been feasible to distinguish deposits from the base of a long-term site (or from a long abandoned settlement, as opposed to an active one) and to isolate true eolian sand, local sandy slope wash, and dumped sands»<sup>66</sup>. Butzer's impression is that «several settlements may well have been incorporated into the dump»<sup>67</sup>. Although the alluvial mud, and mudbrick debris represents a great quantity<sup>68</sup>, this cannot be enough to be the dump of mudbrick which formed the shoring of one of the pyramid construction ramps<sup>69</sup>. However, the limestone debris layer which capped the settlement debris might have been pushed back this far from one of the ramps.

### 5.2. Southern Plain: Workmens' Community?

To the west of this dump site, more artificially deposited debris can be seen on the gentle ridge which

slopes down to the wadi. Further south, the outcrop of the Maadi Formation describes a large circular ridge enclosing a sandy plain (Fig. 14). Covington's 3<sup>rd</sup> Dynasty mastaba tomb is on the southern rim of this bowl-like feature<sup>70</sup>. During his excavations of the area, Petrie probed the floor of this sandy plain and reported:

The whole surface is covered for many feet deep with broken stone chips from quarrying. As it is too remote to have been used as a ground for the waste from pyramid building – such waste being wanted to bank up the pyramid platforms, – the only solution seems to be that a bed of good stone existed here, which has all been quarried out for the pyramids, and only the quarry waste left on the ground. Yet a difficulty remains in there being many pieces of red granite, and some other stones, scattered about the west side of the rocky ridge, as if some costly building had existed in this region. No ground for such a building could be traced, although we looked over the whole area<sup>71</sup>.

That this sandy basin could have been enlarged and deepened by quarrying is something that should be checked in future excavation. Generally, where the strata of the Maadi Formation are exposed, as on the east, north, and west faces of the knoll towering above the main wadi, they appear too thin and laminated to have been useful for the extraction of large blocks, as opposed to the thick, more homogeneous beds of Members II and III in the Mokattam Formation. Still, it is apparent that some considerable cutting away of the knoll overlooking the wadi has occurred.

The layers of alluvial mudbrick, ash, pottery, and more organic inclusions excavated by Kromer were at least partially covered by a thick sandy limestone chip layer. More such settlement deposits might lie under the vast quantity of limestone chip debris which blankets the floor of the sandy plain and the slope down to the wadi. Such debris, like the mound in the Central Field basin quarry, is likely more of the remains of the pyramid supply ramps, pushed down and away from the pyramid at the completion of the project. It may have been pushed up onto the slope at the south side of the main wadi at the completion of the pyramid projects, so that this access route could remain open, until work stopped on the Men-kau-re complex.

Given these considerations, a working hypothesis is that most of the workers would have been temporarily settled along the slopes of the southern side of the main wadi, and back into the sandy plain, forming a community (perhaps of a revolving work force) enclosed, like the later workmens' villages<sup>72</sup>, by natural ridges. Kromer excavated into what may have been the

<sup>64</sup>) K. Kromer, «Siedlungsfunde aus dem frühen Alten Reich in Giseh», *Denkschriften, Österreichische Akademie der Wissenschaften, Philosophisch-historische Klasse* 136, 1–130.

<sup>65</sup>) K. W. Butzer, review of «Siedlungsfunde aus dem frühen Alten Reich in Giseh», *Journal of Near Eastern Studies*, Vol. 41, No. 2 (April 1982); *Archaeology as Human Ecology: Method and Theory for a Contextual Approach* (Cambridge 1982), 93–5.

<sup>66</sup>) *Ibid.*, 94.

<sup>67</sup>) *Ibid.*

<sup>68</sup>) Butzer, *JNES* 41: 2, points out that the bulk of the deposit cannot be determined given a lack of documentation.

<sup>69</sup>) Stadelmann, «La Ville de Pyramide», *RdE* 33, 68.

<sup>70</sup>) D. Covington, *ASAE* VI (1905), 193–218; Petrie, *Gizeh and Rifeh*, 7–8, Pl. vii.

<sup>71</sup>) *Ibid.*, 9.

<sup>72</sup>) See B. Bruyere, *Rapport sur les fouilles de Deir el-Medineh* (1934–35) III. *Le village, les décharges publiques, la station de repos du col de la vallée des rois*, FIFAO (Cairo 1939) in which the workmens' vil-

main trash disposal place, in the far corner of the basin, of the temporary settlement. The mudbrick debris may be from the remains of temporary dwellings for workers, and one would be tempted to see the major erosional break as the time the community may have been abandoned during the construction of Djedefere's Abu Roash pyramid, or the larger unfinished pyramid at Zawiyet el-Aryan<sup>73</sup>.

If they were located on the edges of the wadi and back on the sandy plain, the workers accommodations would not have been far from the termination of the great supply ramps, from which the workers must have descended at the end of each day. At the same time, these accommodations would have been out of the way of the main access through the wadi (Fig. 15).

### 5.3. Abdel Aziz Saleh Excavations: Industrial Installations

The cultural debris on the north rim of the sandy plain – stone chippings, granite fragments, sherds – extends to the west toward the industrial community excavated by Abdel-Aziz Saleh for Cairo University<sup>74</sup>. In a kind of open courtyard defined by stone-rubble walls and with stone-rubble buildings not unlike houses, there lie many large pieces of alabaster, some with red-painted quarry marks. From holes in the floor of the court it can be observed that this settlement was founded upon construction debris. From the standing sections of the CU excavations at the SE and SW parts of the settlement, it can be seen that it was at least partially buried by stone construction debris. The settlement was constructed out of construction debris.

This installation may be part of the work-force layout for one of the three main Giza Pyramids, as Abdel-Aziz Saleh suggested<sup>75</sup>. Alabaster was being worked for royal statues in the reigns of Khufu, Khafre, and

Men-kau-re<sup>76</sup>, and throughout the Old Kingdom at Giza for canopic jars. One would not expect canopic jars to have been manufactured this far from the later cemeteries<sup>77</sup>. The location of the settlement to the south of the necropolis is somewhat predictable if the mammoth construction ramps sloped down from the south faces of the Khufu and Khafre Pyramids, or from the east face in the case of Men-kau-re's Pyramid.

However, the settlement is a bit too close to the Khafre Pyramid for it to have been contemporary with its building, if the massive supply ramp sloped straight up to the higher levels of construction, as shown in Fig. 15. To get a functional slope to these levels, the ramp would necessarily have covered this industrial settlement. If the ramp ran only to the lower part of the pyramid from where it ascended in some other way, possibly winding around Khafre's pyramid, it might not have needed to extend so far to the south, and the settlement could be seen as contemporary with that project. A spiralling or zig-zagging ramp, ascending parallel to the faces of Khafre's Pyramid, would also allow the longer supply end to approach at an angle from the south-southeast (Fig. 17). In this case the industrial community would have been nicely located at the base of the ramp.

In short, the kind of ramp, as mammoth as it must have been, and given the flow of traffic for which it was the conduit, has a major bearing on the distribution of archaeological features. If a straight-on ramp was used by Khafre, this settlement likely dates to the construction on the Men-kau-re complex. This might be reinforced by the fact that the so-called «peribolus walls» of stone rubble which surround Men-kau-re's pyramid run slightly to the SE on the south side which is greatly extended to the east to take in the settlement, as though it was to be claimed for the district of the Third Pyramid.

Much more of the kind of emplacements found by Abdel-Aziz Saleh should be expected in the area about one kilometer to the south of the Great Pyramid. No matter how the ramps finally ascended the pyramids for the final stages of construction, it seems safe to conclude that the major part of the work force would have been settled, even if temporarily, in this area, away from the dust of the quarries and beside the main

lages of Deir el-Medineh, el-Amarna, and Illahun are compared. The workmen's village at Amarna is surrounded on three sides by steep hills which open to the southwest. An alignment of stones, perhaps a low wall, marked the boundary of the site on the southwest; B. J. Kemp, «Preliminary Report on the El-Amarna Survey, 1977», JEA 64 (1978), 24–6, Fig. 2.

<sup>73</sup> N. M. Swelim, *Some Problems on the History of the Third Dynasty* (Alexandria 1983), 125–75, has collected together all the references to the large Unfinished Pyramid at Zawiyet el-Aryan. If the unbuilt pyramid was to have measured 215 m to a side in an area 484 × 424 m, it would have been about the same size as the Khafre Pyramid, another factor favoring a 4<sup>th</sup> Dynasty date for the former; see Maragioglio and Rinaldi, *L'Architettura delle Piramidi Menfite VI: La Grande Fossa di Zawiet el-Aryan, la Piramide di Micerino, il Mastabat Faraun, la Tomba di Khentkaus* (Rapallo 1967), Tv. 2.

<sup>74</sup> Abdel-Aziz Saleh, «Excavations», MDAIK 30, I (1974), 132–54.

<sup>75</sup> *Ibid.*, 40.

<sup>76</sup> See Porter and Moss, *Bibliography* III. 1, 12, for fragments of alabaster statues of Khufu, pp. 21–5 for those of Khafre, pp. 27–31, 32–33, 35 for those of Men-kau-re.

<sup>77</sup> Reisner, *Mycerinus, The Temples of the Third Pyramid at Giza* (Cambridge, Mass. 1931), 45 noted that vessels common to Dynasties V and VI were already being manufactured in the Men-kau-re Valley Temple from fragments of the king's statues. Junker found places in the vicinity of the Khafre Mortuary Temple where stone implements and vases were being manufactured from broken statues of Khafre; Junker, *Giza, Grabungen auf dem Friedhof des Alten Reiches bei den Pyramiden von Giza X* (Vienna 1951), pp. 18, 41, 88, 99.

access to the site<sup>78</sup>. The remains of the industrial settlement suggest a variety of activities: alabaster working, baking, account keeping<sup>79</sup>, and perhaps pottery manufacture<sup>80</sup> – all essential for a pyramid work force.

## 6. Stone Rubble Walls and Pyramid Precincts

Toward the end of Abdel Aziz Saleh's excavations it was revealed that the arrangement of stone rubble walls, of which his industrial settlement is composed, continues up the slope to the south, then toward the west along the rim of the Maadi outcrop, and possibly toward the east to the edge of the sandy plain<sup>81</sup>. Here the walls are not so regular as those which enclose the pyramid precincts, although the construction is basically the same.

### 6.1. Men-kau-re Secondary Enclosure

The stone rubble walls, sometimes with the remains of mud plaster on the faces, describe huge rectangles around the three main pyramids (Fig. 14). To the west of Men-kau-re's Pyramid such walls describe a large additional enclosure, 240 × 160 ms, which seems to enclose little more than the natural desert rock and gravel surface. About 100 m from the SW corner of this enclosure, there is a wall which projects from the enclosure's west wall to the east for about 40 ms. This aligns with the east-west axis of the Men-kau-re Pyramid, and therefore with the axis of its cult layout and causeway.

### 6.2. «Workmens' Barracks»

The so-called «workmens' barracks» west of the Khafre Pyramid (Fig. 14) are also made of stone rub-

ble. These features appear to be composed more of desert surface rocks than construction debris. They are founded upon the unworked and exposed natural rock surface. There is no appreciable midden, or settlement dump, associated with these walls. Today, walking over the sand-filled surface of the walls, of which the patterns can faintly be traced, one can see pottery here and there, some dolerite fragments, but not a lot of obvious settlement debris in the way of ash, charcoal, bone, or fiber.

The «barracks» consist of long parallel comb-like rooms separated by walls about 1.3 m thick. There are about 73 rooms running east-west, and 18 running north-south. There may originally have been as many as 111 rooms. Those which run east-west measure about 2.69 m long by 3.17 m. wide. Petrie excavated some of these galleries and found the walls preserved to a height of 2.13 ms. It has been estimated that from 4,000 to 5,000 workmen could have been housed here<sup>82</sup>.

It is worth noting that the west wall of the «barracks» approximately lines up with the west side of the Men-kau-re Pyramid, although the «barracks» orientation is slightly off toward the NW.

One wonders which phase of the pyramid project would have employed these workers. If the great supply ramp sloped away 600 ms to the south of the Khafre Pyramid (Fig. 15), or to the SE (Fig. 17), the workmen would have had to walk nearly a kilometer just to get to the foot of the ramp. These barracks would have been well situated, on the other hand, when work had just begun on the Khafre Pyramid, before its base level had been cut down by about 10 ms along the west side, or, if the resulting corridor was filled with debris, when the pyramid was at its lowest levels of construction. The barracks, if that is what they are, could also have served in the construction of the Men-kau-re Pyramid. If ramps ascended the pyramid faces in some kind of pattern against the superstructure and parallel to it<sup>83</sup>, the distance of the barracks from the main quarry and termination of the supply ramp would not have been a problem in the case of either the Second or the Third Pyramids.

Maragioglio and Rinaldi report that pottery, fragments of dolerite and alabaster statues, and pieces of quartzite have been found associated with these galleries<sup>84</sup>. They suggest that the galleries are storage facilities for the cult items of the king<sup>85</sup>.

The kind of stones with which the walls are constructed, and the fact that to the east and west of the galleries there is only the natural desert surface showing, may suggest that they were built very early in the Khafre project. The absence of obvious settlement re-

<sup>78</sup>) Ibid., 132, Fig. 1, 147–48.

<sup>79</sup>) Maragioglio and Rinaldi, *Le Piramidi di Zedefrà e di Chefren*, 96.

<sup>80</sup>) Dunham, «Building an Egyptian Pyramid», *Archaeology* 9: 3, 159–65.

<sup>81</sup>) Maragioglio and Rinaldi, *Le Piramidi di Zedefrà e di Chefren*, 96.

<sup>82</sup>) Ibid., 132.

<sup>78</sup>) What had been the mouth of the main access to the construction projects was later filled with the so-called pyramid settlements of Men-kau-re and Khentkawes around the front, and later into the court, of the Men-kau-re Valley Temple. See Reisner, *Mycerinus*, 34–53; Hassan, *Excavations IV*, 53–62; and B. J. Kemp, «Old Kingdom, Middle Kingdom, and Second Intermediate Period c. 2686–1552 BC», *Ancient Egypt: A Social History* (Cambridge 1983), 92–4.

<sup>79</sup>) Abdel-Aziz Saleh, «Excavations», MDAIK 30, I, 141 interprets a large enclosure flanked by sets of storage pits at the northern end of the settlement as a «scribes hall».

<sup>80</sup>) Ibid., 135–6, 138, 141 where large barrel shaped ovens are described which are said to be for bread baking. Being barrel shaped, with an open top, and a lower front aperture, they are not dissimilar to ovens shown in tomb scenes for firing pottery. See Dorothea Arnold, «Wandbild und Scherbenbefund zur Töpfer-technik der alten Ägypter vom Beginn der pharaonischen Zeit bis zu den Hyksos», MDAIK 32 (1976), 5–7, Abb. 3–6. Moreover, the alluvial mud floor in structure H9 which contained a basin lined with mud, as well as the channels sloping away from under the south wall of this and the adjacent structure, may represent facilities for levigating clay for pottery (MDAIK 30, I, 145–6).

fuse, and the fact that the galleries are enclosed by walls on three sides, suggest that they may have been for storage of foodstuff for the work community, under protection and far removed from the workmens' community for security and administration of the commodities (a suggestion I owe to Barry Kemp).

### 6.3. Secondary Walls South of the Khafre Pyramid

The stone rubble wall forming the north side of the enclosure around the Men-kau-re Pyramid continues to the east to run parallel to the south face of the Khafre Pyramid (Fig. 14). Here it forms an elbow to attach to what must be an earlier stone rubble wall situated more to the north. Petrie suggested that the more northward wall was built at the completion of the Khafre complex, whereas the section to which it attaches by an elbow was built at the completion of the Men-kau-re complex<sup>86</sup>. Attached perpendicular to the section coming from the Men-kau-re enclosure there is a section of wall which runs to the south toward the Men-kau-re causeway for about 120 ms.

### 6.4 Stone Rubble Walls Near the Khufu Pyramid

The stone rubble walls also enclosed the Khufu Pyramid. Remains of such a wall can be seen retaining debris upon which the Cemetery en Echelon is partially founded west of Khufu's Pyramid. On the north side of this pyramid, toward the west end, a patch of stone rubble wall can be faintly discerned, though it is being progressively obliterated by tourist activity. The stone rubble wall which ran across the southern rim of the sealed boat pits of Khufu south of his pyramid<sup>87</sup> are part of this arrangement. In the section still remaining over the western boat pit the wall can be seen with embedded granite fragments.

SE of Khufu's Pyramid, and south of the three queens' pyramids, the modern road passes an excavation which exposed two parallel walls composed of stone rubble. These walls are built in sections, like those SE of the Men-kau-re Pyramid. Like the industrial settlement there, these walls rest upon, are composed of, and were buried by construction debris<sup>88</sup>.

### 6.5. Functions of the Stone Rubble Walls

Three possible explanations are offered for the system of stone rubble walls at Giza: 1. they were built mostly at the same time, upon completion of all three pyramid complexes, to zone the necropolis; 2. they were built to reserve an area around each pyramid, upon the completion of each, so that succeeding construction would not encroach upon the finished cult

precinct; 3. they were built as an initial stage in the construction of each pyramid to delimit the work area, in some cases to act as rough markers and backsights for the sides and axes of the pyramids, and in other cases as debris-filled embankments for the transport of materials.

The first explanation is probably to be discounted. The second and third may account for different parts of the system of stone rubble walls at Giza. Certainly the walls which ran over the southern Khufu boat pits are a final addition to this pyramid layout. In some cases the walls may have been related to the pyramid construction, after which they were connected to the walls which zone off each complex. Could the double walls SE of the Khufu Pyramid be part of the supply route from the quarry behind the Sphinx servicing the construction of the Eastern Field Mastabas?<sup>89</sup>

Again we might recall the absence of any obvious large deposits of alluvial mud or mudbrick on the plateau and suggest that the main supply ramps of the pyramids were also constructed of stone debris bonded into walls with *tafl* and/or gypsum mortar, built in sections, and retaining a more loosely dumped fill. When the ramps were dismantled, the bulk of the material was simply pushed down the slope to fill the great depressions created by the quarrying by which stone was extracted to be redeposited to the north in the form of the Giza Pyramids.

Mark Lehner

## Abusir

### *Beiträge zur Methodik der archäologischen Forschungen in Ägypten*

Eine der bedeutendsten, freilich ungleichmäßig durchforschten Epochen der ägyptischen Geschichte ist die Zeit des Alten Reiches. Gerade sie aber ist für die Untersuchung so wichtiger Fragen wie die der sozial-ökonomischen Entwicklung des alten Ägypten von außerordentlicher Bedeutung. Ein Zeitabschnitt, für den der Mangel an Primärquellen besonders stark spürbar war, ist die 5. Dynastie<sup>1</sup>. Die zentrale Begräbnisstätte für fast die Hälfte aller Herrscher der 5. Dynastie in Abusir wurde bereits zu Beginn dieses Jahrhunderts von den Expeditionen der Deutschen Orient-Gesellschaft durchforscht<sup>2</sup>. In die Untersuchungen

<sup>86</sup>) This was first suggested to me by Michael Jones; cf. Abdel-Aziz Saleh, «Excavations», MDAIK 30, I, 140 n. 8.

<sup>1</sup>) Dies betrifft vor allem den Anfang und die Mitte der 5. Dyn., s. W. S. Smith, *The Old Kingdom in Egypt and the Beginning of the First Intermediate Period*, in: CAH I/2<sup>3</sup> (1971), 179 f.; P. Kaplony, *Die Rollsiegel des Alten Reiches I* (MonAeg 2), 285 f.; u. a.

<sup>2</sup>) L. Borchardt, *Das Grabdenkmal des Königs Ne-user-re*<sup>c</sup> (WVDOG 7), Leipzig 1907; id., *Das Grabdenkmal des Königs Nefer-ir-ke3-re*<sup>c</sup> (WVDOG 11), Leipzig 1909; id., *Das Grabdenkmal des Königs S'a3hu-re*<sup>c</sup> I,

<sup>86</sup>) Petrie, *Pyramids and Temples of Gizeh*, 34.

<sup>87</sup>) A. M. Abubakr and A. Youssef, «The Funerary Boat of Khufu», BÄBA 12 (Festschrift Ricke), 1.

<sup>88</sup>) See Abdel-Aziz Saleh, «Excavations», MDAIK 30, I, 137.