

# 15 Reasons why Khufu did *NOT* build the Great Pyramid

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## Introduction

This paper is meant to be a response to a video documentary by Matthew Sibson, author of the *Ancient Architects* channel, aptly called “The Case for Khufu: 10 Reasons Why He Built the Great Pyramid of Egypt” on January 25<sup>th</sup>, 2021<sup>1</sup>. It is meant to provide an alternative view of the timeline and chronology of the Great Pyramid that summarizes various pieces of evidence pointing to a far greater antiquity of the main structures on the Giza Plateau.

The conventional mainstream view of Egyptology is that the Great Pyramid was built as a tomb by order of the 4<sup>th</sup> Dynasty king Khufu (reigned 2,590-2,568 BCE).

This view has been challenged, however, by numerous alternative researchers who have claimed that the Pyramid is in fact much older. Many of these researchers also deny the “Pyramid as Tomb” theory, suggesting instead that the Pyramid served some different purpose. Theories include a repository of antediluvian knowledge, a geodetic marker or a hall of initiation.

In his thoroughly researched and well documented video, Sibson provides 10 reasons why he believes that the mainstream Egyptological view of the Great Pyramid as the tomb of King Khufu is still the most sensible explanation of the age and purpose of the Pyramid.

His 10 points may be summarized as follows:

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<sup>1</sup> See: Matthew Sibson, “The Case for Khufu: 10 Reasons Why He Built the Great Pyramid of Egypt”, *Ancient Architects*, On-line resource: <https://www.youtube.com/watch?v=KF2iyfricVU>, accessed January 29<sup>th</sup>, 2021

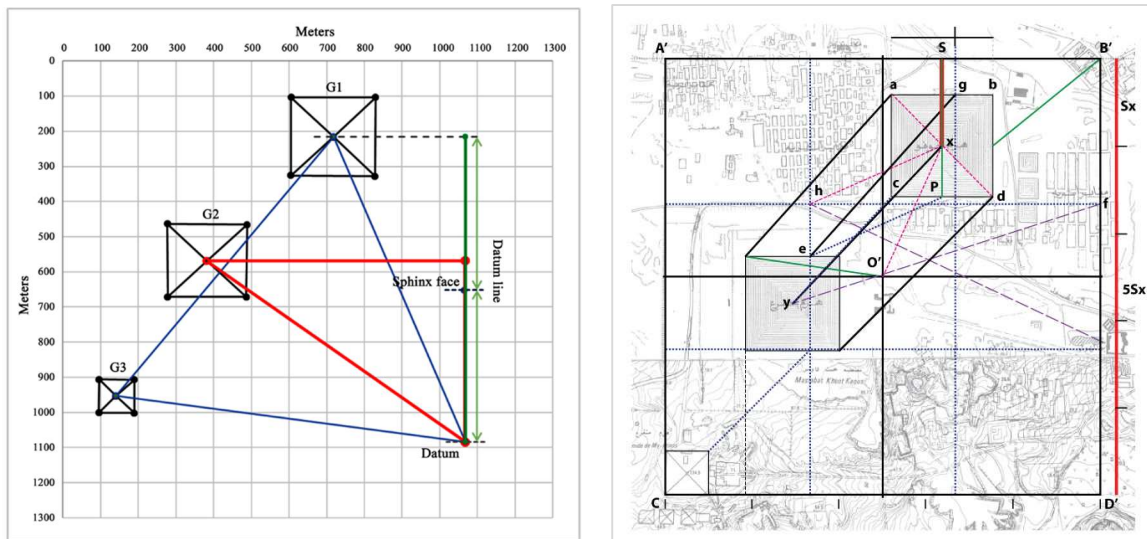
1. The quarries at Giza from which stone was extracted for construction of the Great Pyramid contain the actual cartouches of Khufu inside them.
2. Khufu's name and his image are found on fragments of broken friezes and statues along the now destroyed causeway of the Great Pyramid.
3. Khufu cartouche graffiti are found inside the relieving chambers of the Great Pyramid, directly above the King's Chamber.
4. A cartouche containing the name of Khufu was also found by Georges Goyon on the underside of a casing stone from the fourth tier of masonry of the Great Pyramid.
5. Most of Khufu's royal family, including his children, mother and queens, brother, vizier, closest advisers, aides and servants are all laid to rest in tombs and mastabas surrounding the Great Pyramid.
6. The New Kingdom Egyptians associated Khufu and Khafre with Giza and the construction of the Pyramids.
7. The 26<sup>th</sup> dynasty kings associated the Great Pyramid with Khufu, as shown on the Inventory Stela.
8. The Diary of Mera talks of large amounts of Tura limestone being taken to the Great Pyramid during the reign of Khufu.
9. The Greek historian Herodotus names Cheops (*another name for Khufu*) as the builder of the Great Pyramid.
10. Cartouches bearing the name of Khufu's successor Djedefre are found inside the boat pits of the Great Pyramid.

All these evidence, although not conclusive and somehow circumstantial, is however compelling enough to prove the close association of Khufu with the Great Pyramid. At the same time, it leaves open a number of scenarios, among which the possibility that Khufu did not himself build the great pyramid, but either usurped, restored or enlarged an already existing monument.

We will hereby present 15 reasons why we believe this may have been the case and why, therefore, Khufu did *not* build the Great Pyramid.

## 1. The geometric plan of Giza – Evidence of a unified design

The theory of a unified plan for the three Giza pyramids and the Sphinx, proposed (*among others*) by authors Robert Temple and Andrew Collins, contradicts the idea that the Giza necropolis arose through the separate efforts of different monarchs adding their own pyramids and temples to the plateau<sup>2</sup>. It moreover opens up two different scenarios; one, less radical, according to which each king simply contributed to a plan that had been designed and conceived long before the first stone was ever laid at Giza; and another, far more radical, according to which construction of the main structures on the Giza Plateau, including the three largest Giza pyramids and their subsidiary ramps and temples, progressed simultaneously rather than sequentially over the course of many generations (*as suggested instead by mainstream Egyptology*). While the first scenario, although not necessarily invalidating the tomb theory, requires to explain why different kings would abide to such a plan in the absence of some precise symbolic or religious justification; the second scenario would prove fatal to the “Pyramids as tombs” hypothesis. Both scenarios imply surveying abilities on the part of the Ancient Egyptians far in advance of what has been hitherto believed possible for a civilization that was just barely coming out of the Stone Age.



**Left: Figure 1.** Diagram showing the geometrical relationship of the three Giza pyramids and the Sphinx with the Datum point located on the summit of Gebel Ghibli. After Andrew Collins and Rodney Hale, “A Study of the Simple Geometrical Relationship of the Main Monuments of Giza”, *Archaeological Discovery*, Vol. 4, No. 2, April 2016. **Right: Figure 2.** Diagram of the additional mathematical relationships discovered by Robert Temple based on the “Giza Square”. After Robert Temple, *Egyptian Dawn*, Century Books, 2010.

<sup>2</sup> See for instance: Andrew Collins, *Beneath the Pyramids*, ARE Press, 2009; and Robert Temple, *Egyptian Dawn*, London: Century Books, 2010.

The fact that the Great Sphinx, in its relationship not only with the three main Giza pyramids, but also with certain natural features of the surrounding landscape, seems to have been a key part of this unified plan further suggests that the plan itself must be older than (*or, at the very least, contemporaneous with*) the carving of the Sphinx itself. If the age of the Sphinx truly turns out to be Predynastic, as evidenced by the patterns of rain erosion on both the body of the statue and its enclosure, then the inescapable conclusion is that the entire plan of the Giza necropolis, including its three great pyramids and their satellite pyramids and temples, must have been conceived, if not also executed, during Predynastic times<sup>3</sup>.

## 2. The key dimensions and geodetic location of the Great Pyramid

Much ink has been spent to show just how the Great Pyramid supposedly incorporates the fundamental measurements of the Earth, or to disprove such claims. Yet a few key facts remain:

- The Great Pyramid sits almost exactly on the 30<sup>th</sup> parallel of latitude, at 1/3<sup>rd</sup> of the distance between the Equator and the North Pole. Furthermore, it has been claimed that the pyramid's latitude expressed in decimal degrees as 29.9792458 N codifies the speed of light as 299,792,458 meters/ second.
- Nor is the Great Pyramid the only Egyptian monument located at a significant geodetic location. In fact, the whole sequence of Egyptian temples along the Nile appears to have been determined according to sophisticated geodetic principles. As an example, we may cite the location of Thebes at a distance of 1/14<sup>th</sup> of the Earth's circumference from the Equator, of Siwa at 1/12<sup>th</sup>, Amarna at 1/13<sup>th</sup> and Philae at 1/15<sup>th</sup> <sup>4</sup>.
- The idea that the basic pyramid measurements would yield integer figures when expressed in the metric system is not as outlandish as it sounds, if one considers that the length of the meter is itself not arbitrary, but defined in relation to the dimensions of the Earth as the ten millionth part of the arc distance between the Equator and the North Pole (*or, alternatively, as the 1: 40,000,000<sup>th</sup> part of the earth's circumference*). Now, there is evidence that the ancients employed an even more precise definition of the meter than the one in use today, as shown for instance by the historian of science and professor Livio Stecchini<sup>5</sup>.

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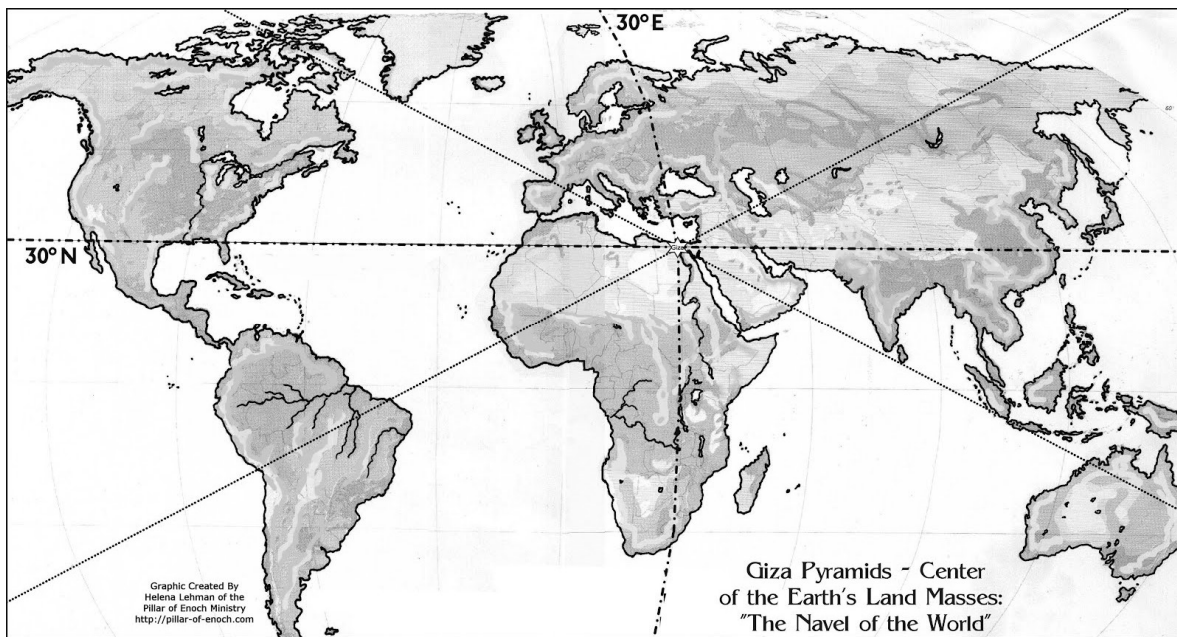
<sup>3</sup> For an overview of the controversy surrounding the age of the Sphinx see: Robert M. Schoch and Robert Bauval, *Origins of the Sphinx*, Rochester, VT: Inner Traditions, 2017.

<sup>4</sup> See: J.S. Gordon, *Land of the Fallen Star Gods: The Celestial Origins of Ancient Egypt*, Bear & Co, 2013.

<sup>5</sup> See Stecchini's Appendix to Peter Tompkins' 1971 book *Secrets of the Great Pyramid*, HarperCollins, 1971.

- An equivalent view to that proposed by Stecchini is also expressed by researcher William Fix, according to which the base perimeter of the Great Pyramid (921.543 meters) equals the value of a half degree of equatorial *latitude*. The same length measured from the corner sockets of the Great Pyramid pavement (927.722 meters) yields the value of a half degree of *longitude*<sup>6</sup>.
- The relationship of the Great Pyramid to the Earth is therefore 1:43,200. This may be demonstrated by multiplying the original height of the pyramid (147.1448 meters) by a factor of 43,200. This gives a value of 6,356,655 meters for the Earth's polar radius, being only 97 meters short of the modern figure<sup>7</sup>. Incidentally, the number 432 is also 1/60<sup>th</sup> of the duration of the precessional cycle of 25,920 years.

The list can continue, but these few facts should suffice to prove that the builders of the Great Pyramid were obviously in possession of a science of measurements and a knowledge of the basic dimensions of the Earth far in advance of what we could attribute to any known ancient Civilization or Culture, and superior in many respects even to 19<sup>th</sup> and early 20<sup>th</sup> Century geodetic science.

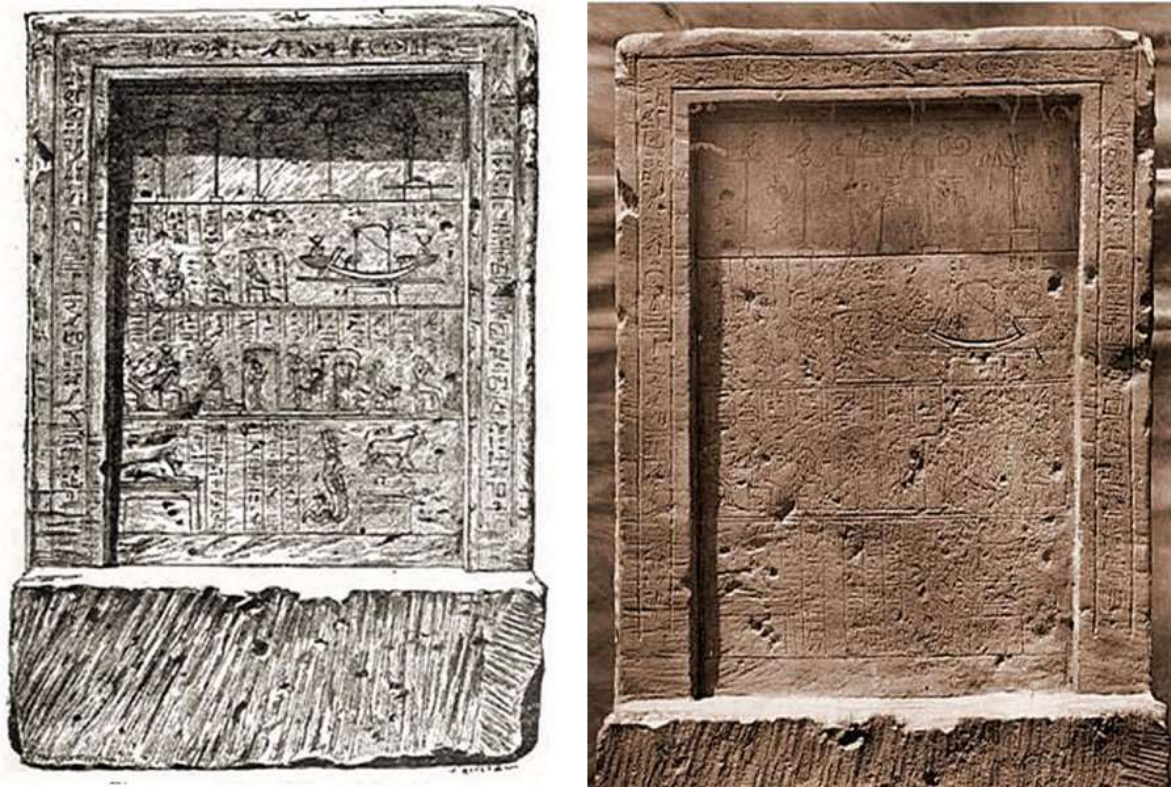


**Figure 3.** The Great Pyramid of Giza is located at the intersection of the longest line of latitude and the longest line of longitude, the exact center of all the land mass in the world. Courtesy of Helena Lehman.

<sup>6</sup> William Fix, *Pyramid Odyssey*, Smithmark Publishing, 1978.

<sup>7</sup> Ibid.

### 3. The Inventory stela



**Figure 4.** The 26<sup>th</sup> dynasty granite Inventory Stela, found near the Great Pyramid in 1858 and now in the Cairo Museum (JE 209). Image in the Public Domain. **Left:** Drawing by Gaston Maspero, *Guide to the Cairo Museum*, 1906. **Right:** Actual photograph.

The Inventory stela was discovered at Giza in 1858 during excavations of the small 26<sup>th</sup> Dynasty Isis temple located near satellite pyramid G1-c in the Great Pyramid's complex. While the dating of the stela to the 26<sup>th</sup> Dynasty (c. 670 BCE) is fairly certain based on stylistic considerations, and the stela's authenticity is not in doubt, considerable debate concerns whether the text on the stela should be considered, as the document itself claims, to be a faithful copy of an inscription dating back to the time of Khufu (c. 2590–c. 2568 BCE), or is in fact a 26<sup>th</sup> Dynasty fabrication created in order to increase the prestige of the Isis temple at Giza by claiming for it an Old Kingdom origin.

The stela suggests that Khufu *found* the Sphinx and the Temple of Isis (*significantly called by the title of "Mistress of the Pyramids"*) already in ruins, and restored them. These were not the only structures on the Giza plateau in the time of Khufu, for the stela also mentions a Temple of Osiris, Lord of Rostaw. According to the interpretation formulated by Manu Seyfzadeh and Prof. Robert Schoch of Boston University, the House of Isis mentioned on the stela should be identified with the Valley Temple of the Second Pyramid, later attributed to Khafre, rather than with the small 26<sup>th</sup>

Dynasty Isis temple near pyramid G1-c<sup>8</sup>. Of course the possibility exists that the two Houses of Isis and Osiris may in fact refer to the two largest of the three Giza pyramids, thus corroborating the idea that Khufu did not build the Great Pyramid, but either simply restored or enlarged it.

#### 4. The Westcar Papyrus



**Figure 5.** The Westcar Papyrus. Photograph taken in the Altes Museum, Berlin (Catalog number P3033). Image in the public domain.

The Westcar Papyrus is a collection of Ancient Egyptian texts dating to the 13<sup>th</sup> Dynasty of the Middle Kingdom (2,050 to 1,750 BCE). Most of the stories contained in the papyrus have the Old Kingdom pharaoh Khufu as their protagonist. One story in particular concerns Khufu's search for the "number [The plan?] of the secret chambers in the Sanctuary of Thoth". This is later said to be contained "in a casket of flint in a room called the Inventory in Heliopolis"<sup>9</sup>. Many researchers have seen in this passage an allusion to Khufu's search for an entrance into the Great Pyramid, here called the "Sanctuary of Thoth". Thoth, the god of knowledge and inventor of writing, later identified with the Greek Hermes, would become closely associated with the Great Pyramid during the Hellenistic period. Coptic and Arabic writers considered the Pyramid to be the tomb of Hermes and a repository of knowledge built by Hermes before the Flood. This tradition is believed to have originated with the Roman Jewish historian Flavius Josephus in the 1<sup>st</sup> Century CE, but could in fact have much older roots in the Middle and Old Kingdom period.

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<sup>8</sup> Manu Seyfzadeh and Robert M. Schoch, "The Inventory Stele: More Fact than Fiction, *Archaeological Discovery*, 2018, 6, pp. 103-161.

<sup>9</sup> A.M. Blackman, *The Story of King Kheops and the Magicians*, J.V. Books, 1988.

## 5. Manetho – First Dynasty Pyramids?



**Figure 6.** The Abydos Kings List, dating to the reign of Ramses II, possibly one of the original documents upon which Manetho based his *History of Egypt* in the 3<sup>rd</sup> Century BCE. Image in the public domain.

The Egyptian priest Manetho was the author in the early 3<sup>rd</sup> Century BC of a now lost *History of Egypt* in three volumes, fragments of which survive in the works of Josephus and of the Christian Fathers Sextus Julius Africanus and Eusebius of Caesarea. In his Kings List, Manetho assigns several thousands of years to the Predynastic period of Ancient Egypt before the First Dynasty. According to the list of Manetho, a certain king Uenephês, the fourth king of the First Dynasty, built the first pyramids in the country near Kôchômê. The exact location of Kôchômê is unknown, but it is believed that the name refers to a part of the Memphite necropolis comprising Giza and Sakkara<sup>10</sup>. It is certainly significant in this respect that the tomb of the First Dynasty king Enezib (*or Anedjib*) was built in the shape of a stepped pyramid *before* it was seemingly altered to a palace-façade mastaba. If true, this would push the origin of the pyramid structure at least to the time of the First Dynasty.

Manetho agrees, however, with Herodotus in claiming that the Great Pyramid was built by Suphis, the same king that Herodotus calls Cheops or Khufu.

<sup>10</sup> Manetho, *History of Egypt and Other Works*, translated by W.G. Waddell, Loeb Classical Library 350, Cambridge, MA: Harvard University Press, 1940.





**Figure 7.** A rare image of the stepped pyramid (Also known as Mastaba 3038) attributed to King Enezib, the fourth or fifth king of the First Dynasty, near Sakkara, dated to approximately 2,900 BC – 400 years earlier than the supposed date of construction of the Great Pyramid. After Walter B. Emery, *Archaic Egypt*, Penguin, 1961, pp. 142-145.

## 6. Esoteric tradition, Arabic and Coptic accounts of the Pyramids

The idea of the pyramids not being just tombs, but repositories of knowledge is certainly not a new one, and was a favorite subject of Coptic and Arabic writers of the early Middle Ages. It is through this channel that the idea probably made its way into the West until becoming a key part of western esoteric beliefs on the Pyramids.

Already in the 1<sup>st</sup> Century CE the Roman Jewish Historian Flavius Josephus spoke of the twin pillars erected by the Sethites in the Land of Siriad and inscribed with the knowledge of the time before Flood. The land of Siriad mentioned by Josephus is in fact no other than Egypt (*the term itself appears to be a corruption of Sirius, the star upon which the Egyptians based their Sothic calendar*). The word used by Josephus for “pillars” is also rather curiously rendered in the original Greek as *Pyramos* (*πυραμος*), also meaning Pyramid, instead of the familiar *Stylos* (*στύλος*) for column<sup>11</sup>.

Moving on to Medieval times, the Coptic Papyrus of Abu Hormeis, as translated by Vyse (*Operations Carried On at the Pyramids of Gizeh*, 1837) contains an account of the construction of the pyramids

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<sup>11</sup> Flavius Josephus, *Antiquities of the Jews*, Book I, Ch. 2, 3.

that claims to be a copy of an inscription found at Nineveh on a tablet of gold and copied during the reign of the Roman Emperor Diocletian (284-305 CE). The papyrus claims that the Pyramid was built as a tomb by the antediluvian king Surid. It also claims that upon its walls were written *“the mysteries of science, astronomy, geometry, physics, and much useful knowledge, which any person, who understands the writing, can read.”* It also mentions *“vast treasures”* and *“innumerable precious things”* enclosed inside the Pyramids before the Flood.

Many of the later Arabic sources, including al Mas’udi and al-Maqrizi, also maintain that the Pyramids were built before the Flood by the great antediluvian sages Hermes and Agathodaimon, which became later identified with the Hebrew patriarchs Enoch and Seth.

## **7. Different phases of construction, marked by significant differences in the quality of masonry and course thickness**

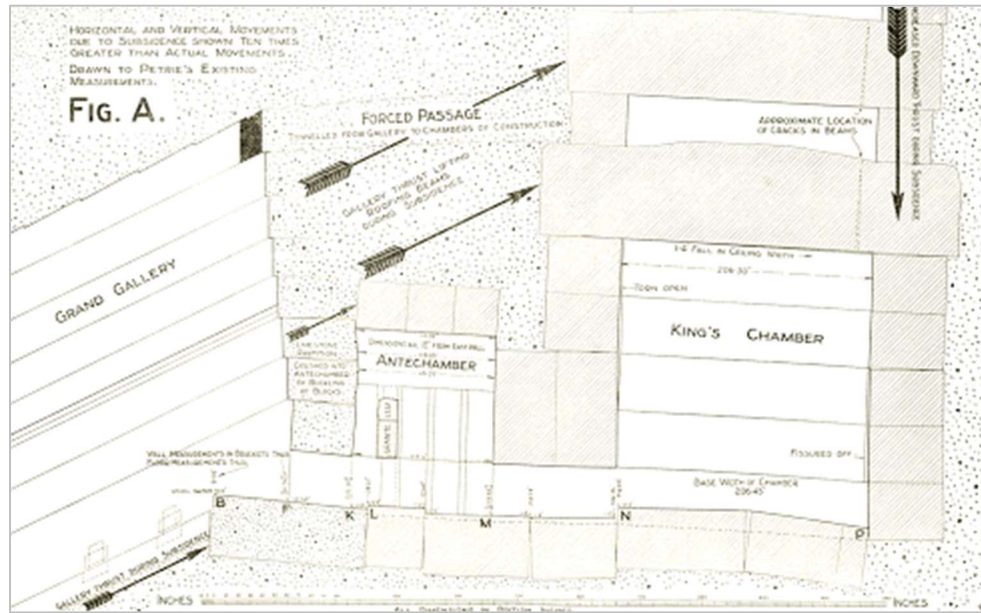
In his book *The Pyramids and Temples of Giza* the Egyptologist William M. Flinders Petrie remarked the great difference in the general workmanship and quality of construction that characterizes the three Giza pyramids.

More surprising are perhaps Petrie’s comments on the inferior execution of certain parts of the Great Pyramid itself. Within the King’s Chamber, he cites numerous examples of *“rough and coarse workmanship”* in the walls, floor and ceiling. These he calls truly *“astonishing”* and a show of *“how badly pyramid masons could work”* compared with the *“exquisite masonry of the casing and entrance of the Pyramid”*. This observation takes on a particular significance since it is above this chamber that the famous painted cartouches containing Khufu’s name were found; thus suggesting that this entire section of the pyramid, including the King’s Chamber, could be either a restoration or a new construction completed entirely during the reign of Khufu.

In another passage Petrie comments on the seemingly unexplainable change observed in the quality of construction:

*“During the course of building there was evidently a great change in the style of the work; a change, however, belonging more to the builders than to the masons. The pavement, lower casing, and entrance passage are exquisitely wrought; in fact, the means employed for placing and cementing the blocks of soft limestone, weighing a dozen to twenty tons each, with such hairlike joints are almost inconceivable at present;*

and the accuracy of the levelling is marvelous. But in the higher parts, the gallery, for instance, is far from such excellence; and the upper part of it is very skew and irregular, the ramp surface being tilted more than an inch in a width of 20 inches. In the Antechamber the granite has never been dressed down flat, and defective stones are employed; where the limestone was very bad, it was roughly plastered over, and many parts are strangely rough". [Pyramids and Temples of Giza, p. 171]<sup>12</sup>



**Figure 8.** Exaggerated subsidence distortion diagram of the King's Chamber and Antechamber inside the Great Pyramid. After D. Davidson and H. Haldersmith, *The Great Pyramid: Records*, vol. I, Williams and Norgate, 1948, plate XXV.

The following comment also appears interesting in relation to the King's Chamber mode of construction and the general accuracy of the higher portions of the Pyramid:

*"In the King's Chamber the masonry is very fine, both in its accuracy of fitting and in the squareness and equal height of all the blocks; but the builders were altogether wrong in their levels, and tilted the whole chamber over to one corner, so that their courses are 2 inches higher at the N.E. than at the S.W., a difference much greater than that in the whole base of the Pyramid. An error like this in putting together such a magnificent piece of work, is astonishing, for the walls are composed of nearly 1/10 of a mile length of granite blocks about 4 feet high, and probably as thick, all of which are gauged to the same height with an average variation of only 1/20 of an inch. As it would be difficult to*

<sup>12</sup> William M. Flinders Petrie, *The Pyramids and Temples of Giza*, London: Field and Tuer, 1883, p. 171

*suppose any architect allowing such errors of building, after so closely restricting the variations of masons' work, it strongly suggests that the granite had been prepared for the chamber long before it was built, and that the supervision was less strict as the work went on, owing to more hurry and less care, or owing to the death of the man who had really directed the superfine accuracy of the earlier work". [Pyramids and Temples of Giza, p. 171]<sup>13</sup>*

These comments by an authority like Petrie are particularly interesting as they seem to suggest one of two possible scenarios: Either the pyramid was completed in two phases, characterized by a very different level of technical workmanship and therefore likely separated by a significant amount of time; or some unexpected event, like the sudden death of Khufu, forced the builders to terminate hastily the rest of the monument. This second scenario, however, appears unlikely in light of the fact that it is the cartouche of Khufu, and not of one of his successors, that is found in the relieving chambers above the Great Pyramid. If Khufu had died before the completion of the King's Chamber, it would have been far more likely to find his successor's cartouche in the relieving chambers above the King's Chamber, whereas it is still the name of Khufu that we find in these chambers. For example, Djedefre, Khufu's successor and the man who likely buried him, left his own cartouche, and not Khufu's, in the boat pits next to the Great Pyramid, which were only sealed after Khufu's death. It is also extremely unlikely that Djedefre would have gone through the enormous task of completing his predecessor's pyramid (*which at this point only reached to a height of about 30 meters – the elevation of the 35<sup>th</sup> course of masonry, on which we will return later*), still less than halfway completed and lacking moreover its entire casing. This leaves open the possibility that Khufu "found" an incomplete pyramid, which he completed with the addition of the King's Chamber and the stone courses above it.

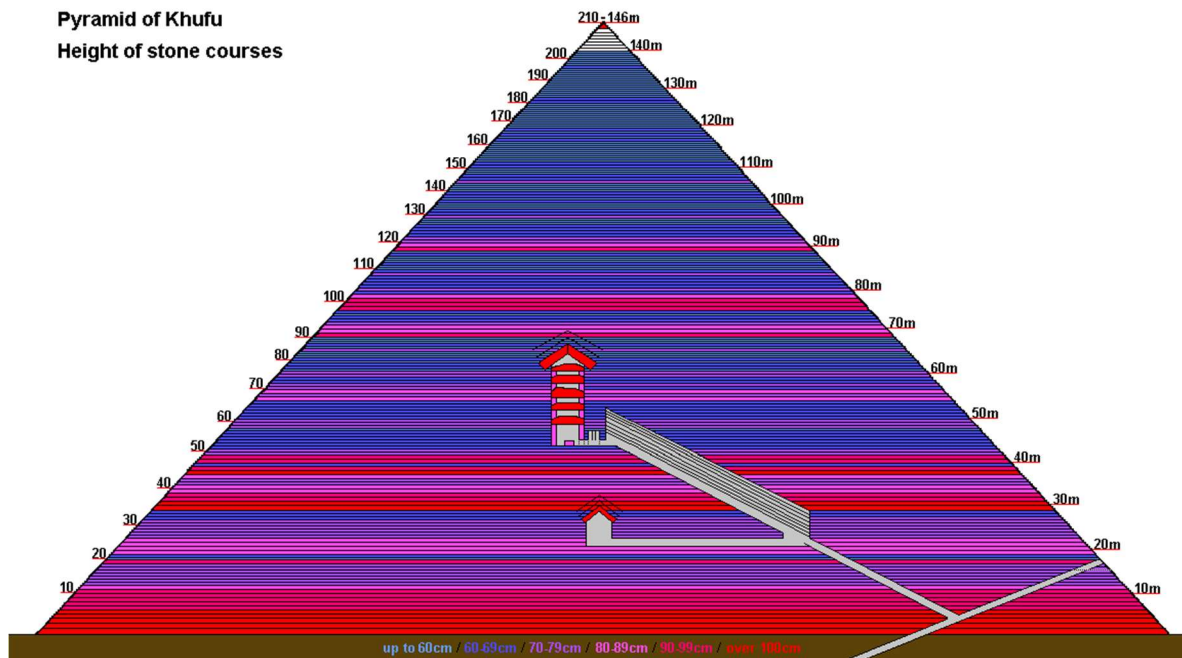
We can identify the exact point where one phase of construction stopped and another one began at the level of the 35<sup>th</sup> course of masonry. This course, located at a height of about 30 meters, is significant for it is, at 127 cm high, the thickest course in the entire pyramid, aside from the first base course<sup>14</sup>. While there is presently no commonly accepted explanation for the variation in height of the different courses (*The courses numbered 44, 90, 99 and 108 are also significantly thicker than the ones immediately above and below them*), the change in workmanship observed by

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<sup>13</sup> Ibid., p. 171

<sup>14</sup> See: Franz Lohner, <https://www.cheops-pyramide.ch/khufu-pyramid/stonecourses-pyramid.html>. On-line resource. Last accessed January 29<sup>th</sup>, 2021.

Petrie above this course suggests that the original pyramid-platform only reached up to this height before the time of Khufu.



**Figure 9.** Diagram showing the different thickness of the stone courses in the Great Pyramid. The highest stone courses are shown in red. After Franz Lohner, <https://www.cheops-pyramide.ch/khufu-pyramid/stonecourses-pyramid.html>.

Similarly, an obvious change in workmanship may be seen in the Second Pyramid, attributed to Khafre, after the first six or seven courses, at a height of approximately 10 meters (*Unfortunately no precise measurements of the courses of the Second and Third Pyramid exists*). These first lower courses are in fact more similar to a cyclopean stone platform, built of immense limestone megaliths like the ones found in the Sphinx and Valley Temple as well as in the Upper (so called “mortuary”) Temple of the Second Pyramid – some of which are estimated to weight between 200 and 400 tons. The Third Pyramid may also have been completed in two phases, as suggested by its unfinished granite casing only reaching to a height of 16 courses. Interestingly, Petrie considered the quality of the core masonry of this pyramid to be second to none and equal at least to the Great Pyramid’s; this in spite of the obvious alterations and very rough workmanship of the Third Pyramid’s interior chambers and passageways.

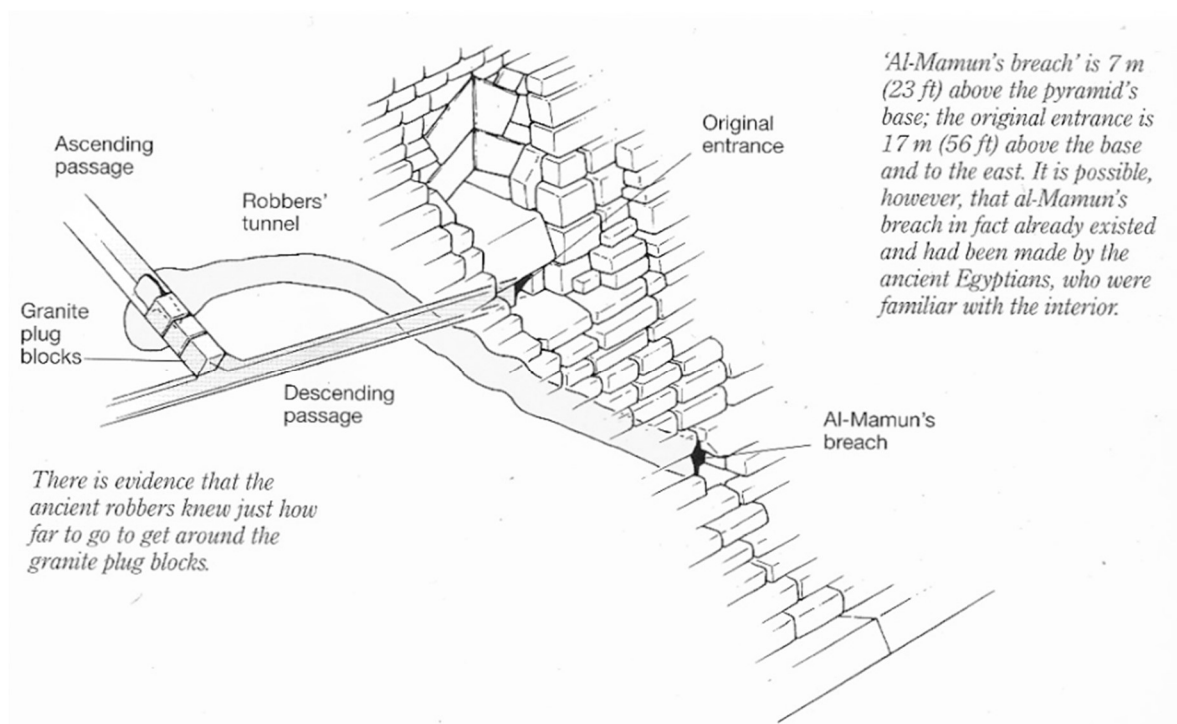
From all this evidence presented so far it appears possible, and indeed highly probable, that the 4<sup>th</sup> Dynasty kings Khufu, Khafre and Menkaure did not in fact build the three Giza Pyramids, but either completed or restored some already existing megalithic structures. These would have then

looked more like some immense flat-topped platforms than pyramids. Their additions, moreover, appear to be of far inferior workmanship to that exhibited by the earlier, pre-4<sup>th</sup> Dynasty structures.

We will refrain at this point from any speculation concerning the age of these early megalithic structures, except in saying that their origin appears to be at least Predynastic.

## 8. Ancient intrusions into Great Pyramid

An aspect of the Great Pyramid construction that has never been quite adequately explained is the origin of the forced passages known as Al-Mamun's tunnel and the "Well-Shaft" connecting the Subterranean Chamber to the Grand Gallery. The conventional explanation is that Al-Mamun's tunnel was dug by the Caliph Al-Mamun in 820 CE to enter the Great Pyramid, at a time when the location of its original entrance was no longer known. The absurdity of such an idea, however, becomes apparent when one considers that the original entrance to the Great Pyramid was never truly lost and was certainly known in antiquity (*as evidenced by the ancient graffiti found in the Subterranean Chamber*). It is moreover found only a few meters above Al-Mamun's breach. All this suggests that the tunnel was not dug from the outside, but rather from the inside out.



**Figure 10.** Diagram of Al-Mamun's tunnel (here called Robbers' tunnel), showing position with respect to the original entrance into the Pyramid and descending passage. This tunnel was dug by someone with an obvious knowledge of the internal structure of the Great Pyramid, so it is even stranger that they would have not chosen to enlarge the already existing descending passage instead. From Mark Lehner, *The Complete Pyramids*, Thames & Hudson, 2008.

In our opinion, this tunnel was dug to either introduce or remove *something* from inside the Great Pyramid. What this *something* was we may never know, but it was certainly a sizable object that could not have fit through the narrow descending corridor.

If the tunnel was dug from the inside out, by people who knew the internal plan and layout of the Pyramid, these same people must have first been able to penetrate the upper chambers from a point above the granite plugs blocking the ascending passage. It is unclear, however, why these same people would have then dug a new tunnel leading to the exterior of the Pyramid instead of simply enlarging the descending passageway (*which was by then open and accessible*) after bypassing the granite plugs, if their intention was simply to take something in or out of the Pyramid.

The very crude “Well-shaft” is another forced passage dug to connect the lower Subterranean Chamber with the base of the Grand Gallery. The general consensus is that this shaft was created to allow an escape route to the men in charge of the King’s burial after the granite plugs were lowered down the ascending corridor. However, it could also have been built by people with knowledge of the internal layout of the Pyramid to reach the upper chambers while bypassing the granite plugs.

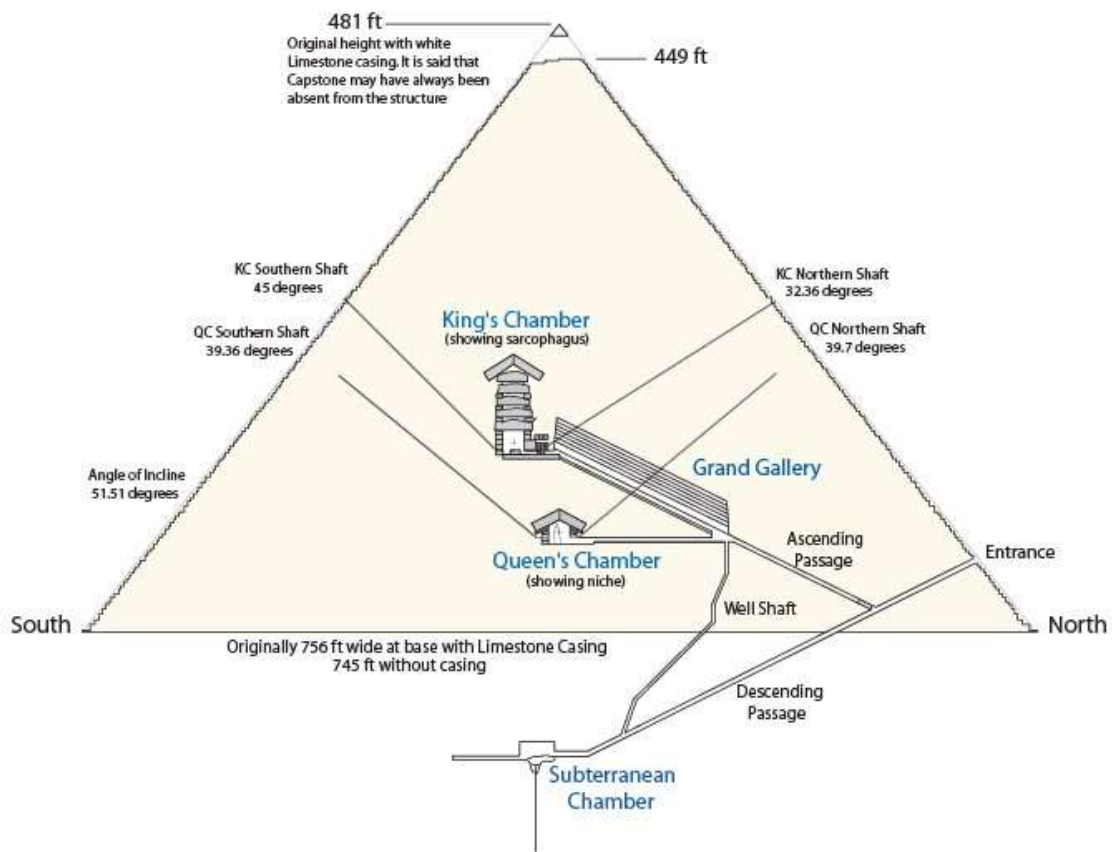


Figure 11. Interior diagram of the Great Pyramid showing the position of the so-called “Well-Shaft”. From Wikipedia.

Whatever the purpose of this shaft, it is clear that it was never intended to be part of the original construction and was at best an afterthought. Whoever dug it, moreover, certainly possessed an accurate knowledge of the internal distribution of the Great Pyramid, so that this tunnel can be in no way attributed to medieval or even ancient intruders. This brings to mind the enigmatic description contained in the Westcar Papyrus of Khufu's search for the "*number of the secret chambers in the Sanctuary of Thoth*". Was this some ancient plan or diagram of the Great Pyramid? If so, Khufu or one of his successors may have dug the so-called "Well-shaft" in order to access the upper chambers of the Great Pyramid (*which must have been by then already sealed or otherwise inaccessible*). To this same epoch may also date Al-Mamun's tunnel, which may have been dug to either allow the removal of something from the Great Pyramid, or else the insertion of a sizable object like Khufu's sarcophagus, which would have been impossible to introduce in the Pyramid through the narrow Well-shaft.

## **9. Inconsistencies in the timeline of construction**

Classical sources from Herodotus to Diodorus Siculus and Pliny the Elder state that it took 100,000 men over 20 years to build the Great Pyramid. This is an incredibly short period of time if we consider the many generations and even centuries required to build some of the most famous European cathedrals, whose total volume however pales in comparison to that of the Great Pyramid.

The Pyramid is believed to contain an estimated 2.3 million stone blocks, weighting an average of 2.5 tons each. The heaviest granite beams in the King's Chamber weigh an estimated 50-80 tons and are the largest stone blocks employed in the entire Pyramid.

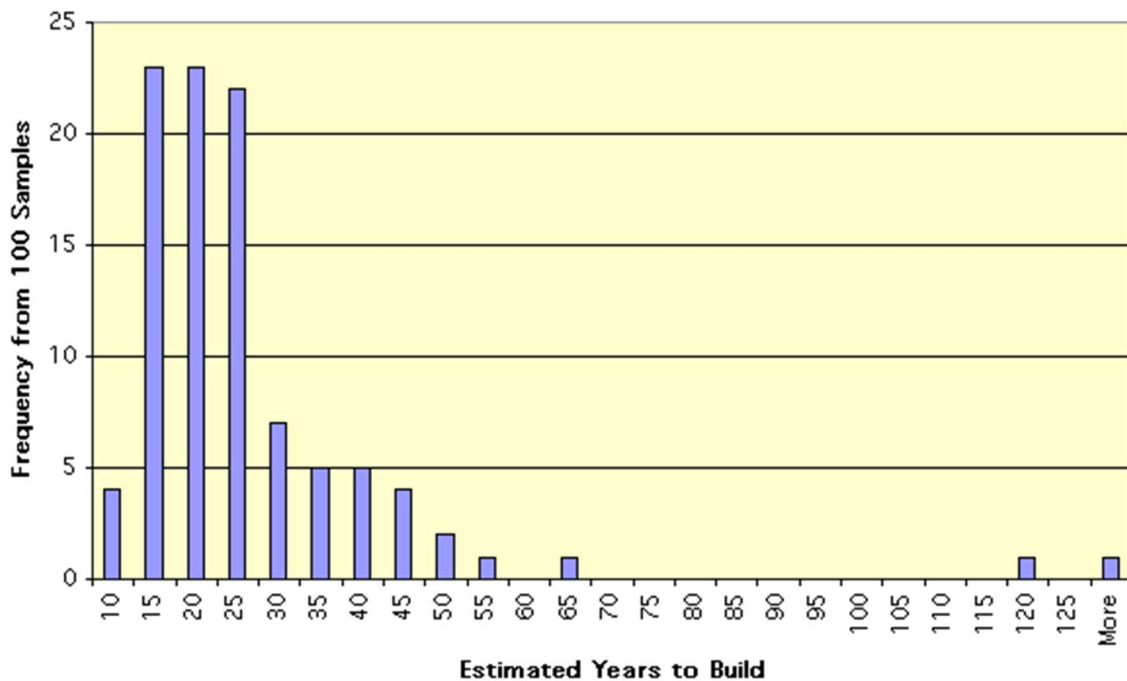
A simple calculation shows that, in order to complete the Pyramid in 20 years, it would have been necessary to lay one stone every 2 minutes, or 32 blocks an hour, assuming a 10-hour work-day and 365 working days a year. This average, however, is misleading for it does not consider the much greater work required to raise a stone to a height of over 100 meters up the pyramid than in one of the base courses. This is even without entering into any discussion of how the stones were raised. The stones would have had to be quarried, transported, cut into shape and raised to their desired location up the pyramid. While most of the stone came from nearby quarries, the fine Turah limestone used for the casing came



from quarries located on the opposite bank of the Nile, at a distance of some 20 kilometers from Giza.

Professor Derek K. Hitchens has since made available on his website what is possibly one of the most reliable and accurate models of how much time and how many men it would have taken to build the Great Pyramid using only 4<sup>th</sup> Dynasty technology. His estimate substantially confirms the figure of Herodotus by suggesting a likely build time of between 24 to 25 years and a peak workforce of between 60,000 and 100,000 men during the time of inundation. These estimates come, however, with a significant degree of uncertainty, since a simple change in the simulation parameters can result in build teams of as low as 10 years or as high as 120 years or more<sup>15</sup>. At any rate, this would have been one of the largest workforces ever employed on a single project in the history of mankind.

**Distribution of Estimated Building Times—Khufu Necropolis**



**Figure 12.** Statistical distribution of estimated building times required to build the Great Pyramid based on 100 simulation runs. After Prof. Derek Hitchens, “The Pyramid Calculator”, <https://egypt.hitchens.net/the-pyramids/the-pyramid-calculator/>.

<sup>15</sup> Derek K. Hitchens, “The Pyramid Calculator”: on-line: <https://egypt.hitchens.net/the-pyramids/the-pyramid-calculator/>

The question is – *Could 4<sup>th</sup> Dynasty Egypt have sustained such a large workforce?*

We do not know with certainty what the total population of Egypt was during Old Kingdom times, but estimates range between 1 and 1.5 million<sup>16</sup>. This was of course the *entire* population of Egypt. If we only consider the area around Memphis, this number should be reduced by at least a factor of 3 or 5. This gives a population of between 250,000 and 500,000 people in the Memphite region that could have been conscripted for work on the Great Pyramid. Modern census data shows the working age population to typically represent between 50% and 70% of the total population of any given country, that is excluding children below the age of 15 and the elderly. Since only the men would have been directly employed in the construction of the Pyramid, we should further reduce this figure by half. This puts the total number of working-age men that could have been conscripted for work on the Great Pyramid to between 75,000 and 150,000.

With between 60,000 and 100,000 men employed at any time for building the Great Pyramid, this would have left hardly anyone left to tend the fields in the entire Memphite region (which itself represented between one third and one fifth of the total population of Egypt at the time). To assume a lower number of men employed in the construction of the Great Pyramid - say half the figure – would have at least doubled the total time required for construction from about 25 years to over 50 years. This makes it increasingly unlikely that a single king, in this case Khufu (*whose regnal length was recorded as 23 years, according to most sources*) could have alone completed the Great Pyramid during his lifetime.

## **10. Where are the workers' houses, tombs, tools, etc.?**

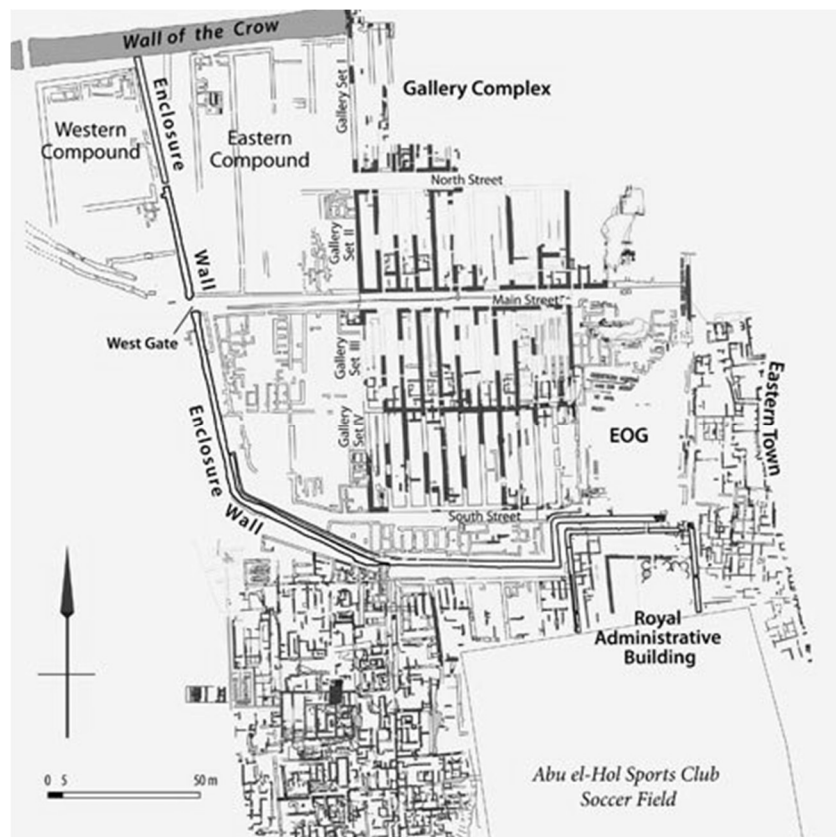
The discovery in 1988 of the “Lost City” of the pyramid builders 400 meters south of the Sphinx made global headline news and is still often cited as confirmatory evidence that Khufu did indeed build the Great Pyramid. Upon closer examination, however, the capacity

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<sup>16</sup> See: Steven Snape, *The Complete Cities of Ancient Egypt*, New York: Thames & Hudson, 2014

of the supposed “City” appears totally inadequate for housing the population of tens of thousands required for the construction of the Great Pyramid and its Pyramid complex.

So far, according to Egyptologist Mark Lehner, only about 10 acres of this “Lost City” have been mapped and documented, and it is unlikely that given the geography of the plateau the settlement could have been much larger<sup>17</sup>. Estimates of population density in ancient times are notoriously difficult to make, but the number most commonly used for estimating the population of ancient settlements in Egypt and Sumer is 200 persons per acre. This is not taking into account the fact that, in reality, a large number of buildings in the supposed Pyramid City were in fact not habitational, but administrative or dedicated to storage and other productive or manufacturing activities.



**Figure 13.** A map of the alleged “Lost City” of the Pyramid builders near Giza. The total size of the settlement is only a few football fields. From the PBS – Nova website: <https://www.pbs.org/wgbh/nova/article/lehner-giza/>. Last accessed January 29<sup>th</sup>, 2021.

<sup>17</sup> See: Linda Meadows, “Mark Lehner and the Lost City of the Pyramid Builders”. On-line resource: <https://www.robinsongardens.org/mark-lehner-and-the-lost-city-of-the-pyramid-builders/>, last accessed January 29<sup>th</sup>, 2021.

Even assuming that only half of the settlement has been excavated, while the rest still lies buried under the desert sands, the town could have hardly housed a population of more than 2,000 to 4,000 units. This is of course nowhere close to the 60,000 or 100,000 men that would have been required at peak for building the Great Pyramid.

At best, this small settlement (*whose habitational areas covered an area only slightly larger than those of Deir el Medina, another Pharaonic village that served the Valley of the Kings near Thebes*), would have scarcely been able to house the population required for building the dozens of elite tombs, mastabas and satellite pyramids that formed part of the Great Pyramid complex. One would also expect to find there mountains of discarded tools like stone hammers, pounders, axes and maces (*not to mention the metal chisels and utensils, that would have likely been melted again to recover the valuable metal, rather than scrapped*). Yet only a very small number of these tools have been found.

Very few tombs on the Giza plateau can also be attributed with any degree of certainty to the workers responsible for the construction of the Giza necropolis. Only a handful of these tombs can be dated to the reign of Khufu.

Where is then the evidence for the tens of thousands of workers that would have been required for building the Great Pyramid in the time of Khufu, not to speak of the other two Giza pyramids and the countless other tombs that form part of the Giza necropolis?

## **11. Pyramid (d)evolution**

The 4<sup>th</sup> Dynasty pyramids represent absolute outliers in the panorama of Egyptian dynastic history. The current model of how the pyramid form supposedly evolved from the earlier mastaba tomb fails entirely to explain the incredible leap in technology and workmanship that one observes between the still comparatively crude step pyramid of Djoser at Sakkara and the first true pyramids of Giza, Meidum and Dahshur. It also fails to explain the sudden and incomprehensible decline in pyramid building technology witnessed after the end of the 4<sup>th</sup> Dynasty. It is as if, after having perfected the pyramid form with the three Giza Pyramids in ways that would be hard to replicate even with the aid of modern technology,

the 5<sup>th</sup> and 6<sup>th</sup> Dynasty kings reverted to the much simpler techniques of the Third Dynasty. These monuments are not only significantly smaller, but also far more primitive in terms of construction techniques, consisting of a rubble or mudbrick core encased in limestone blocks. The extensive reuse of allegedly 4<sup>th</sup> Dynasty granite and basalt elements by the 5<sup>th</sup> and 6<sup>th</sup> Dynasty kings further shows that the builders of that time lacked the technology to create similar artefacts, and had therefore to resort to plundering earlier monuments for the purpose of decorating their own funerary complexes.



**Figure 14 and 15.** The Pyramid of Khafre (Left), majestically standing guard over the Giza plateau with part of its original casing still intact near the summit. Photo by Author. Compare to the ruined pyramid of Unas (Right), last king of the 5<sup>th</sup> Dynasty. From Wikipedia.

We can only make sense of this reversed evolution scenario by assuming that so many of the alleged 4<sup>th</sup> Dynasty structures and pyramids were simply appropriated by the kings of that dynasty and must be therefore the work of a civilization that vanished long before the Dynastic period and was in possession of a technology for cutting, moving and raising huge blocks of stone far in advance of that of the Dynastic (*and, for what we know, also Predynastic*) Egyptians.

This apparent paradox is even better exemplified by the following charts showing the utter disproportion between the individual and combined volume of the alleged 4<sup>th</sup> Dynasty Pyramids with that of all previous and later pyramids built in Egypt over the course of over a thousand years. In fact, the Great Pyramid alone contains more stone than all the pyramids built in Egypt either before or after the time of the 4<sup>th</sup> Dynasty combined.



These charts still fail to take into account the difference in construction techniques between the 4<sup>th</sup> Dynasty pyramids (*the sole to possess a solid masonry core*) and all the other previous and later pyramids, whose core consists exclusively of mudbrick and rubble.

## 12. Anomalous Radiocarbon and OSL dates

While the pyramids themselves cannot be dated, it is possible however to date organic materials found in their interior, and even in some cases the epoch when a stone surface was last exposed to direct sunlight during construction.

Numerous samples of wood and other organic materials from all three Giza Pyramids have been subject to Radiocarbon dating, producing a broad range of dates. A first attempt at Radiocarbon dating the three Giza Pyramids was conducted in 1984, yielding dates for all three pyramids that were on average 374 years older than the accepted Old Kingdom chronology. A second dating project in 1995 produced dates closer to the standard Egyptian chronology by 200 to 100 years, but with a significantly broader range. One possible explanation advanced by Egyptologists for these earlier dates is that “old wood” was somehow incorporated in the construction of later pyramids<sup>18</sup>.

Even accounting for the wide range of dates obtained from the samples, these do not appear to be sufficiently removed from the accepted dates for the reigns of Khufu, Khafre and Menkaure to invalidate *per se* their Pyramids’ attribution. A key limitation of Radiocarbon dating, however, is that this method only allows to date organic materials, but not the structures themselves. There is always the possibility that these materials were introduced at a later time, perhaps during repairs or restorations of the original structures.

A novel dating method called OSL (*Optically Stimulated Luminescence*), developed by Professor Ioannis Liritzis of the University of the Aegean and already successfully applied to the dating of Greek monuments, allows to date with reasonable accuracy the epoch in which a covered stone surface was last exposed to direct solar radiation (*usually at the time*

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<sup>18</sup> See: “Dating the Pyramids”, *Archaeology*, vol. 52, No.5, September/ October 1999.

of construction). In 2014 this dating method was applied to several Ancient Egyptian monuments, with surprising results.

Although no samples were taken from either the Great Pyramid or the Second Pyramid, dates were obtained for the Valley Temple of Khafre, the Sphinx Temple and the Menkaure Pyramid. The earliest date obtained for the Valley Temple was  $3,060 \pm 470$  BCE. A granite block sample from the Sphinx Temple also yielded a date of  $3,100 \pm 540$  BCE. The earliest date from the Giza Plateau came however from the Menkaure pyramid, where a block of the granite casing yielded a date of  $3,450 \pm 950$  BCE. This last date in particular is almost a millennium earlier than the supposed dates of reign of Menkaure ( $2,490$ - $2,473$  BCE)<sup>19</sup>.



**Figure 16.** A view of the unfinished granite casing and floor of the Menkaure Pyramid, where the sample for OSL dating was taken. Note how only the central portion of the casing of each Pyramid's face was smoothed, whereas the remaining blocks were left in the rough. Image in the public domain. From Wikipedia.

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<sup>19</sup> Ioannis Liritzis and Asimina Vafiadou, "Surface Luminescence dating of some Egyptian Monuments", *Journal of Cultural Heritage*, June 2014



While it is true that, in principle, the upper range of these dates obtained by Optically Stimulated Luminescence would fit (*although barely*) the accepted timeline of the 4<sup>th</sup> Dynasty, there is an equal probability that the lower range dates are the correct ones. These would date the construction of at least the two megalithic temples near the Sphinx – the Valley and the Sphinx temple, and of the Third Pyramid, to between 4,400 and 3,530 BCE.

In the case of the Menkaure Pyramid, it is worth noting that the only dated sample was taken from the outer granite casing, which would have been the last part of the pyramid to be completed. The core of this pyramid may therefore turn out to be much older.

Unless samples are taken from the core of each pyramid, the possibility remains that these dates, although already earlier than the 4<sup>th</sup> Dynasty period, may however refer to repairs or restorations of the structures, rather than to their original epoch of construction.

### 13. Iron artefacts in the Great Pyramid?

It is generally believed that the only metals known to the Pyramid Builders in the time of Khufu and adapt for making tools were arsenical copper and some early forms of bronze.

It is also believed that iron was not introduced in Egypt until at least 1,500 BCE, and then only from the Middle East and the Levant. It is therefore surprising to find out that a piece of wrought iron was discovered in 1837 by Howard Vyse near the mouth of one of the air shafts of the Great Pyramid, which his discoverer proclaimed "*the oldest piece of wrought iron known*". While meteoric iron was known since prehistoric times, the production of wrought iron of non-meteoritic origin required metallurgical techniques that would not be introduced in Egypt for at least another thousand years from the supposed time of construction of the Great Pyramid. Vyse himself certified that the piece of iron in question:

*"was taken out by me from an inner joint, after having removed by blasting the two outer tiers of the stones of the present surface of the Pyramid; and that no joint or opening of any sort was connected with the above-mentioned joint, by*

which the iron could have been placed in it after the original building of the Pyramid.” [Howard Vyse, *Pyramids of Gizeh*, I, p. 276]<sup>20</sup>

As to further dispel the possibility of fraud, Petrie observed that the artefact still bore the cast impression of a nummulite fossil, which proved beyond a doubt that the piece must have been buried for ages between two blocks of nummulitic limestone<sup>21</sup>.



**Figure 17.** A picture of the iron plate discovered by Vyse in 1837 in a joint between two blocks of the Great Pyramid. Photo © copyright El Gayar and Jones, *JHMS*, 23/2 1989, Fig. 1a, p. 76.

While initial studies described the manufacturing technique of the iron piece as “primitive”, a more recent 1993 study suggested that the chemical profile and physical characteristics of the plate are indicative of the use of a blast furnace process, which is only believed to have reached the Middle East in the post-medieval period. To the two authors of the study, this is evidence of the non-ancient or modern origin of the plate<sup>22</sup>.

If we believe the words of Vyse, however, it is entirely impossible that the artefact could have been introduced in the joint between the two blocks where it was found after the construction of the Pyramid. *Who then possessed blast furnaces over 4,500 years ago?*

## 14. Mechanical methods of the Pyramid builders

The level of workmanship exhibited by numerous Egyptian artefacts suggests the use of mechanical methods for working, drilling and cutting stone, such as would hardly have been

<sup>20</sup> Howard Vyse, *Operations carried on at the Pyramids of Gizeh in 1837, 1840-2*, Vol. I, p. 276

<sup>21</sup> William M. Flinders Petrie, *The Pyramids and Temple of Gizeh*, 1883, pp. 212-13

<sup>22</sup> Paul Craddock and Janet Lang, "Gizeh Iron Revisited", *Journal of the Historical Metallurgy Society*, Vol. 27 No. 2, 1993, pp. 57-59

available during the 4<sup>th</sup> Dynasty period, and indeed during much of Egyptian history until very recent times. In some cases, the level of finish and the tool marks left on some of the artefacts are suggestive of a level of technology that could not be matched even with the finest machinery and equipment of today. The mechanical methods of the Pyramid Builders have been discussed at length by several authors, including the renowned master craftsman and engineer Christopher Dunn. Many of the questions brought forth by Dunn have not yet been addressed by professional Egyptology.

Some of the most astounding Egyptian artefacts providing evidence of the level of technology available in antiquity are those representing tubular drilling in very hard stones like granite, basalt and diorite. Some examples of this technique had already called the attention of the 19<sup>th</sup> Century Egyptologist William Flinders Petrie, who in his book on the Pyramids and Temples of Giza left the following account of tool marks that left a spiral groove on a granite core:

*“The spiral of the cut sinks .100 inch in the circumference of 6 inches, or 1 in 60, a rate of ploughing out of the quartz and feldspar which is astonishing”* [William M. Flinders Petrie, *The Pyramids and Temples of Giza*, 1886, p. 177]

Petrie had good reasons to find this rate of ploughing astonishing, for the technology to achieve such results did not exist yet in 1886. According to Dunn, even modern granite diamond drills of the diameter of the sample described by Petrie, rotating at 900 revolutions per minute, can only penetrate at a rate of 1 inch in 5 minutes, or 0.002 inch per revolution. This means that whatever tools the ancient Egyptian used for drilling into granite had a feed rate *500 times* greater than even modern diamond tools<sup>23</sup>.

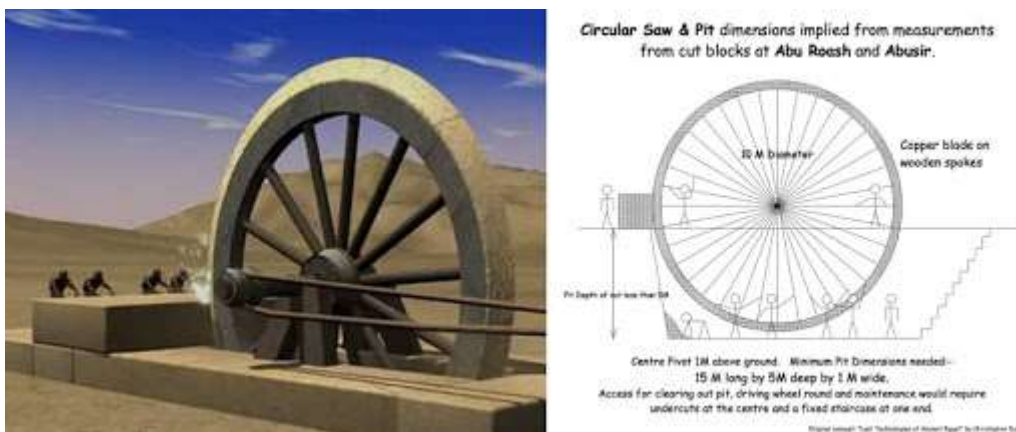
This artefact is by no means unique, for hundreds more examples can be cited from Egyptian temples and pyramids of perfectly drilled holes through very hard stones like granite, basalt and diorite, straight and circular saw marks of incredible radius, and even

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<sup>23</sup> Christopher Dunn, “Advanced machining in Ancient Egypt”, on-line resource, last accessed January 29<sup>th</sup>, 2021: <https://www.theglobaleducationproject.org/egypt/articles/cdunn-1.php>

tridimensional contouring of the kind that could only be achieved on a modern CNC numerical control machine.

Among these, a particularly remarkable artefact comes from the ruined 4<sup>th</sup> Dynasty pyramid of Abu Rawash, attributed to Khufu's successor Djedefre. The artefact in question is a single slab of granite displaying unmistakable saw marks left by what must have been a huge circular saw. In order to produce the type of precise cut observed on the stone, the saw employed must have had the incredible diameter of nearly 10 meters or 35 feet. Even more perplexing is the fact that the radius is not only constant throughout the surface of the stone, but also through its depth, to create a slight concavity. To obtain such a result the axis of the saw should have been able to move freely in three dimensions, something nearly impossible to imagine for a saw of that diameter<sup>24</sup>.



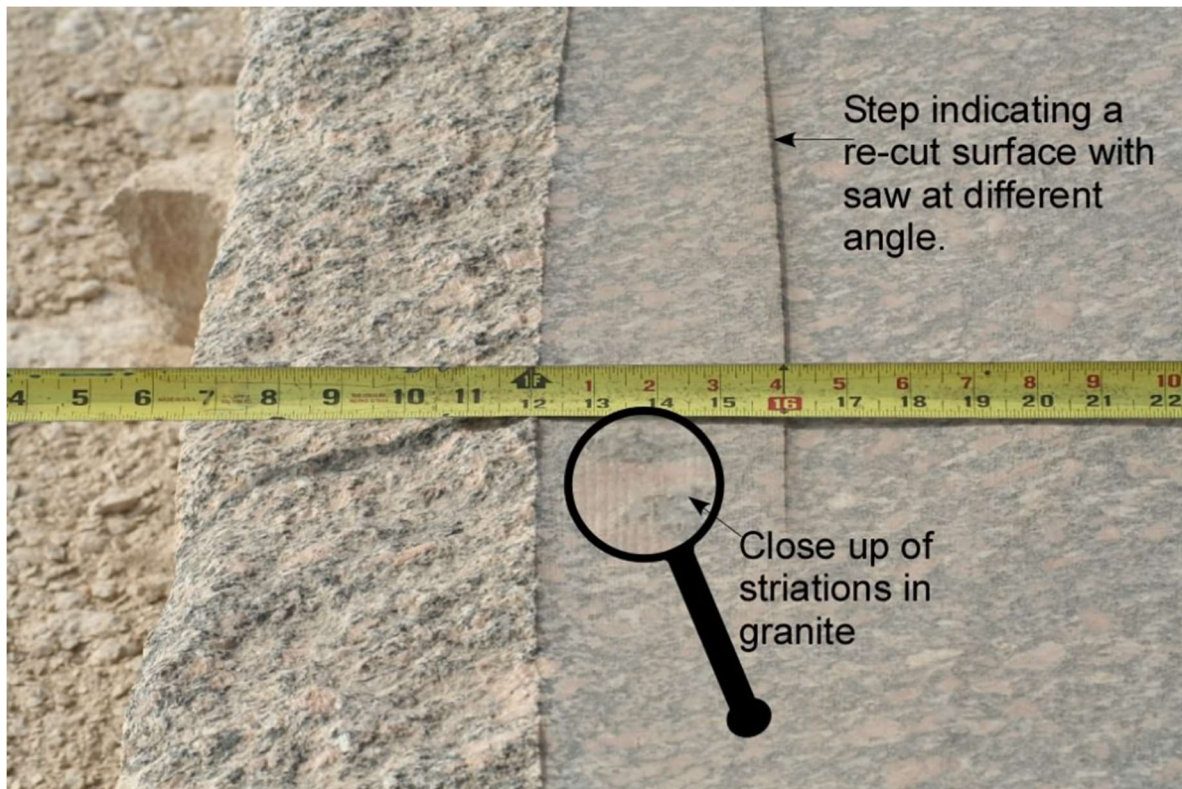
**Figure 18.** Artist's reconstruction of the huge circular saw of more than 10 meters in diameter required to produce the saw marks found on a granite slab from Abu Rawash. Left: History Channel. Right: Christopher Dunn, *Lost Technologies of Ancient Egypt*, 2010.

Even more astonishing is the fact that the technology to produce these artefacts seems to have been present since the time of the earliest Dynasties, whose achievements in working with hard stones were never replicated throughout the rest of Egyptian history: A cache of over 40,000 hard stone bowls and vessels was discovered in tunnels dug under the 3<sup>rd</sup> Dynasty Pyramid of Sakkara<sup>25</sup>. These vessels, of various forms and shapes, are often

<sup>24</sup> See: Christopher Dunn, *Lost technologies of Ancient Egypt*, Bear & Company, 2010

<sup>25</sup> Joshua J. Mark, "The Step Pyramid of Djoser at Sakkara", on February 14, 2016. On-line resource: <https://www.ancient.eu/article/862/the-step-pyramid-of-djoser-at-saqqara/>, accessed January 29<sup>th</sup>, 2021

inscribed with the names of the kings of earlier dynasties (*although it is possible that these were added long after the original vessels were carved*). The vessels show evidence of turning by lathe and drill marks identical to the ones described by Petrie in other granite artefacts from Giza.



**Figure 19.** A close-up view of a carved granite stone slab from Abu Rawash showing circular saw marks. After Christopher Dunn, <http://gizapower.com/Abu/index.htm>, 2006. On-line. Last accessed January 29<sup>th</sup>, 2021.

## 15. Repairs and surface block erosion of Dahshur pyramids

Because of the great similarity in the techniques employed for their construction, the dating of the three pyramids attributed to the 4<sup>th</sup> Dynasty king Snefru at Dahshur and Meidum also has direct implication on the dating of the three great Giza Pyramids.

The Bent Pyramid of Dahshur is a particularly interesting case study as it is the only one of the great 4<sup>th</sup> Dynasty Pyramids to have preserved a substantial part of its original casing virtually intact – perhaps as a consequence of the particular way the casing stones were laid on sloping rather than horizontal planes.

As observed by author Ralph Ellis, the visible casing of this pyramid appears to be a mix of perfectly white and smooth stones, having an almost “new” appearance, with other very eroded stone blocks whose surface has detached in places leaving deep holes in the façade. Ellis believes this is due to the fact that new pieces of limestone were added in antiquity where the surface of the original stone blocks had fallen off. He also notes that only the outer face of the stone was taken away and replaced, since each casing stone is over 2 meters long and deeply encased in the underlying masonry of backing stones.



**Figure 20.** The magnificent Bent Pyramid of Dahshur, with a large part of its casing still intact. From Ivrienen at English Wikipedia.

If this pyramid was repaired at some point in antiquity, the most likely scenario is that Snefru was the author of the renovations, which also seemingly extended to the interior of the pyramid. The upper chamber in particular appears to have been deliberately filled with a rough masonry of small stone blocks, and still contains a substantial cedar-wood scaffolding. According to Ellis:

*“We can now speculate that the repairs we can see seem to have lasted the last 4,600 years without further attention; thus it would be sensible to assume that 4,600 years would be the minimum time required before the pyramid began to look shabby and the first repairs were made. If this is so, then the minimum age for the pyramid is some 9,200 years ago. The extent of the repairs, however, indicate that much more time passed before the first repairs were made. If the time period to the first repairs were double the 4,600 years, then the construction of this pyramid would have been 13,800 years ago.” [Ralph Ellis, “Pyramid Repairs”. On-line: <https://www.artifice-design.co.uk/rosetau/repairs.html>]<sup>26</sup>*

If such extensive repairs were also conducted by the other 4<sup>th</sup> Dynasty kings Khufu, Khafre and Menkaure on the three Giza Pyramids, then it becomes possible to explain such finds as the presence of Khufu’s cartouche in various points inside the Great Pyramid and also on some of its outer casing stones as the result of the renovations conducted by this king on the Pyramid.

## Conclusion

The most logical conclusion from all the evidence presented so far is that Khufu did *not* build the Great Pyramid, but instead restored and possibly completed an already existing and far older structure on the Giza Plateau.

We may venture even further to suggest that the Great Pyramid was completed in at least three different phases of construction, all seemingly following a unified plan evidently conceived in very remote antiquity. These phases show significant variations in both the quality and accuracy of the work, for which the only and most logical explanation is that each phase of construction was separated from the others by a significant amount of time, perhaps in the order of centuries or even thousands of years.

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<sup>26</sup> Ralph Ellis, “Pyramid Repairs”. On-line: <https://www.artifice-design.co.uk/rosetau/repairs.html>. Last accessed January 29<sup>th</sup>, 2021.

Not enough elements exist at present for us to be able to assign a date to the first phase of construction of the Great Pyramid. This phase extended in height at least until the level of the 35<sup>th</sup> course of masonry. This part of the pyramid is characterized by a level of precision that Petrie himself described as “*almost inconceivable at present*”. On the other hand, the courses above show a marked decline in the quality of construction, although this seems to be due more to the builders than the masons, as already observed by Petrie.

The section of the pyramid from the level of the base of the Grand Gallery to that of the five relieving chambers above the King’s Chamber belongs to a time when construction techniques had already decayed significantly, but a large number of already worked stone blocks was still available together with the means for finishing and raising them into position at a height of nearly 70 meters up the Pyramid. If we believe that Khufu was responsible for the creation of the “Well-Shaft” and of Mamun’s tunnel in order to access the upper chambers of the Great Pyramid, then it follows that this section of the pyramid must have been already completed and sealed before the time of Khufu.

This second phase of construction, dating to before the reign of Khufu, probably reached the level of the 100<sup>th</sup> course of masonry, at a height of about 78 meters.

The presence of Khufu’s cartouches in three of the relieving chambers above the King’s Chambers (*yet, curiously, in no other chamber inside the Great Pyramid*), suggests that this king repaired the sections of the Pyramid above the King’s Chamber, which had either collapsed or had never been finished. Khufu may then have completed the rest of the Pyramid, a fact that may explain also the numerous errors in orientation and changes of direction that can be observed in both the Queen’s and the King’s Chambers’ air shafts.

If Houdin’s theory of internal ramps used for the construction of the Great Pyramid is correct, then Khufu may have been able to use some of these internal ramps to raise the remaining stone courses. The volume of stone required to complete the Pyramid from the level of the 100<sup>th</sup> course to the apex would have been less than 15% of the total volume of the Pyramid, or about 250,000 cubic meters – comparable to the Third Giza pyramid and to some 5<sup>th</sup> and 6<sup>th</sup> Dynasty Pyramids.