CHAPTER 11

The Pyramid of King Khafre

1. The Return to Giza

King Djedefre relocated the royal pyramid project from Giza to Abu Rawash. Yet under his successor, King Khafre, construction returned to Giza, where a new large pyramid—comparable in scale to that of Khufu—was initiated. Whether Khafre himself ardently desired to build such a massive pyramid cannot be stated with certainty, but given the magnitude of the undertaking, his personal approval must have been indispensable.

In Chapter 10, I noted that Djedefre's pyramid appears to reflect a design philosophy distinct from the horizontal masonry and safety-oriented engineering seen in the Red Pyramid and Khufu's pyramid. This observation may be more significant than it first appears. During the fifty years from Sneferu to Khufu, not only did a technical tradition develop—especially after the "bending" of the Bent Pyramid—but a large community of craftsmen, quarry workers, polishers, transport crews, overseers, and high-ranking officials also emerged. Their livelihoods, status, and authority had been sustained by the large-pyramid program for half a century. Under Djedefre, many of these individuals may have found themselves marginalized.

If Khafre expressed interest in constructing a massive pyramid, it is likely that these groups strongly supported the initiative.

Although it is difficult to apply modern political logic to ancient Egypt, where the king was regarded as divine, even a king's ambitions required the backing of a vast bureaucratic apparatus. The desire of these groups



Fig. 11-1. The Pyramid of King Khafre and the Sphinx (photographed in January 2025).

to revive the large-pyramid project may have formed an important foundation for Khafre's decision.

However, Khafre and the ruling elite must also have been aware that Khufu's pyramid had suffered major delays. Whether the construction period could be shortened was undoubtedly a central question.

One of the reasons I suspect that Khufu's pyramid remained unfinished is precisely that Khafre approved the construction of another giant pyramid at Giza.

From the perspective of the pyramid-building community, Giza offered far better conditions than Abu Rawash, where only a small pyramid had been built. Even after eight years of abandonment, the infrastructure for large-scale construction at Giza would have remained largely intact. The plateau also had a proven record of bedrock stability.

If Khufu's pyramid had been abandoned during the construction of its 204th course, the mudbrick scaffolding and spiral ramps would still have

surrounded the structure. These materials could have been reused, significantly reducing the preparatory phase of Khafre's project.

Moreover, the causes of delay in Khufu's pyramid must have been thoroughly analyzed. It would have been natural to assume that eliminating the factors responsible for the prolonged construction—excessive safety design and repeated trial-and-error—would allow for a shorter timeline. In modern manufacturing, reducing labor hours through design and process revision is routine; the same logic would have applied here.

During Djedefre's eight-year reign, generational turnover among the pyramid-building workforce must also have occurred. Given that adult life expectancy in ancient Egypt was only twenty to thirty years, eight years would have been sufficient for older members of the Khufu-era workforce to be replaced by younger ones. The generation that had emphasized extreme safety measures during the Red Pyramid period would have largely disappeared, and younger, more flexible engineers likely assumed leadership roles. This shift would have encouraged a transformation in design philosophy.

The primary cause of delay in Khufu's pyramid was excessive safety design combined with repeated experimentation—technical factors above all. Thus, in designing Khafre's pyramid, construction speed was likely the highest priority, and Khufu's over-engineered and overly cautious methods were probably revised.

If technical improvements made a shorter construction period feasible, then building another giant pyramid adjacent to Khufu's would have been entirely rational. The bedrock at Giza had already proven capable of supporting a massive structure, and the site offered the advantage of locally quarried limestone.

I also propose another possibility. If Khufu's pyramid had been abandoned during the casing stage, the enormous ramps used for transporting casing stones would still have existed, and large quantities of unpolished casing stones would have remained on site. For Khafre, this would have been an extremely attractive resource. With both core blocks and casing stones available for reuse, Giza would have been the most

rational construction site.

One might naturally ask: Would Khafre really have used his father's pyramid as a source of building material?

The two solar boats—constructed from highly valuable imported cedar from Lebanon—were not reused, even though they had been disassembled into timber. Because the solar boats had already been consecrated and transferred to the priesthood, they were treated as sacred installations, regardless of their practical value. The pyramid, however, though monumental, would have been regarded as an unfinished structure lacking religious consecration. From this perspective, Khafre may have felt little hesitation in reusing its materials.

Another important point is that Khafre did not succeed Khufu directly. His reign followed the eight to ten years of Djedefre, who had entirely abandoned Giza. Although Khafre was Khufu's son by blood, he was the third king in the sequence.

For these reasons, I believe Khafre's return to Giza was not merely an expression of youthful ambition but a rational decision based on the conviction that a giant pyramid could indeed be completed through improved efficiency.

In the following sections, I will analyze the differences in design philosophy between the pyramids of Khufu and Khafre.

2. The Design Philosophy of Khafre's Pyramid

Although Khufu's pyramid and the pyramid built subsequently by King Khafre are nearly identical in size and external form, their internal structures differ markedly. The underlying design philosophies are fundamentally distinct.

The structural drawings published by the British explorers Howard Vyse and John Shae Perring reveal that Khafre's pyramid is astonishingly simple compared with that of Khufu. The interior of Khafre's square-based pyramid is essentially solid masonry, with the core filled entirely with stone.

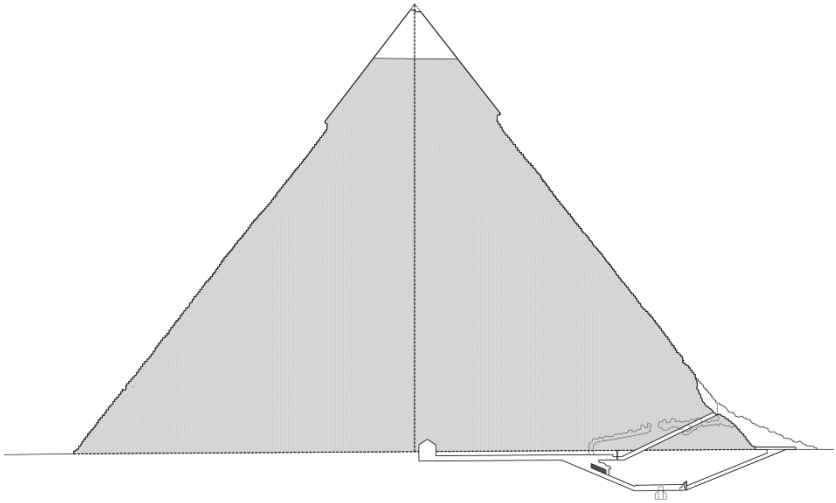

Fig. 11-2. Internal structure of the Pyramid of King Khafre (traced from Howard Vyse, Operations Carried on at the Pyramids of Gizeh)

The most striking feature of this diagram is that the burial chamber is half-embedded in the bedrock, with the upper half originally exposed at ground level—or at least situated close enough to the surface that it was excavated downward from above. Unlike Khufu's pyramid, Khafre's pyramid lacks a gravity-relieving system; instead, a simple gabled ceiling stone rests directly over the chamber.

There are two entrances, and two distinct routes converge partway toward the burial chamber. The horizontal passage leading to the chamber lies near the interface between bedrock and ground surface. It appears that not all of this passage was tunneled through solid rock; rather, portions were quarried open from above and then roofed with ceiling stones. This method—using the bedrock as sidewalls while avoiding the difficulty of full tunneling—was far more efficient and highly rational.

Given such a straightforward internal structure, and considering that casing stones still survive near the summit, the overall preservation of Khafre's pyramid is superior to that of Khufu's. For this reason, I initially

assumed that the design philosophy must have been excellent, and that the quality control of stonework and construction must likewise have been exemplary.

However, upon consulting the literature, I encountered assessments that contradicted my expectations. Petrie notes that, in contrast to the precisely finished stones of Khufu's pyramid, the blocks of Khafre's pyramid are irregular in shape and frequently packed with mortar. Wieser claims that the pyramid was built atop a rocky hill to save stone.

This was unexpected. Yet Wieser's assertion that the pyramid was built on a high hill to conserve stone is poorly supported. If the hill had been high enough to significantly reduce the volume of masonry, a deep vertical shaft would have been required to install the gabled ceiling of the burial chamber. Moreover, although Wieser and Perring belonged to the same survey team, Perring's own published diagrams depict a relatively flat bedrock surface, contradicting Wieser's interpretation.

Petrie's observation, however—that Khafre's masonry is noticeably less regular than Khufu's—matches my own impressions from walking around the Giza pyramids over two days in 2008. Anyone who compares the two structures on site will immediately recognize the difference. Relative to the crisp, orderly masonry of Khufu's pyramid, Khafre's stonework is indeed less uniform.

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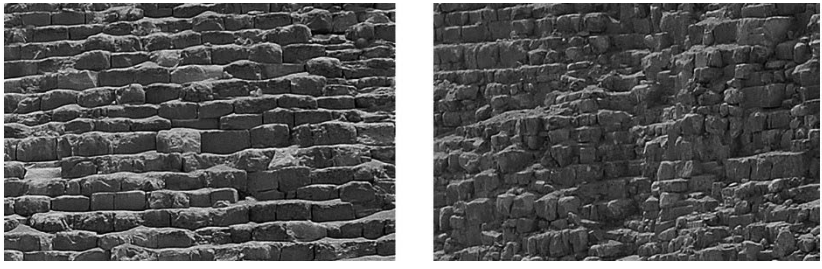

Fig. 11-3. Masonry of the Pyramid of Khufu (left) and the Pyramid of Khafre (right), both photographed in August 2008.



Fig. 11-4. Close-up view of the upper portion of the Pyramid of King Khafre (photographed in 2025).

irregular in shape and frequently packed with mortar—was something I had already noticed during my two-day survey of the Giza pyramids in August 2008. Anyone who compares the two structures on site will immediately recognize the difference; relative to the crisp and orderly masonry of Khufu's pyramid, Khafre's stonework is indeed less uniform.

Although the dimensions of individual blocks are not perfectly consistent in either pyramid, Khufu's masonry clearly consists of limestone blocks that were shaped, at least in principle, into rectilinear forms before being laid. In contrast, the blocks of Khafre's pyramid lack uniformity in both shape and size, producing an impression of instability. In earthquake-prone Japan, the perimeter of such a structure might well be cordoned off as a hazard zone, so precarious does it appear.

However, when I examined photographs taken during my return visit in January 2025, I noticed that the stones directly beneath the surviving casing blocks near the summit appear to be worked with care comparable to that seen in Khufu's pyramid. This suggests that the uppermost courses may have been executed with greater precision than the lower ones.

Nevertheless, it would be premature to conclude—based solely on the present appearance of the masonry—that Khufu's pyramid was categorically superior to Khafre's. Both structures have survived for

4,500 years, and Khafre's pyramid retains a substantial portion of its casing stones near the summit. This fact alone cautions against simplistic judgments based solely on the current condition of exposed masonry.

3. The Evolution of Internal Pyramid Structures

Among the pyramids of the Third Dynasty, the largest—the Step Pyramid of King Djoser—is renowned for its extraordinarily complex subterranean architecture, resembling an underground palace. The unfinished step pyramids of Sekhemkhet and the so-called "layer pyramid" attributed to Khaba also employed underground burial chambers.

In contrast, Sneferu, founder of the Fourth Dynasty, constructed the burial chamber of his Meidum pyramid (Fig. 11-5-A) near the interface between bedrock and ground surface.

The internal structure of Sneferu's subsequent Bent Pyramid (11-5-B) shows a period of experimentation. The initial plan involved a descending passage leading to an underground burial chamber. However, the inward-leaning masonry of this large pyramid produced substantial vertical pressure along the central axis, and combined with the fragile bedrock at Dahshur, caused damage to the subterranean chamber. As a result, the burial chamber was relocated upward into the core of the pyramid. This modification must have occurred early in construction, before the masonry had risen significantly; carving a chamber into a completed core would have been extremely difficult and structurally hazardous.

In the Red Pyramid (11-5-C), the burial chamber was built entirely above ground. After the "failure" of the Bent Pyramid, the new project team likely abandoned the idea of subterranean chambers altogether. Because both the Bent and Red Pyramids employed corbelled ceilings, their chambers could not be wide, resulting in long, narrow, corridor-like spaces.

With Khufu's pyramid (11-5-D), however, the concept of the burial chamber changed dramatically.

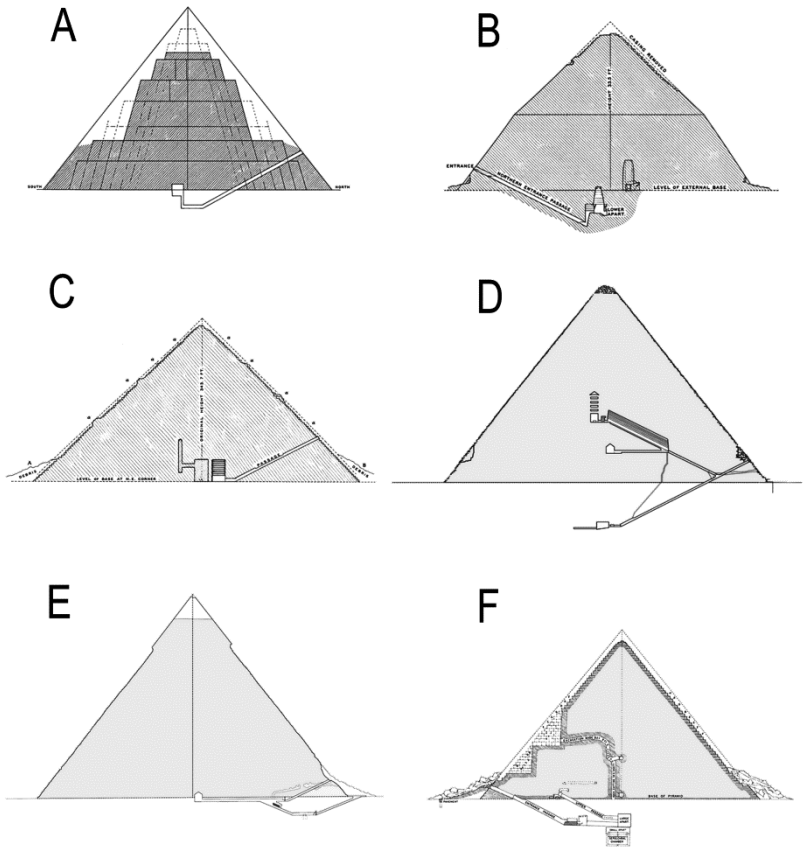

Fig. 11-5. Internal structures of the Fourth Dynasty pyramids (based on the structural diagrams of Perring and Petrie; scales of individual pyramids are not uniform).

The unfinished subterranean chamber of Khufu's pyramid appears to have been an attempt to revive the Third Dynasty tradition of underground burial chambers. Although such chambers had proven problematic at Dahshur due to weak bedrock, the strong limestone plateau at Giza made the idea reasonable. Yet the subterranean chamber was never completed.

The pyramid's steep slope of 52 degrees and design height of 146 meters must have created constant anxiety regarding vertical

gravitational load. To mitigate this risk, the builders appear to have conceived an innovative idea absent from earlier pyramids: placing the burial chamber higher in the structure, where vertical load would be reduced. The first attempt at an internal chamber was the Queen's Chamber. After observing deformation or cracking—or the absence thereof—the builders likely judged the chamber safe and proceeded to construct the higher King's Chamber.

Even so, concerns about vertical load from the pyramid's mass persisted, leading to the adoption of the King's Chamber's complex gravity-relieving system. In other words, Khufu's pyramid seems to have been designed with the intention of "escaping upward," relocating the burial chamber progressively higher as construction advanced.

Khafre's pyramid (11-5-E) also appears initially to have been planned with a subterranean chamber, but this idea was soon abandoned. The final chamber was placed near the surface of the bedrock. Its walls incorporate the natural rock, while the gabled ceiling was installed either on exposed bedrock or on bedrock quarried downward. The design philosophy resembles that of Sneferu's Meidum pyramid.

In Menkaure's pyramid (11-5-F), the subterranean chamber was revived once again.

Thus, even among pyramids that appear externally similar, the internal design philosophy fluctuated continuously.

Khufu's pyramid is particularly unusual within the Fourth Dynasty: its burial chamber was placed high within the masonry core, far above the bedrock. Khafre's pyramid, by contrast, returned to a more orthodox approach.

Khufu's builders trusted the strength of the Giza bedrock, yet the unprecedented slope of 52 degrees and design height of 146 meters must have produced persistent fear of vertical load and ground pressure. I believe this anxiety manifested in the pyramid's complex internal structure. Khafre's pyramid, on the other hand, reflects a design philosophy grounded in confidence that "the bedrock is sufficiently strong."

As an aside, although the internal structures of these pyramids vary

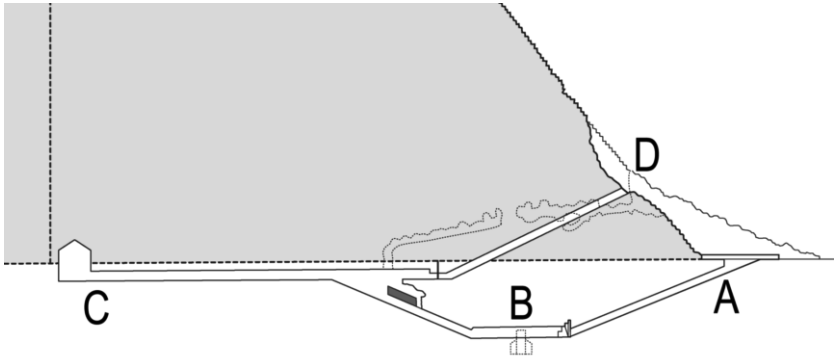

Fig. 11-6. The two passageways of the Pyramid of King Khafre (traced from Perring's structural diagram).

widely, their passage slopes cluster around 26 degrees—a striking pattern. This is unlikely to be coincidental. In ancient Egyptian units of slope (the seked), a ratio of 2 horizontal to 1 vertical corresponds to 26.56 degrees. This simple ratio may have made design and construction easier, explaining the consistent use of this angle.

4. The Burial Chamber of King Khafre

It is reasonable to assume that, in constructing Khafre's pyramid, the builders conducted geological investigations to confirm the strength of the bedrock, and that an underground burial chamber—similar to that planned for Khufu—was initially contemplated.

Section 11-6-A shows the descending passage leading underground. Today, this passage serves as the entrance used by visitors to access the interior of the pyramid. The passage slopes downward and reaches a depth of approximately 20 meters, where it transitions into a horizontal corridor leading to point B. At B, a small chamber was constructed, and a vertical shaft was cut into its floor. This feature closely resembles the subterranean chamber of Khufu's pyramid.

I believe this descending passage originally served as a preliminary exploratory shaft, intended to assess the thickness, quality, and uniformity

of the bedrock before full construction commenced. At the time excavation began, the plan likely included not only this exploratory shaft but also a large subterranean burial chamber extending from the horizontal section at B—essentially following the same conceptual model as Khufu's pyramid.

However, the underground chamber was never built. The actual burial chamber is a "semi-subterranean" structure, created by quarrying downward from the bedrock surface. This interpretation is consistent with descriptions by Dr. Mark Lehner and by Maragioglio and Rinaldi in L'architettura delle piramidi menfite – Parte IV: La Grande Piramide di Cheope.

The reason for abandoning the subterranean chamber in favor of a semi-subterranean one remains unclear.

Nevertheless, if Khufu's subterranean chamber had functioned as a monitoring post—confirming that no anomalies existed within the bedrock—and if the vertical shaft at B provided sufficient information regarding bedrock thickness and quality, then the builders may have concluded that the bedrock at Khafre's site was comparable to that at Khufu's. This would justify the decision that "the bedrock is sufficiently reliable."

This conclusion appears to be supported by the placement of the burial chamber and its horizontal access passage: both lie just below the bedrock surface. This configuration allowed for easy quarrying from above, avoided constructing a chamber entirely within the masonry core, and ensured that vertical loads on the passage and chamber were borne by the surrounding bedrock rather than by the pyramid's masonry. The location is, in this sense, structurally optimal.

Furthermore, the gravity-relieving structures so prominent in Khufu's pyramid are almost entirely absent in Khafre's. The only comparable feature is the gabled ceiling of the burial chamber.

Recent muon-radiography investigations of Khafre's pyramid have not revealed any large internal cavities, further supporting the interpretation that no additional chambers exist above the burial chamber.