



Giza As Is: Unfinished Business Reveals the Human Hand

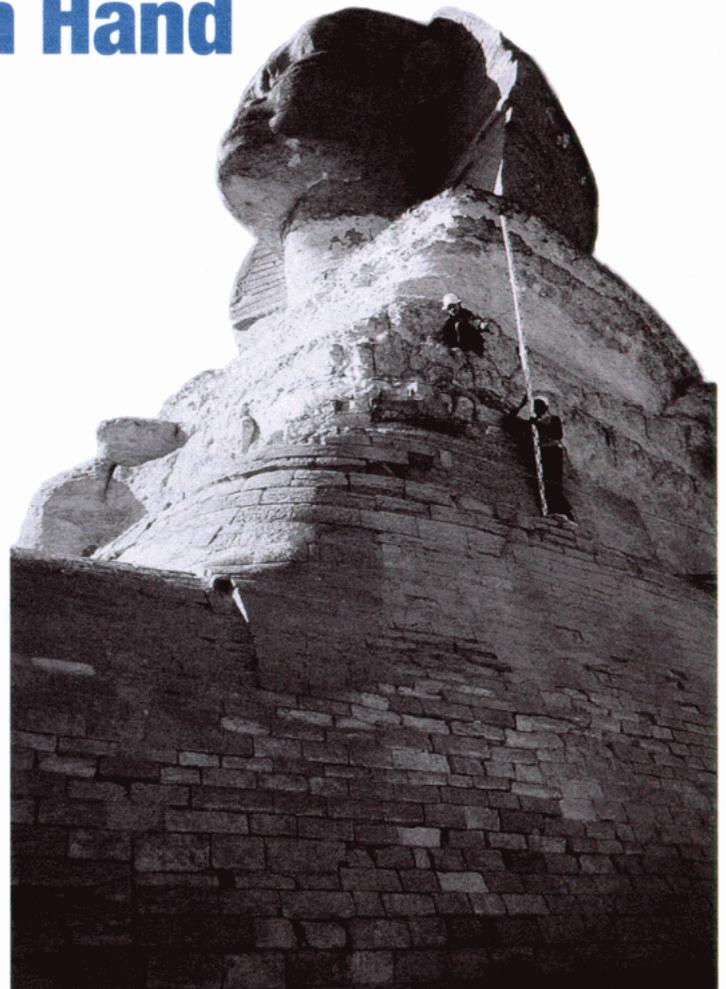
We have just finished our final field season of the two-and-a-half-year Millennium Project. By early summer we will have much to report. In the meantime, for this issue of **AERAGRAM** we would like to pause and look at other areas of the Giza Plateau—the wider context of the royal production facility that we have been excavating. It has been said that archaeological excavation should be shifted away from the big sites of stone monuments—Giza, Saqqara, and Luxor—to salvage settlement sites in the Delta and Oases. Ironically, this could have sites like Giza suffer reverse discrimination. It is just at these famous sites, so heavily trafficked by tourists and impinged upon by modern structures, that salvage archaeology to retrieve the soft tissue of ancient settlement is needed, be it clusters of workers' houses outside the royal tombs in the Valley of the Kings or pyramid towns along the base of the Saqqara plateau. For this component—the human structures of everyday life—is what is most missing and most endangered at the sites of famous monuments. Retrieving such “soft tissue” motivates our excavations at Giza.

Having said that, far be it for us to reverse discriminate against the big stone monuments. Our “Lost City” came into existence to create these stone structures. Careful observation of the monuments reveals as much about their humanity as our excavations of the site where the builders lived.

Continual Construction Project

We tend to look at the pyramids, temples, Sphinx, and tombs as static monuments, each built according to a template at one point in time. In fact, the Giza Plateau was a massive construction site, in a continual state of flux, throughout the 4th Dynasty and later. We see numerous alterations and renovation as well as unfinished work in many of the structures. Indeed the Giza Plateau abounded in unfinished projects through the 4th Dynasty.

This fact is troubling to the goal of “capturing” complete, ideal monuments. But that is not our goal. Instead our aim is to find the human hand in these activities—the processes, how people and resources were marshalled for this perpetual construction project. Unfinished work reveals this hand.



Mark Lehner maps points on the Sphinx's shoulder with the assistance of his long-time helper, Abd el-Qader, as part of the 1979-1983 Sphinx Project, sponsored by the American Research Center in Egypt.

Looking at Mortuary Temples, Pyramids, and the Sphinx

Menkaure's unfinished mortuary temple (page 6) has immediate relevance to our work since our production facility appears to have been heavily used during this pharaoh's reign. Unfinished work and design changes in midstream take to task the view that the Sphinx was built in Khufu's image (page 10). Similarly, careful observation of the fabric of pyramids (page 4) reveals how much our theories of how they were built depends on our mental templates instead of the ground truth reality. ▲▲▲

David Koch's Bedrock Support

New Yorker David Koch is used to big accomplishments. With his brother Charles he has worked relentlessly to develop the family business that he joined in 1970. In a little over 30 years, Wichita-based Koch Industries, a diversified energy conglomerate, grew 100-fold to become the second largest privately held corporation in the United States.

We like to think that David can count the growth of the Giza Plateau Mapping Project as one of his accomplishments. With his financial support and encouragement, our archaeological project at the Great Sphinx and the "Lost City of the Pyramids" was transformed from a one-man operation into a major excavation that is reshaping our understanding of Old Kingdom Egypt.

In the 1980s Mark Lehner was slowly and methodically mapping the Giza Plateau with periodic help from surveyor David Goodman of the California Highway Department. Although the work progressed slowly, Mark had big ambitions. He hoped to create a data base and computer model of the whole plateau, and carry out long-term excavations at the pyramid builders' settlement south of the pyramids complex.

This dream could have languished for years had it not been for a fateful meeting with David Koch in the fall of 1986, arranged by Bruce Ludwig, AERA board member and long-time supporter. When Mark laid out his goals, David encouraged him to create his "dream" project with all the excavators, specialists, and equipment he would need, and pledged to support a field season. At the time Mark had just started graduate school in Egyptology at Yale University and was bogged down in studies of ancient Egyptian history and language. Three years later he was finally ready for a field season that would take up David's challenge. In December and January 1988-'89 a full-fledged team of archaeologists, surveyors, and specialists dug the first excavation squares in the area south of the pyramids complex.

Since that first field season, David Koch has continually supported our efforts, funding excavations twice in 1991, again in



David Koch, Executive Vice President of Koch Industries, philanthropist, and stalwart supporter of the Giza Plateau Mapping Project since 1986.

1993, 1995, 1997, and 1998, as well as the Pyramids Radiocarbon Dating Project. When Ann Lurie offered a challenge grant to launch the Millennium Project in 1999, David provided substantial matching funds. And he has continued to help support each successive season of the project.

David Koch: Prairie Origins, Old World Values

David's father, Fred C. Koch, a brilliant chemical engineer, inventor, and entrepreneur, expected his sons to develop their talents and earn their own way. He set a stunning example. Armed with a degree in chemical engineering from Massachusetts Institute of Technology, he started a small engineering firm in 1925, went on to build and operate a major refinery near St. Louis, and eventually expanded the family business into other areas. Along the way he developed an improved method of thermal cracking, which increased the gasoline yield of refineries, and invented Flextray, a device that revolutionized distillation technology.

Following in his father's foot steps, David attended MIT. After earning BS and MS degrees in chemical engineering, he worked for several different firms in Boston and New York.

Carrying on the Family Legacy

After Fred Koch died in 1967, David and his three brothers inherited the company. In 1983 he and Charles bought out their brothers to gain control of Koch Industries. David joined a subsidiary of Koch Industries, the Koch Engineering company in New York, in 1970, and rose through the ranks. Today David heads the

Chemical Technology Group.

Since their father's death, the Koch brothers have shrewdly expanded the business from a refinery and petroleum concern into a conglomerate with interests in asphalt, natural gas, chemicals, plastics, and other ventures.

Philanthropist

Outside of his life as a businessman and engineer, David is best known as a philanthropist. He feels a strong moral responsibility to help others, inspired by his father's example. In an article in the Fall 1999 issue of *MIT Spectrum* by Elizabeth Karagianis, David explained, "I get a great deal of pleasure from giving away money to worthy causes." He would most like to be thought of as "a guy who does well by doing good."

Since 1982 David has provided around \$100 million in funding for a wide variety of organizations, causes, and projects. The nearly 100 recipients of the David H. Koch Foundation awards reflect David's broad range of interests—education, medicine, science, politics, public policy, the arts, and culture. In addition, he takes an active role in many of his causes, spending about one third of his time on philanthropic work. He serves on boards and advisory panels of 21 organizations.

Among David's major causes is education. Having derived so much benefit from MIT, he serves on its board and contributes generously. He helped fund the MIT Chemical Engineering Practice School and in 1999 pledged \$25 million for the MIT Cancer Research Institute. As a former captain of the MIT varsity basketball team and star athlete, David is an avid supporter of MIT sports. David also contributes to his alma mater Deerfield Academy and serves on its board. In addition, he has helped to fund a variety of programs for underprivileged youth, such as the National Foundation on Teaching Entrepreneurship.

Much of David's philanthropy focuses on biological and cancer research and on improving medical centers. He is a member of the board of trustees of New York

University Medical Center; Memorial Sloan-Kettering Cancer Center; CaP CURE Cancer Foundation; the Whitehead Institute, a biological research center affiliated with MIT; Rockefeller University; and the House Ear Institute; all of which he has helped to support financially. He has also contributed to the New York Presbyterian Hospital; the Manhattan Eye, Ear and Throat Hospital; the Johns Hopkins Medical Center; National Prostate Cancer Coalition; and Cold Springs Harbor Laboratory.

With his science and engineering background, David is intrigued with basic research and supports it generously. In addition to funding our work at Giza, he

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contributes to the American Museum of Natural History and Earthwatch Expeditions, as well as serving on the boards of these organizations. With a keen interest in human evolution, David has been a board member and major supporter of the Institute of Human Origins (IHO), an organization dedicated to the recovery and analysis of the fossil evidence for human evolution.

David's interests also extend to the arts and cultural institutions. Over many years he has been a steadfast supporter of the American Ballet Theatre. He is on the chairman's council of the Metropolitan Museum of Art and he has been a generous donor, helping to fund the conservation laboratory and a textiles exhibit. He has also given to the Library of Congress and the New York Public Library. For many years he has been an advocate for public television, serving on the board of WGBH in Boston and contributing regularly to its programs.

Free Market Values

Like his father, David Koch believes in the free market system, limited government, privatization, and individual liberties. In 1980 he ran for Vice President as the Libertarian candidate. Though no longer a politician, David still contributes to the debate about public policy. He supports a variety of public policy institutes and other organizations that promote the free enterprise system, such as the Aspen Institute, the Reason Foundation, the Institute for Humane Studies at George Mason University, and Citizens for a Sound Economy. Since 1980 he has been on the board of the Cato Institute in Washington and supports and advises it.

Consistent in his beliefs, David Koch gives many of his charitable contributions with few strings attached. Often donating to the "general fund," he allows recipients to decide how the monies will be spent, something that is unusual in the world of philanthropy.

A gregarious man with a large network of friends, David and his wife Julia are very active in New York's social life. With their young son and daughter, they live in a Manhattan landmark, the apartment formerly owned by Jacqueline Kennedy Onassis.

Success Requires Hard Work

David believes, "The key to success is hard work. Success requires dedicated work ...not just a brief spurt. It's a continuous way of life, day after day, week after week, year after year" (*MIT Spectrum* article by Elizabeth Karagianis cited above). David's dedicated work has certainly paid off with his major accomplishments in business and philanthropy.

We are very thankful that he decided to put his philosophy to work on the Giza Plateau Mapping Project. His persistent support and encouragement year after year has helped us uncover an enormous ancient city of the pyramids of vital importance to the human career. We are most grateful for his help and inspiration.

The Fabric of a Pyramid: Ground Truth

Ground truth, I was once told, is a NASA term for what we observe on the ground on the Earth, Moon, or Mars, as opposed to our images from afar. A careful study of ground truth can often wither distant images. A careful look at what is on the ground at Giza can shatter our images—received, assumed, inherited mental templates—about the pyramids. Let me give one example.

Ten years ago, after I had been walking the Giza Plateau for almost twenty years, I sat in a tent behind the elegant Mena House Hotel with Michael Barnes and Julia Cort, producers of “This Old Pyramid,” the WGBH NOVA film about pyramid building. The idea was to test ancient tools, techniques, and operations that might have gone into building the Giza Pyramids. Roger Hopkins, a stone mason from Sudbury, Massachusetts, was over-seeing the building of a small pyramid with limestone blocks the size of some of those in the Great Pyramid.

It was time for Roger to lay in the second course of blocks of the internal step pyramid. He was unabashedly setting the blocks by steel cable hung from the teeth of a powerful front loader. (We knew we could not replicate ancient pyramid building 100% but we wanted to test ideas about techniques used in the higher courses). How wide should Roger make the step? We were going on a mental template—widely assumed by pyramid theorists—of regular stepped courses of stone from top to bottom. We turned to the reference books at hand for some figures on pyramid steps. Then it hit me: why look in the books? The real thing is right there. I pointed through the opening of the tent to the real Great Pyramid looming up on the plateau. Tape measures in hand, we headed to ground truth, bedrock reality.

Bedrock Reality

Now everyone sees what looks like regular steps on the Giza Pyramids, the core or

packing blocks—called “packing” because they once filled the space between pyramid core and outer casing. These remain after the smooth outer casing was removed in the Middle Ages. But when we measured, it turned out that the steps were not regular! Here was a step more than a meter wide, over there almost nothing! The idea of regular steps was just that—an idea, a mental template, and no more. It was a mental template that I had held on to during twenty years of passing by and clambering up and down these towering masses of stone.

Considering the keen interest in pyramid building and the legion of theories about technique, it is remarkable that very little has been written about the actual fabric of the pyramid body. Most theorists simply assume the pyramids are composed of regular, modular, squared blocks of stone neatly stacked. This mental template obscures more than it represents the physical reality of the pyramid. Bedrock reality is always more complicated.

Great Pyramid “Slop Factor”

While the size of the Great Pyramid is indeed astounding, it is still a very human monument, not the product of industrial-age uniformity and precision. It contains an estimated 2,300,000 blocks of stone, often said to weigh on average about 2.5 tons each. But this does not mean that all or even most of the stones weigh 2.5 tons. The “average” leads to an image of uniformly squared, well-fitted blocks. Yet anyone who looks carefully at the pyramid can see that this is far from true, as the NOVA team and I discovered. The outermost packing stones are not only irregular but are also progressively smaller toward the top. Behind them the core stones are even more irregular.

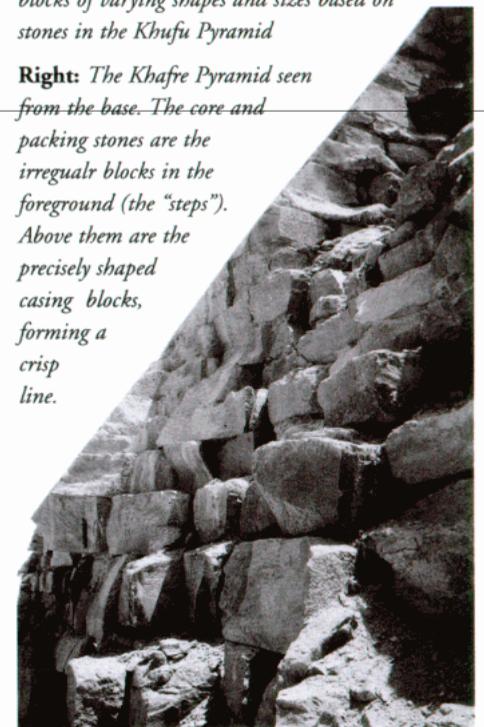
During the 1830s Howard Vyse gouged a hole in the center of the south side of Khufu’s pyramid while looking for another entrance. In this wound we can see how

the builders dumped great globs of mortar and stone rubble in wide spaces between the stones. There are big blocks, small chunks of rock, wedge-shaped pieces, oval and trapezoidal pieces, as well as smaller stone fragments jammed into spaces as wide as 22 centimeters between larger blocks (photo on the facing page). We might use an American auto mechanic’s expression to say the core masonry has a very large “slop factor.”

Why was the core stone so irregular? It was only fill for the gleaming shell. It was in this outer casing that the builders achieved the great precision in the pyramids that has fueled so much modern speculation and awe. From the very few casing stones that remain at the base, we can see with what skill and care the builders placed them to form the foot of the pyramid. Joints between large casing blocks, some weighing as much as 15 tons, are often so fine one cannot even insert a razor blade, and these fine seams sometimes run back from the outer face more than a meter. But the casing stones themselves were probably

Across both pages: *Outline drawings of core blocks of varying shapes and sizes based on stones in the Khufu Pyramid*

Right: *The Khafre Pyramid seen from the base. The core and packing stones are the irregular blocks in the foreground (the “steps”). Above them are the precisely shaped casing blocks, forming a crisp line.*



not uniform in size from top to bottom, as we can see in the Khafre Pyramid where the uppermost casing remains like the frosting on a snow cone.

Casing in the Khafre Pyramid

I measured the thickness of these casing courses where I could reach them on the overhang of the northeast corner of Khafre's Pyramid. From lower to upper they are: 82, 67, 35, 45, 66, 44, and 45 centimeters thick. The blocks are not modular! Looking out across the expanse of casing, I also noted that the slabs are not flush, but stagger by a few millimeters. Had they been trimmed in place we would expect the faces to be flush. Perhaps the slope was cut into the blocks before they were laid, or perhaps the stones shifted after the casing farther down was removed.

The packing blocks that served as fill between Khafre's core and casing were not regular either. I was able to measure some of these slabs, immediately below the extant casing at the top of the northeast corner, and found that they range from 38 to 67 centimeters thick, probably a match to the thickness of the missing casing.

Nor is the square of Khafre's pyramid perfect. In 1881, Sir Flinders Petrie determined the square of the pyramid base by extrapolating the corners from the casing socle, the bedding of the lowest course. He checked the angles of the casing preserved at the top of the pyramid in relation to the square of the base by triangulation with his theodolite. His measurements indicate a slight twist to the pyramid of 3° 50'. The builders had to *bend* the corner angles slightly to make them meet at the apex! Pyramid building was not an exact science; much of it was ad hoc.

Core Stone in the Khafre Pyramid

At the base of Khafre's pyramid we see other evidence of ad hoc building. Here the coursing of the core stones are not all horizontal. The builders tailored blocks to fit the sloping bedrock that they left protruding in the core as they leveled the surrounding court and terrace. In the north-

east and southeast corners, where the downward slope of the plateau left no bedrock in the core, the builders used enormous limestone blocks, two courses thick, to level the perimeter.

Above the base, the pyramid core is made up of very rough, irregular stones. Covering more than the lower third of the pyramid, this rubble layer could be packing between core and casing, left after the casing stones were ripped away. On the other hand, the upper third of the pyramid core appears to be stone blocks in regular stepped courses. But on closer inspection even these blocks turn out to be far from uniform. I measured the widths and heights of each course from the casing down to the rubble zone on the northeast corner and they showed considerable variation. A sample of block heights ranged from 90 to 1.20 meters and the widths of the steps varied from 23 centimeters to a meter!

Loose, Lumpy Interior

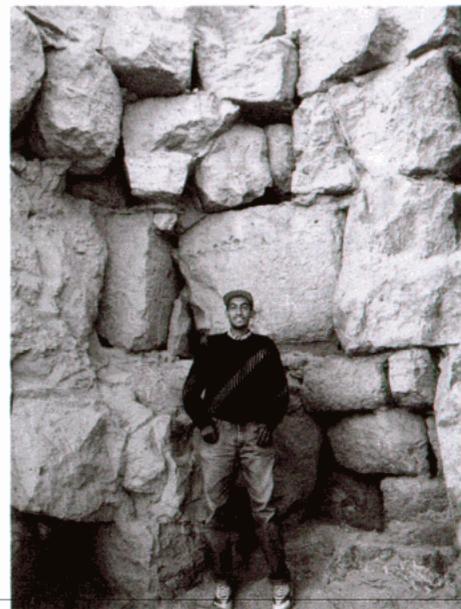
Like Khufu's pyramid, Khafre's core is composed of loose, irregular fill. Through seams and gaps in the stepped core blocks, limestone chips and rubble are visible. In 1818 when Giovanni Belzoni cleared out a robbers' tunnel that had been forced through the center of the north side of the pyramid, he found that the fabric of the pyramid kept collapsing. "This was due without doubt to the incompactness of the internal masonry and the lack of mortar, so that the blocks are not always in contact at the sides, and cannot mutually support each other," according to Vito Maragioglio and Celeste Rinaldi who carried out an architecture survey of the pyramids between 1963 and 1975.*

Implications for Pyramid Building

Most theorists—both professional and amateur—assume that the pyramids are composed of generic two-and-a-half-ton blocks. They then set about theorizing how the builders got these blocks up and in place, ignoring the "slop factor" evident throughout the pyramids except in the fine

casing. Some ground truth is in order for these theorists.

The fact that the bulk of the pyramid is not modular squared blocks laid in regular courses has enormous implications for how we should be looking at ancient Egyptian pyramid building. If the blocks are not of modular sizes, the tools for hauling, such as



Ashraf Abd al-Aziz stands in the gash made by Howard Vyse in the south face of the Khufu Pyramid during his 1836-38 explorations.

wooden sledges or cradles, could not be standardized. It is hard to imagine the builders using levers, fulcrums, and cribbage supports for "blocks" that are not square but trapezoidal or oval or irregular. Given that much of the fill is rubble, it is far more likely that ramps and embankments, rather than fulcrums and levers, were used for lifting material. We even have to wonder if the builders sometimes used the same stony stuff for both ramps and pyramid fill.

Pyramid construction was far less regular and standardized than our mental templates have led us to believe or allowed us to see. If we want to understand the pyramids and other construction at Giza we have to shed our received models and look to the ground truth. ~ Mark Lehner

* V. Maragioglio and C. Rinaldi, *L'Architettura delle Piramidi Menfite*, Parte V, p. 52. Rapallo: 1966.

A Tale of Two Towns: Menkaure, Kentkawes, and the “Lost City of the Pyramids”

When George Reisner excavated Menkaure’s pyramid and temples between 1906 and 1910 he found a complete archaeological profile of the life of this complex from its construction to its abandonment. One of his findings, that Menkaure’s builders never finished the pharaoh’s pyramid complex, is of particular importance to our excavations.

Life and Death of a Pyramid Complex

Menkaure’s pyramid, the last of the three Giza monuments, is considerably smaller than his predecessors’. But his temple complex was to have been a grand affair. Reisner found that his builders began with the same confidence as when they had worked for Khafre and “planned a stone temple of grandiose proportions” (diagram on the right). But it was never completed. In the upper temple (the mortuary temple, located in front of the pyramid) the workmen had laid out the core walls in colossal limestone blocks. In the Valley Temple they had laid giant blocks for a foundation platform and completed portions of the northern and western walls. Then the construction stopped abruptly, presumably because Menkaure died.

Menkaure’s successor and son, Shepseskaf, resumed work but abandoned the giant core block construction and finished the temples in plastered mud brick. On a stela he decreed: “He made it as a monument for his father, the King of Upper and Lower Egypt, [Menkaure].” Reisner found the stela in fragments near the entrance to the upper temple.

Khentkawes: The Mysterious Queen

Toward the end of the 4th Dynasty a queen named Khentkawes, about whom we know very little, built a large mastaba-like tomb and pyramid town just north-

west of Menkaure’s Valley Temple (map on page 8).

Soon after, the royal house moved away from Giza and Shepseskaf went to South Saqqara to build his own funerary monument. But the Giza Plateau was not totally abandoned.

Against the front of Menkaure’s Valley Temple a warren of mud brick houses, bins, and small round granaries sprang up (map on facing page). The inhabitants ostensibly carried on rituals for the dead king and were probably rewarded with an exemption from taxes in goods and labor. (See “Sacred Slum” on the facing page.)

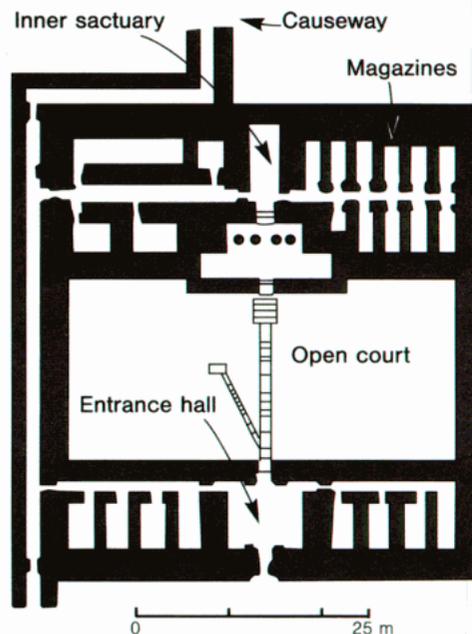
Menkaure, Later Kings, Our Excavations

It is likely that while Menkaure’s temple construction was underway, our royal production complex and workers’ town was in its heyday. Smoke curled from dozens of bakeries turning out the big conical loaves of heavy bread that sustained these very workers, or their contemporaries.

Colleagues have asked: How do we know? How do we know this complex supported workers during pyramid and monument construction? Isn’t it possible that the complex furnished offerings for the temples *following* construction over the many years that daily services were carried on in these institutions?

It could well be that our production complex sent goods for cult services that were underway during Menkaure’s and perhaps Shepseskaf’s reign. But any role it played in provisioning those services would have ceased by the end of the 4th Dynasty.

We can confidently say after ten years of digging in this complex that all of our material culture, particularly the ceramics, date to the middle to late 4th Dynasty. Styles of material culture changed inexorably 4,600 years ago, just as they do



Ideal: The first phase of Menkaure’s Valley Temple, which was begun in stone but completed in mud brick by Pharaoh Shepseskaf, Menkaure’s son.

today, so that periods can be readily distinguished. After several seasons at Giza, our ceramicist, Anna Wodzinska, has seen little or no 5th Dynasty or later pottery among our finds.

Perhaps the most compelling indicators of 4th Dynasty occupation are the inscribed mud sealings that we have recovered throughout the excavations. These little bits of especially hard mud derive from the seals on bags, boxes, string locks of doors, and pottery vessels. Rolled with an incised cylinder when wet, they bear hieroglyphs giving the names of institutions, officials, kings, and possibly personal names. We have many bags of sealing material in our store yet to check for inscriptions, but thus far, of the 589 sealing fragments with incised or impressed designs that we have registered, 61 have royal names. All but 10 of these bear Menkaure’s name and none have later pharaohs’ names—not even Shepseskaf’s. Since Reisner found sealings of several later Old Kingdom pharaohs in Menkaure’s Mortuary Temple, we might expect them on our site if it had remained in service long after the 4th Dynasty.

Continued on page 8

Sacred Slum: Life and Death of a Pyramid Town

George Reisner, digging in 1906-1910, and Selim Hassan in 1932, found a small town fronting on the Menkaure Valley Temple. Egyptologists have long known of "pyramid towns" from texts on tombs and stelae. Tombs at Giza record the titles of mayors and overseers of the pyramid towns of Khufu and Khafre. On a stela found at Dahshur, Pepi I, a 6th Dynasty pharaoh, decrees that the inhabitants of the pyramid town of 4th Dynasty pharaoh Sneferu (builder of the Bent and North Pyramids of Dahshur) and their wells, trees, and canals were exempt from taxes.

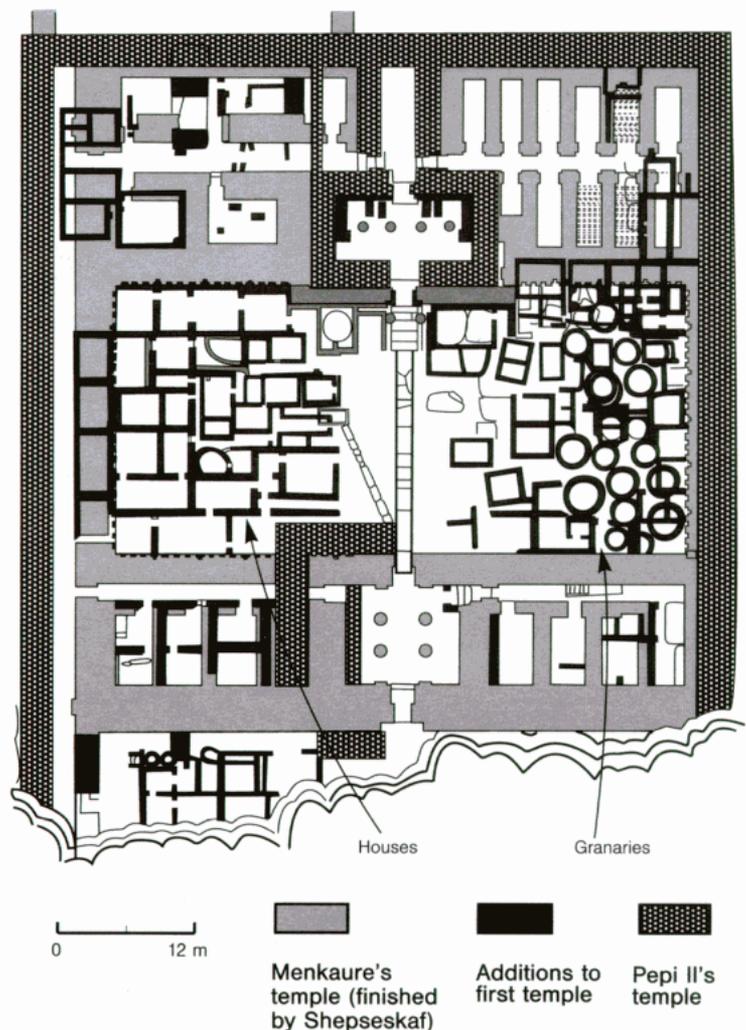
After Menkaure died, the inhabitants of his pyramid town were also exempted from taxes, so long as they served the cult in memory of the dead king. Their town in front of the temple was comprised of small mud brick houses and round silo granaries. During the life of the temple, as the pyramid town continued to grow, its wattle, daub, and mud brick huts and bins spread up over the eastern temple wall and into the court. To keep the settlement at bay, a thick screen wall was built across the open portico on the western side of the court. A doorway at the top of the limestone ramp gave access to the inner sanctuary. Four alabaster statues of Menkaure flanked the door to the offering hall—the *raison d'être* of the town.

As the town invaded the temple, the driving force may have been tax relief rather than piety. Indeed, one has to wonder about how devout these "priests" were considering the condition of the temple and the deceased king's images. The famous triad and the dyad statues of Menkaure, some of the most renowned pieces in art history, were stacked on the dirty floors of back magazines, a far cry from their current homes in elegant track-lit modern museums of the world's great cities! Already in the first phase of the temple's use, the residents were smashing some of Menkaure's statues to make funerary vases for those who still chose to be buried in the Giza necropolis.

At some point during the 6th Dynasty, probably before the reign of Pepi II, the temple was badly damaged by a flash flood running down the desert plateau after a downpour. The flood washed away the western end of Menkaure's offering room and pooled in the court.

Rebirth of a Pyramid Town

Sometime around the middle of his reign, Pepi II, the last king of Dynasty 6, renewed Menkaure's cult and rebuilt his valley temple. Reisner found a decree of Pepi II in the vestibule exempting the inhabitants from taxes. Originally displayed near the entrance, it declared that "in the pyramid town of the King of Upper and Lower Egypt, Menkaure-is-divine...My Majesty (Pepi II) commands the protection of this pyramid town." The king granted privileges and exemptions to the "priests" of the pyramid city.



Real: The valley temple, as Reisner found it. The granaries and tiny houses invaded the temple after Menkaure's death and again after Pepi II rebuilt the temple during the 12th Dynasty.

A rectangular thick-walled anteroom replaced the recessed portico in front of the sanctuary. On the trodden dirt floor of the offering room Reisner found a simple bench of water-worn alabaster slabs where the townsfolk must have left the deceased king his token sustenance. The small mud huts, storage bins, and grain silos of the renewed pyramid town again filled the open court of the Valley Temple. Meanwhile the denizens maintained the cult of the king in a dark closet-sized sanctuary at the rear of the Valley Temple, and in the upper Mortuary Temple. In its second phase the Valley Temple was really nothing more than the sanctuary (anteroom and offering room), and the enclosing walls of this warren of small rooms and granaries. All but the very core of the original temple was choked and buried by the very town that existed to service it.

A Tale of Two Towns *Continued from page 6*

In sum, all the archaeological evidence—seal impressions, ceramics, other artifacts—indicates that our site was in its penultimate phase in the reign of Menkaure and that it went out of use soon afterwards, probably after work on his pyramid ceased.

Final Days

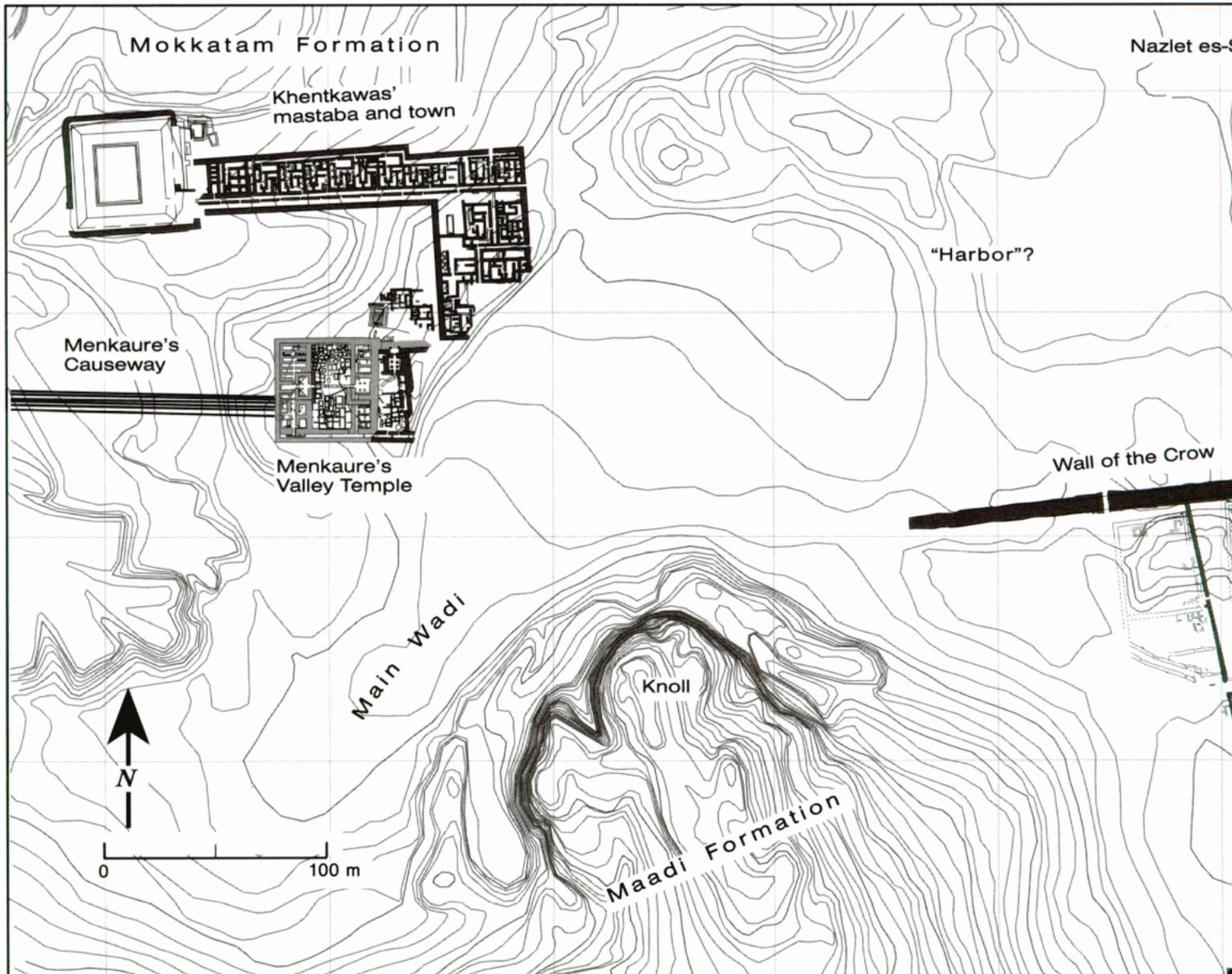
We see signs that during the site's final phase people were still occupying it after the gallery complex had begun to fall into ruin, perhaps during the years following Menkaure's death while his monuments were being completed. It has been my impression that the gallery complex was

purposefully dismantled. Not all team members and visiting colleagues agree.

As we analyze our voluminous samples of ancient plant remains, animal bone, and ceramics, we also keep an eye out for changes that might reflect the royal house's departure from Giza during the reign of Shepseskaf, while he was finishing his father's pyramid complex. One impression is that there was a change in the way the production facility was provisioned with meat. Richard Redding, our faunal analyst, has found a shift in the animal bone suggesting a change from ceremonial center fare to perhaps workmen's humble meals, possibly because the Royal House had left.

In the gallery complex, which represents

the earlier phase, there are high levels of 2-year-old cattle and young sheep-goats, predominately male, but very little pig. The cattle almost certainly came from estates on the Delta, such as the site of Kom el-Hisn, where young cattle were fattened for sacrifice at ceremonial centers. In the later deposits, such as in the Buttress Building, the cattle bone are from older animals. They may have been procured from local villages, rather than specialized estates. During the later phase sheep-goat were also procured in a different way. Far less abundant than in the earlier phase, their bones are only from meat-bearing elements, indicating that they were butchered elsewhere, rather than on site as they were in the gal-



leries. Richard suggests that the sheep-goat meat was supplied as “prepared packages,” possibly from a central authority.

In contrast to the galleries, the Buttress Building has an abundance of pig, a food which would not have been supplied by the state. In ancient Egypt pig breeding was a cottage industry, outside the state’s purview. It most likely came from nearby, perhaps even raised in the domestic areas of the site.

Our Site and Pyramid Towns

Egyptologists have espoused two views about the towns that sprung up around pyramids. On the one hand there are suggestions that a royal residence would have

been part of the pyramid town. Produce and livestock from farms, ranches, estates and villages throughout the Delta and Middle Egypt could thus have been delivered directly to the town. With pyramid and royal residence thus linked, Giza could have been a kind of national capital—“downtown Egypt”—for three generations.

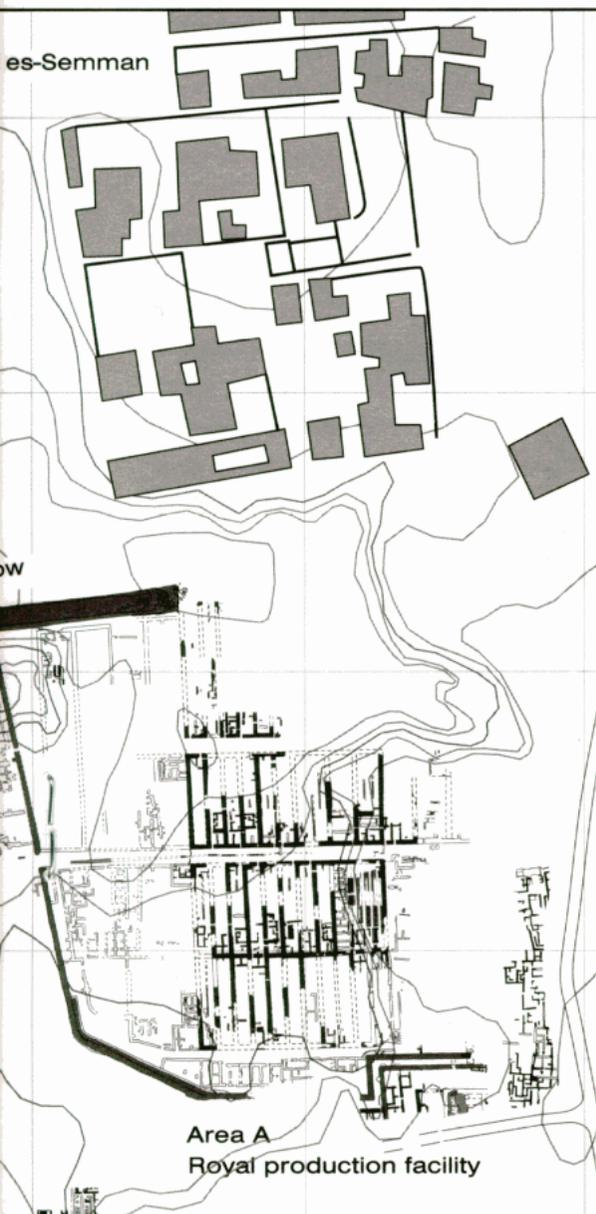
On the other hand, it has been suggested that pyramid towns were small, and grew into irregular villages over time. Barry Kemp has cited the settlement that invaded the Menkaure Valley Temple as the “villagization of a monument.” Paule Posener-Kriéger estimated that the population of a pyramid town would have been a few hundred at most, based on the Abusir Papyri, the archives of the pyramid temple town of 5th Dynasty pharaoh Neferirkare.

These two images of pyramid towns must reflect realities before and after a king’s death. The well-planned town of Khentkawes, stretching along her causeway just north of the Menkaure Valley Temple, is the footprint of a town created by the royal house as it moved out of the area. The long-term history of this settlement is poorly known. But the sacred slum of Menkaure, as it developed through the course of the Old Kingdom, represents the life cycle of a pyramid town after the royal house is long gone, except for cameo appearances in the form of decrees etched in stone.

Context

This is the historical and archaeological context in which we must interpret our discoveries south of the Wall of the Crow. Much of what we have mapped, and most of what we have excavated intensively, is from a transition period at Giza, a transition from a site of royal design to a village

The Giza Plateau showing our excavations in Area A, Menkaure’s Valley Temple, and Khentkawes’ mastaba/pyramid town. The contemporary village Nazlet es-Semman lies very close to our site. The contours of the plateau are shown in gray, with the darker lines indicating 5-meter contours. (Topo map and plan of Area A by Peggy Sanders, Archaeological Graphic Services.)



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Harvard University

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of hangers-on, servicing the memory of a deceased king in return for exemptions from obligations. Where members of the royal house once directed building operations, and the organization, planning, and provisioning that made pyramid building possible, only some select few administrators remained. As the royal household left for South Saqqara, those posted to Menkaure’s endowment began moving to the walled Valley Temple town.

Since the temples of Menkaure’s pyramid complex were far from completion when this shift occurred, it is almost certain that our site fed and housed people hard at work on this royal monument.

~ Mark Lehner

Unfinished Business: The Great Sphinx

Why it is most probable that Khafre created the Sphinx

The enigmatic Great Sphinx of Giza has inspired a wealth of speculation about its age, its creators, and its original purpose. In the last decade popular writers have proposed that the Sphinx is a remnant of an advanced civilization, mostly lost to archaeology, that existed between 9,000 to 12,000 years ago. Within the ranks of orthodox Egyptology speculation has led to the notion that Khufu built the Sphinx and that it is his face on the massive lion body. But this idea does not hold up to the harsh glare of bedrock reality. There is solid architectural evidence that ties the Sphinx and its temple to the final building activities of the Khafre Pyramid complex.

The Quarry Construction Process

First, it is pretty clear that the 4th Dynasty builders created the Sphinx, its temple, and the Khafre Valley Temple as a continuous architectural landscaping project (diagram on facing page). The ancient quarrymen created a U-shaped ditch, freeing a block from which they carved the Sphinx. They took the stone away in huge blocks that formed the cores of the walls of the Sphinx and Khafre Valley temples. They completed the walls with a casing of red granite from Aswan and finished the floors with white Egyptian alabaster.

It is not a new idea that the three monuments were built as one project. As early as 1910, when the Sphinx Temple was still buried under 15 meters of debris, Uvo Hölscher, the excavator of the Khafre pyramid temples, already perceived that the Sphinx and Valley Temple were built concurrently.

When the Swiss architect-Egyptologist, Herbert Ricke, carried out a detailed study of the Sphinx Temple between 1967 and 1970, he suggested that it was created along with the Sphinx and the Khafre Valley Temple as part of the same quarry



Ulrich Kapp maps the side of the Sphinx using photogrammetry as part of the Sphinx survey carried out by James Allen and Mark Lehner and sponsored by the American Research Center in Egypt. The layer cake effect in the Sphinx's body is the product of differential erosion of the various layers of the Member II section of the Mokkatam formation from which the statue was carved. When the stone was quarried it was taken out in large blocks that were used to build the Khafre Valley and Sphinx Temples. The masonry on the Sphinx's rump and flank are ancient and modern restoration efforts.

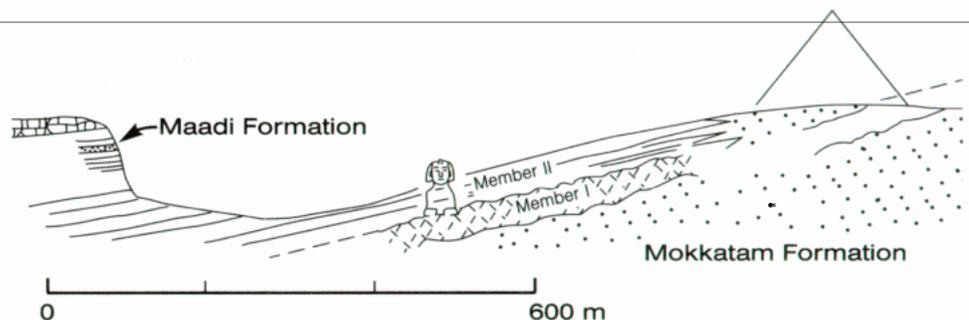
and construction process.

In 1980 Thomas Aigner, a geologist from the University of Tübingen, reinforced this hypothesis with a study of the geological layers in the Sphinx and each of the 173 core blocks in the Sphinx Temple. I met Tom as he was doing a specialized study of sea-floor sedimentation that occurred 50 million years ago in the Eocene Period. The Mokkatam limestone, (Middle Eocene) formation that furnished most of the stone for the pyramids, resulted from this sedimentation process, along with the Maadi Formation to the south,

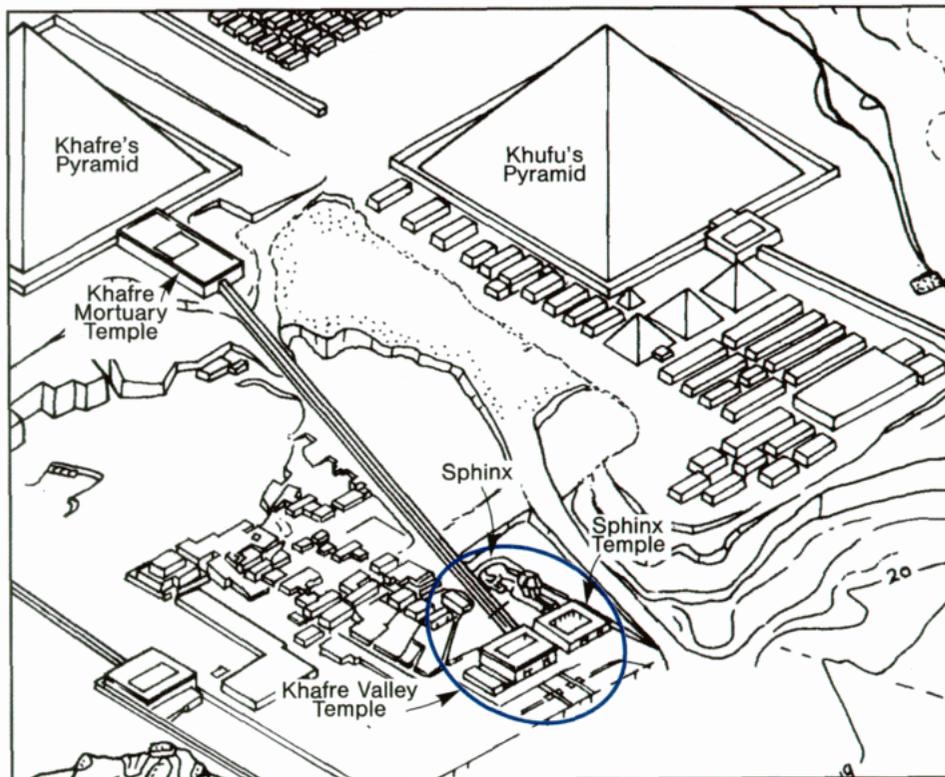
which is geologically younger (Upper Eocene). We logged the lithic features of the bedrock layers in the Sphinx core body, the surrounding ditch and in each and every limestone block in the Sphinx Temple walls. Tom's expertise confirmed Hölscher's and Ricke's suspicions and gave us further insights into the sequence of quarrying and building that created the Sphinx and the two temples in front of it.

The Natural Rock Statue

The Sphinx is carved directly from the natural limestone of the Mokkatam Form-



Cross-section of the Giza Plateau running from north-northwest to south-southeast. The Sphinx was carved from strata of Member II of the Mokkatam Formation. The Khafre Valley Temple and the Sphinx Temple were built in front of it on a terrace cut out of Member I, an Eocene shoal and coral reef. (After a section drawing by Tom Aigner.)



Giza Plateau showing the Khafre mortuary complex. The Sphinx, Sphinx Temple, and Khafre Valley Temple (in the blue oval) were built as one continuous architectural landscaping project.

ation (diagram facing page). To free the block of the Sphinx, the quarrymen cut deep into the lower layers (Member II) of the Mokkatam Formation, a hard-soft sequence lying directly on the hard and brittle limestone formed from an Eocene shoal and coral reef (Member I). The block for carving the Sphinx, oriented east-west, came to be in a ditch (photo to the right and on the facing page) that opened to the east where the quarry workers had already cut out a broad lower terrace (Terrace I) from the coral reef limestone. The Khafre Valley Temple sits on the south end of this terrace. While we were not able to scrutinize the massive blocks of the Khafre Valley Temple as thoroughly as those of the Sphinx Temple, it appears that most of the Valley Temple blocks probably derive from layers running through the upper part of the Sphinx body and head.

An Unfinished Royal Project

It is a striking fact that from the hundreds of Old Kingdom tombs at Giza, Egyptologists cannot recognize any titles of priests or priestesses that clearly belong to the

Sphinx Temple. The absence of any clergy must be the result of the temple never having been activated. It was never "turned on," because the builders left it unfinished.

How far did they get? Although someone stripped the Sphinx Temple of its gran-

ite casing and alabaster flooring in antiquity, anyone visiting the temple today can see traces of how far along the builders were in their project. Clearly visible are the seats or emplacements for individual casing blocks cut in the floor at the base of the walls. This is where the builders had finished covering the gigantic limestone core blocks with red granite casing. (It was easier to trim away the softer limestone than the hard granite in adjusting each block).

The ten deep sockets cut into the floor in front of the massive court pillars were once fitted with colossal statues that graced the open court (diagram on next page). There are also sockets for 24 pillars of the colonnade, each a granite shaft, and for two pillars in front of a central sanctuary on both the east and west. The whole composition is thought to reflect the rising and setting sun, and the 24 hours of the day and night. Since the builders only made sockets and cuttings at the time that they set up the granite pillars or casing blocks, these features track how much of the temple they had finished.

From his meticulous study, Ricke believed that they had completed the interior of the temple. They were just about to

Continued on page 12

The ditch dug through the Mokkatam formation to create the Sphinx, seen here from the rump end. To the right the layers of the formation's Member II can be clearly seen.



Unfinished Business *Continued from page 11*
 begin on the exterior when they quit the job. The cuttings for the granite wall casings stop just outside the entrance doorways. The builders left extra stock of stone protruding from the huge core blocks forming the front corner hubs of the temple. At the base of the northeast corner, removal channels in the rock floor show exactly where a team stopped leveling the floor in advance of the casing crew, working just behind them.

We see little evidence that the alabaster pavement had been finished. Ricke found a series of small conical protrusions of bedrock here and there in the temple floor, which he suggested were used in leveling the floor (like boning rods). He proposed that the alabaster pavement, 50 to 60 centimeters thick, could have covered them, but I believe these odd protrusions would have been eradicated had the pavement been completed across the temple floor. We do not find cuttings for placing individual floor slabs, such

as exist in the pyramid courts of Khufu and Khafre.

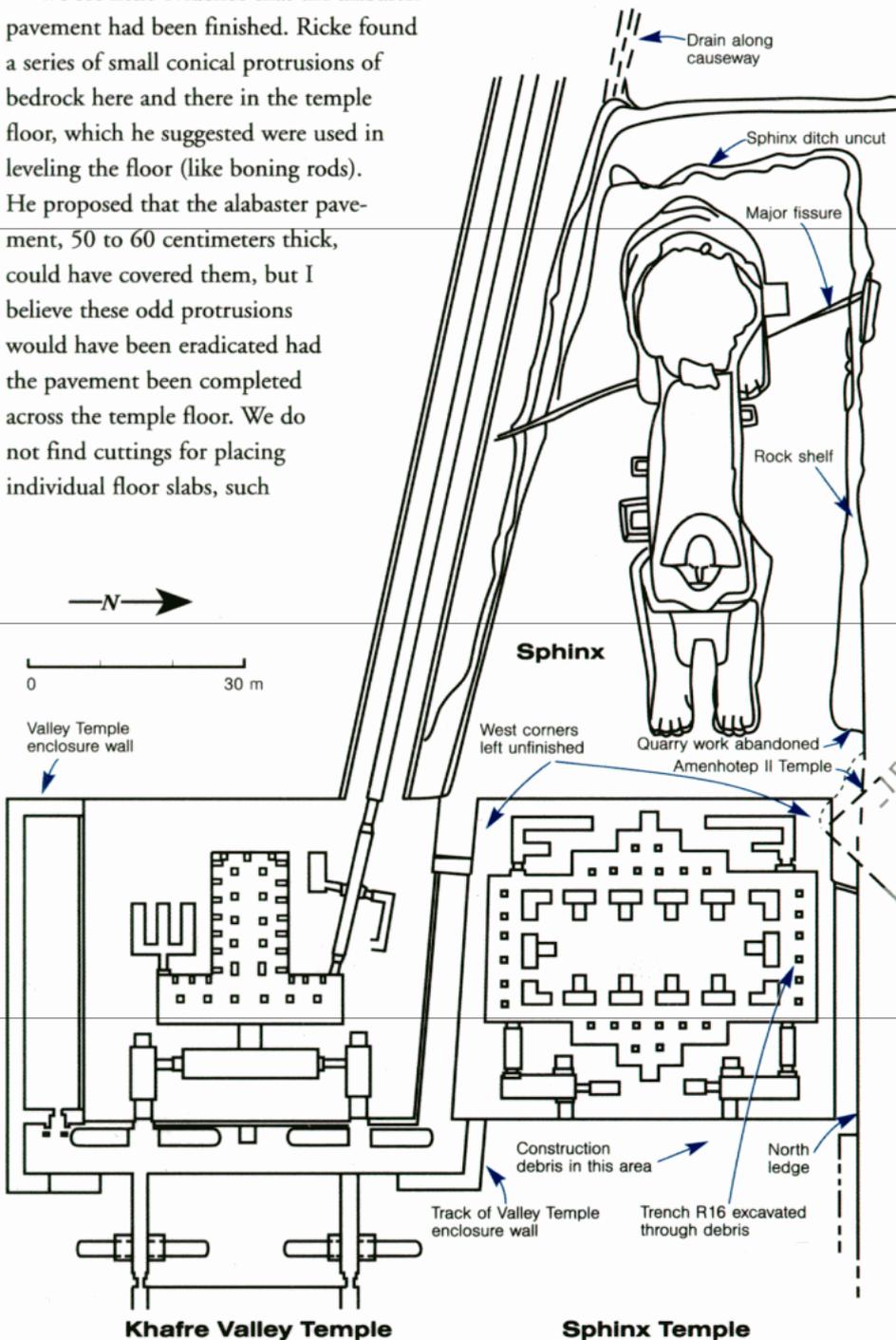
In 1979 Zahi Hawass and I found evidence that Khafre's builders had not quite finished carving out the Sphinx ditch either. By cutting the temple terrace lower than the Sphinx floor the builders left a tall vertical bedrock ledge that forms a corridor with the north wall of the Sphinx Temple (diagram below). At the east end the ledge

runs under the modern road descending from the Great Pyramid. To the west, the ledge forms the north side of the Sphinx ditch, but here the quarrymen did not finish cutting the line. The point at which they stopped is just opposite the Sphinx's left (north) forepaw and below the entrance of the 18th Dynasty mud brick temple of Amenhotep II, built 1,200 years after Khafre when the Sphinx Temple was buried. From here to the back of the Sphinx ditch, the unfinished part is a rock shelf of decreasing width. Behind the Sphinx, the workmen were nowhere near finishing the outline of the ditch. When they stopped work they left a huge massif of hard Member I rock jutting out to within a few meters from the rear of the Sphinx.

When they stopped work on the Sphinx Temple the builders had already placed the immense court statues and the colonnade pillars into their sockets. They had raised three courses of core blocks at three corners, but not at the northwest corner where we found the blocks that they left en route to the third course.

The builders raised the core walls ahead of the casing. But they had encased at least the lower part of the interior walls with granite. In 1979 I excavated a trench, designated R16, through a pile of ancient debris in the north end of the temple. Modern excavators left this pile undisturbed because the debris supports a topped core block of colossal size. The bulk of the material that we excavated looked like construction debris. Underneath the debris, we found a layer of sky-blue granite dust upon the floor. Granite dust, a blend of the red feldspar, black hornblende, mica and quartz that constitutes granite, is produced from sanding and polishing. The granite dust stopped just at the edge of the socle for the granite casing on the wall. This little fact confirmed for us that before the builders stopped, they had been smoothing the interior granite sheathing. As they sanded it with quartzite abraders, the dust collected at the foot of the wall. Much later, when despoilers pulled the granite

Schematic plan of the Sphinx, Sphinx Temple, Khafre Valley Temple, and causeway.



Khafre Valley Temple

Sphinx Temple

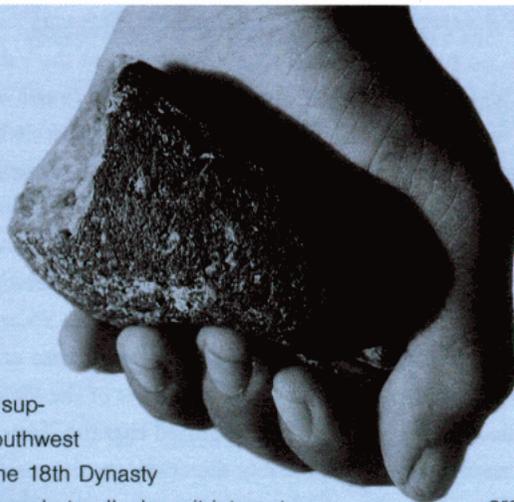
Walking Off the Job

In 1978 Zahi Hawass and I cleared off the top of the north ledge along the north side of the Sphinx and discovered rectangular humps, depressions, and channels. This kind of pattern is found in many places at Giza where work was left unfinished. The ancient quarrymen removed bedrock by channeling to isolate humps that they would then knock away with heavy hammer stones.

The channels and depressions on the north ledge of the Sphinx ditch were filled with very compact sand and gypsum that we had to remove with small pick hammers. Embedded in the fill we found fragments of pottery, including half of a common 4th Dynasty jar used for beer or water, and hammer stones, one of which still had copper flecks on the percussion end where it was used to strike a chisel. Sphinx builders must have abandoned these tools when they stopped work cutting the north side of the Sphinx ditch.

Later in 1978 we found more evidence of the Sphinx builders in a small mound

of debris in the north-east corner of the Sphinx ditch. Left by previous excavators, this mound supports the southwest corner of the 18th Dynasty temple of Amenhotep II where it juts out over the north ledge of the Sphinx ditch and over the northwest corner of the Sphinx Temple. At the base of the mound we found three large limestone core blocks that the ancient builders seem to have abandoned while they were dragging them over to complete the work on the corner of the Sphinx Temple. One block rested upon debris containing numerous pieces of 4th Dynasty pottery. The other two rested on a layer of desert clay, called *tafla*, that the builders used as a lubricant for dragging blocks and sledges. Just under the clay layer, we found



Chert hammerstone which was used by workmen to remove bedrock from north ledge of the Sphinx ditch.

cuttings in the rock floor that were used as sockets for thick wooden levers used to maneuver the ends of the blocks. This little archaeological tableau, conserved under the 18th Dynasty temple, is the tail end of the same quarry-construction process that created the Sphinx and the stone temples immediately to the east.

These preserved "frozen moments" in the construction process add to the conclusion that the builders walked off the job before finishing the Sphinx ditch and temple. The Sphinx-Sphinx Temple complex was the last major project of the Khafre pyramid complex.

~ Mark Lehner

casing out of its socket, the debris spilled in and over the granite dust.

Messy Yard

If the original builders left the Sphinx Temple unfinished, the immediate area to the east must have been a rather untidy construction yard, littered with masonry waste, ramp material, and temporary facilities for on-going delivery of granite and alabaster. Indeed, recent clearing in front of the Sphinx Temple, encountered just such stony debris.

In 1983 Egyptian Antiquities workers cut a north-south trench through this debris 12 meters in front of the northeast corner of the Sphinx Temple for installing an iron fence. Bread mold fragments and the bases of crude red ware jars date the deposit to the Old Kingdom. It consisted of concentrated granite dust, 38 centimeters thick, just like we saw in the trench R16 inside the Sphinx Temple. In this layer

we encountered large granite pieces with gypsum adhering. The granite dust must be waste dumped here from work on granite sheathing inside and near the north doorway of the temple 4,500 years ago. Underneath, down to the bedrock floor, was a compact layer, 32 centimeters thick, of yellowish-brown or tan debris, also comparable to deposits in R16, and in our 1978 trenches outside the northwest corner of the Sphinx Temple.

Construction Sequence

If the Sphinx Temple and the Khafre Valley Temple had been excavated according to modern archaeological standards, we would know far more about the state in which the builders left the site. Unfortunately, the large-scale clearing, and the poor recording, left us scant stratigraphic clues about the temple's history. I am convinced, though, that the complete archaeological tableau would have shown that the Sphinx Temple

was the last major item, left unfinished at the end of Khafre's reign. It is even possible that the builders left the whole interior of the Sphinx Temple filled with the kind of construction debris that the earlier large-scale excavations left behind here and there. Centuries later, those who systematically stripped the Sphinx Temple of its granite casing and colossal statues must have turned over the construction embankments and debris that the original builders left inside the temple. Ricke thought there had been two periods of stone robbing in the Khafre Valley complex, the first in the 12th Dynasty reign of Amenemhet I when the Sphinx Temple interior was stripped and the second when the granite was removed from the Valley Temple exterior.

The fact that the Sphinx ditch and the Sphinx Temple were left unfinished is itself suggestive that they were the last items under construction in the reign of Khafre.

Continued on page 14

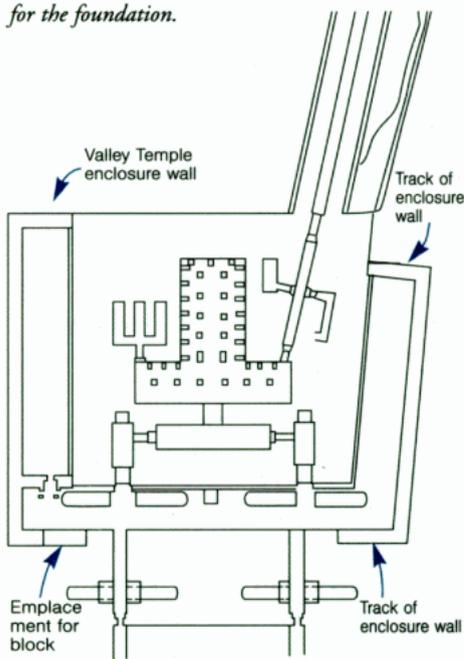
Unfinished Business *Continued from page 13*
(See box “Walking off the Job” on previous page.) Would Khafre have erected his beautifully finished Valley Temple smack beside the unfinished Sphinx Temple and its messy construction yard without cleaning it up?

No, the general picture we have been able to salvage from the large-scale expeditions that cleared out the Sphinx and the two temples suggests that all three monuments originated from the same long-term project. A list of the evidence associating the Sphinx complex with Khafre’s pyramid complex is shown on the facing page. What I believe is the clincher that Khafre made the Sphinx and its temple is laid out below.

The Clincher: Valley Temple Enclosure Wall and Sphinx Temple

The most striking and clearest evidence that the Sphinx Temple, and therefore the Sphinx, were created in Khafre’s reign, *after* the Valley Temple, is an early enclosure wall around the Valley Temple. Sometime after it was built, the northern side and northeastern corner were dismantled to accommodate new construction—namely

Khafre’s Valley Temple with the north section of the enclosure wall recreated from evidence of the cuts for the foundation.



the Sphinx temple. The wall, running parallel to the south side of the Valley Temple, is composed of a single course of locally quarried monolithic limestone blocks. At the western end, two blocks make a corner and attach to the southwest corner of the Valley Temple. The end block is fitted over a small granite block that remains *in situ* from a low granite bench, 75 centimeters wide, that ran along the base of the south, east, and north sides of the Valley Temple. Ricke recognized that the “bench” and probably the entire granite casing of the valley temple was completed before the wall of large limestone blocks was built.

This wall runs 8.5 meters south of the south side of the Khafre Valley Temple. It turns 90° at the edge of the bedrock terrace in front of the Valley Temple, where one large block remains of the eastern part after the turn. In front of this block to the north, the rock floor is cut as an emplacement bed for an additional long block that must have been removed. This missing block would have brought the wall to within 5 meters of the southern entrance ramp of the Valley Temple.

In front of the opposite northeast corner of the Valley Temple the foundation track of a similar wall is sunk into the bedrock. This northern wall also ran parallel to the temple and 8.5 meters north of the north wall. Exactly like the wall on the south, the track on the north is close to 2.6 meters (5 cubits) wide. And just like the wall on the south, the foundation cutting of the wall on the north shows that it turned a corner to run along the front edge of the terrace in front of the Valley Temple. Like the southern arrangement, the wall on the north stopped 5 meters from the northern stone entrance ramp. The northern wall also attached to the back end of the temple, 6 meters east of the northwest corner. As on the south, this connection is marked by a single granite block remaining of the bench along the base of the Valley Temple.

The northern and southern walls once formed an enclosure, like two arms, attached to the back western corners of the

Valley Temple and reaching out to enclose the front eastern corners, leaving a wide space for the approach ramps and front terrace. However, the wall on the north was almost completely removed, leaving only its track cut into the rock floor.

The reason the wall was removed was the Sphinx Temple. Its south wall was plopped directly over the path of the northern enclosure wall of the Khafre Valley Temple. Ricke pointed to one block of the northern enclosure wall still in its track because the builders incorporated it into the core of the southeast corner of the Sphinx Temple. This block is very close in size and shape to the blocks of the Valley Temple southern enclosure wall.

On top of all the other relationships that tie the Sphinx and Sphinx Temple to the final phases of building Khafre’s valley complex, the path of the missing northern enclosure wall makes it as certain as we can be in this business that Khafre’s builders:

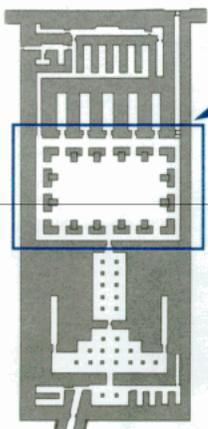
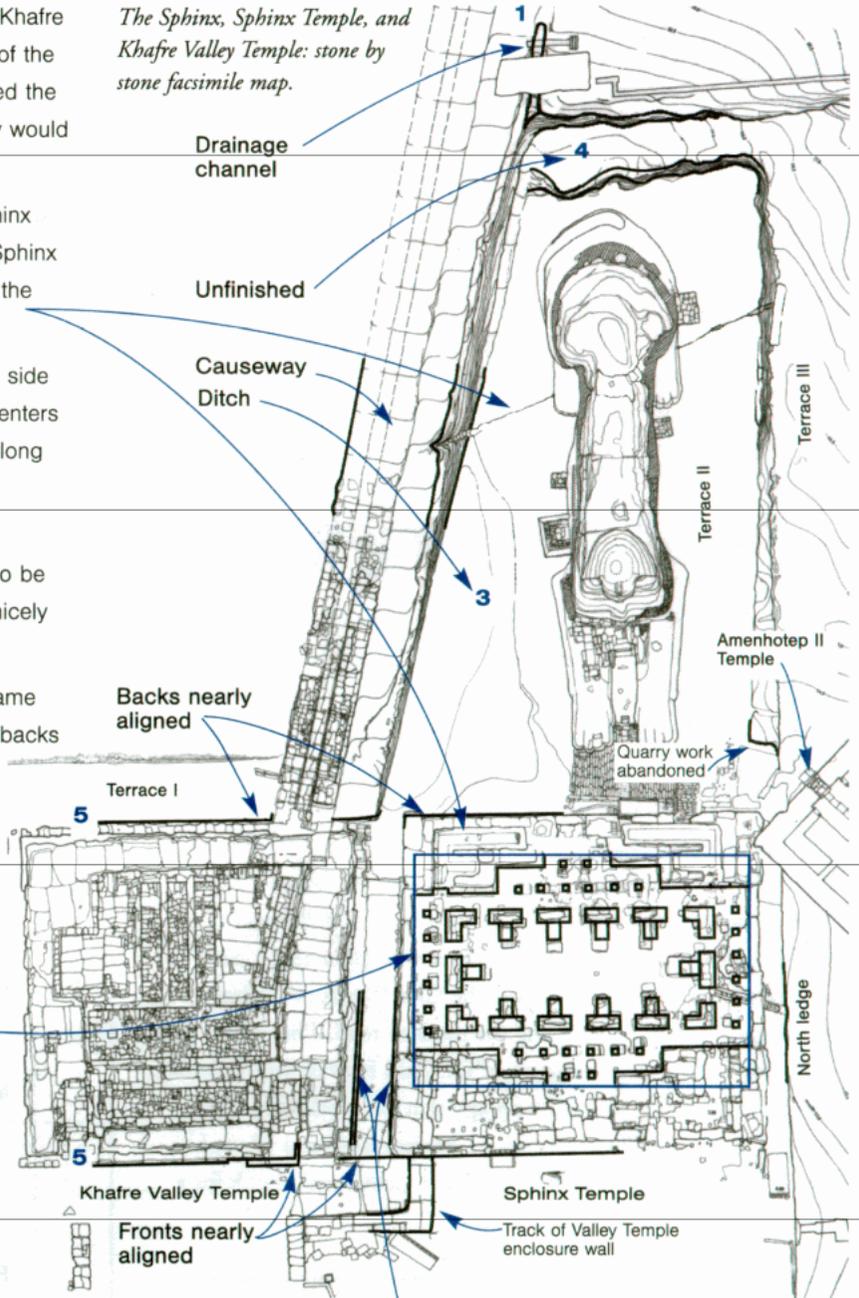
1. Completed Khafre’s Valley Temple with its granite casing.
2. Built the northern and southern enclosure walls.
3. Removed the northern wall.
4. Built the Sphinx Temple where the northern wall had been.
5. Used huge blocks from the Sphinx quarry for the Sphinx temple walls.
6. Abandoned the quarrying of the Sphinx ditch and construction on the Sphinx Temple shortly before either were completed.

No matter what our art historical sense would have us believe about the giant face of the Sphinx resembling the tiny face of Khufu on the only known image of this king (a little figurine found at Abydos in Upper Egypt), no matter how much it fits our idea of 4th Dynasty religion and politics (for example, the idea that Khufu considered himself to be the sun god, Ra, and therefore he should have made the Sphinx, an image of the sun), the bedrock facts of the quarry-construction history at ground truth point to Khafre as the Sphinx builder.

Drawing the Sphinx to Khafre: Summary of Structural Evidence

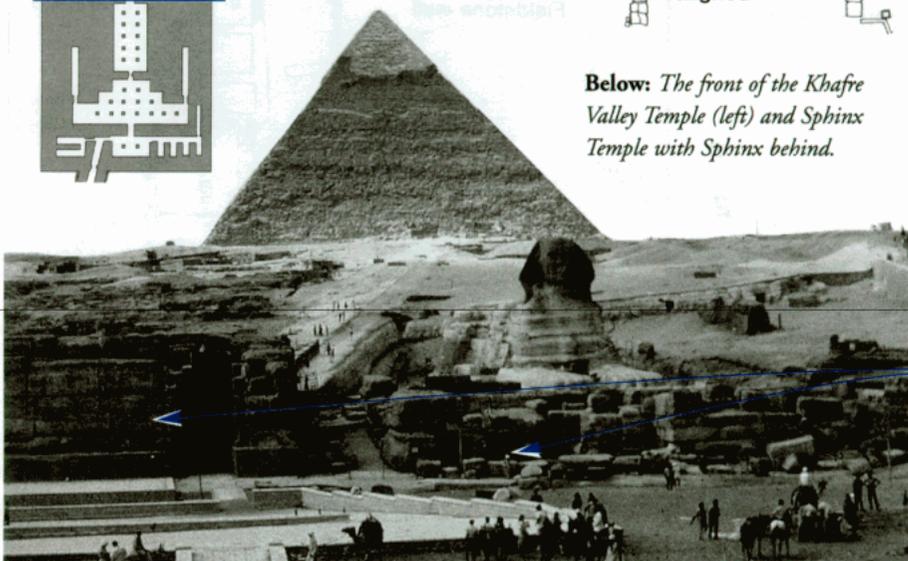
- 1. Drainage channel** - Runs along the north side of the Khafre causeway and opens into the upper southwest corner of the Sphinx ditch. It looks like the ancient quarry men formed the Sphinx ditch after the Khafre causeway. Otherwise they would not have the drain empty into the Sphinx ditch.
- 2. Same quarry and construction sequence** - The Sphinx and Sphinx Temple were part of the same sequence. Sphinx Temple blocks derive from the lower bedrock layers in the Sphinx ditch.
- 3. Sphinx ditch** - The south side of the ditch is the north side of the foundation of the Khafre causeway just where it enters the Khafre Valley Temple. The Sphinx ditch was sunk along the south side of the causeway that already existed.
- 4. Sphinx Temple and Sphinx ditch left unfinished** - This suggests that they were the last major structures to be worked on in the area. The Khafre Valley Temple was nicely finished inside and out.
- 5. Shared terrace** - Khafre's Valley Temple sits on the same leveled terrace as the Sphinx Temple. The fronts and backs of the temples are nearly aligned.
- 6. Nearly identical court design and dimensions** - Sphinx Temple and Khafre's upper Pyramid Temple are the same design except the upper temple had 12 instead of 10 colossal statues. (No evidence of colossal statues in the Khufu mortuary temple.)

The Sphinx, Sphinx Temple, and Khafre Valley Temple: stone by stone facsimile map.



Left: Khafre's Upper Temple. The court is outlined with a blue box.

Below: The front of the Khafre Valley Temple (left) and Sphinx Temple with Sphinx behind.



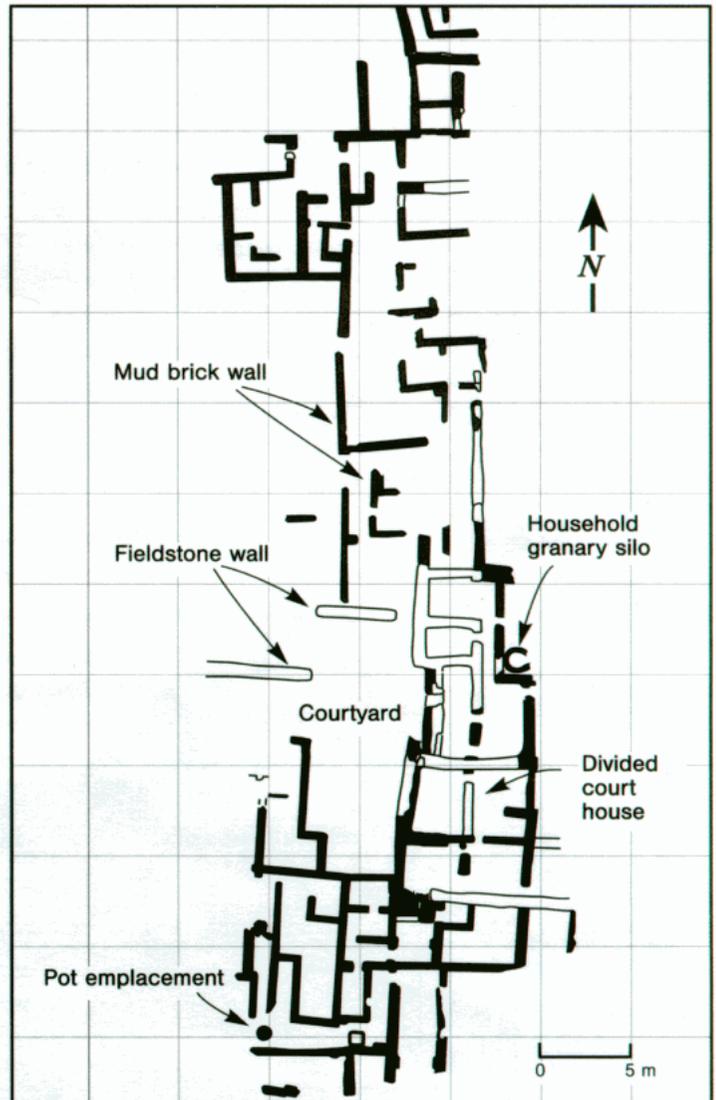
- 7. Walls parallel** - Sphinx Temple south wall is parallel to the Valley Temple north wall, showing the same deviation north of due west. The Sphinx Temple builders must have adjusted it to the already existing Khafre Valley Temple.
- 8. Same style** - Walls of Sphinx Temple and Khafre Valley Temple were built of same large limestone core blocks with harder red granite as a finish. Khufu's Pyramid Temple was not built with monolithic core blocks.

PREVIEW Finding the Folk: The Workmen's Houses

We were in the field from early January until May this year and once again our new findings have surprised and amazed us. On the far eastern side of the site we have found a residential complex which we believe housed the more permanent workers who helped build the pyramids. (See map on pages 8-9 to discover where this complex is located within the site.) It is housing that would be at home in any ancient Near Eastern settlement: mud brick and fieldstone walls, rectangular chambers, "snail houses," quern stones, a small granary, mud-lined bins, and alleyways.

We worked in this area ahead of a team constructing a new high security wall that will enclose the Giza Plateau, running on the eastern side of the site along the modern road. This wall is part of the site management program of Dr. Zahi Hawass who encouraged our work and predicted long ago that the workers' houses once stretched east of the area where we excavated and where his team continues to discover the "Workers' Cemetery." Look for a report on the houses in our next issue.

A sample of the residential district close up. The layout is more or less orthogonal but far less rigid than the gallery system to the west. The rooms are also smaller and more varied than in the galleries (map on pages 8-9).



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