The Pyramid of Menkaure, at Giza.

A Layman's Guide

Keith Hamilton 2nd December 2020

The above image shows the remains of what is normally referred to, as the third pyramid of Giza, and attributed to the 4th dynasty pharaoh Menkaure (sometimes referred to as Mykerinos). Significantly smaller than the neighbouring pyramids of Khafre and Khufu; early accounts from Herodotus and Diodorus Siculus tend to give Menkaure good press compared to the previously named kings. Portrayed as a somewhat benevolent leader, who presumably rescued his people from building yet another huge mountain of stone; though one can't help thinking that those tasked with the granite requirements of his pyramid, might have some choice words on his benevolent nature.

A lot of this granite can be seen above (once again I am most grateful to the Isida project for the use of their images) in the form of intact casing and scattered stones in the foreground.

Menkaure's family tree is far from clear, though most publications suggest that he was the son of Khafre, and Khufu's grandson. Given its location on the Giza plateau, one would assume that extensive data is available on the pyramid; however, this appears to not be the case, and once again we are mostly reliant on quite dated reports.

Exploration

Whilst the Great Pyramid was largely open to ancient travellers, who provide various accounts of its internal structure; such accounts extending to Khafre's and Menkaure's pyramids are rare. This is probably down to entrance locations of the latter two being closer to the ground; such that when the fine casing was robbed, the associated debris would soon cover them and eventually be lost. Khafre's upper entrance would be discovered by Belzoni on the 2nd March 1818[1] on a shoestring budget, and there can be little doubt that had resources allowed, he would have found the entrance into Menkaure's pyramid. Belzoni states his work at Menkaure's pyramid;

"I commenced my labours on the north side, and, after removing a great quantity of materials, found a considerable accumulation of enormous blocks of granite, which had evidently formed the coating. –Proceeding yet lower, as I cleared away the rubbish I found, that part of the coating still remained in its place down to the bases. The removal of these blocks would evidently have brought me to the entrance into the pyramid, but it required more money and time than I could spare."[2]

The honour of finding the entrance to Menkaure's pyramid fell to Howard Vyse, some 19 years later, when the entrance to the pyramid was discovered on 29th July 1837.[3] Vyse, a British army officer and politician arrived in Egypt in December 1835 (aged 51), not with any intent to excavate the pyramids, but to tour Upper and

[1] Operations and Discoveries in Egypt and Nubia, Belzoni,1820, page 268
[2] Ibid, page 280-281
[3] Operations Carried on at the Pyramids of Gizeh in 1837, Vol 2, page 69-75

Lower Egypt. His travel to Upper Egypt was postponed, due to a favourable opportunity to tour Syria in February 1836; meanwhile, in the intervening time he explored the pyramids of Lower Egypt, where he appears to have developed a keen interest, especially at the Giza pyramids. Prior to leaving Alexandria for Syria on the 26th February, Vyse had a meeting with Giovanni Caviglia (an Italian explorer who had made significant discoveries at Giza) and offered to fund excavations inside the Great pyramid, which Caviglia declined. Vyse would return to Egypt on the 25th October 1836 to commence his tour to Upper Egypt, and he tells us; *"I had not the remotest idea of engaging in any operations at the Pyramids."*[4] However, shortly after his arrival, he entered into an agreement with a Mr Sloane and Colonel Campbell to procure a firmaun to excavate at Giza, with the operations being supervised by Caviglia. Vyse's share of the initial costs was 200 dollars, and shortly after in November he set of on his tour to Upper Egypt.

Vyse would return to Giza on the 24th January 1837 after his busy tour of Upper Egypt, and anxious to see what progress was made by Caviglia; however, Vyse was disappointed by Caviglia's progress, and on the 11th February, Caviglia was dismissed and Colonel Campbell would relinquish his share of the operations.[5] Luckily for Vyse he was introduced to a civil engineer, John Shae Perring who would be instrumental in assisting Vyse in his operations on the Giza plateau. The operations were many and varied, with Menkaure's pyramid being but one part; moreover, Vyse was not shy of using gunpowder to expedite excavations: though he was not alone in using gunpowder, Auguste Mariette would also use gunpowder. Vyse would depart Egypt in August and publish his findings in three volumes, which is still a primary source of information.

Flinders Petrie would use his exceptional surveying skills to add some further data to that obtained by Vyse. His findings on the Menkaure pyramid were published in 'The *Pyramids and Temples of Gizeh"* 1883.

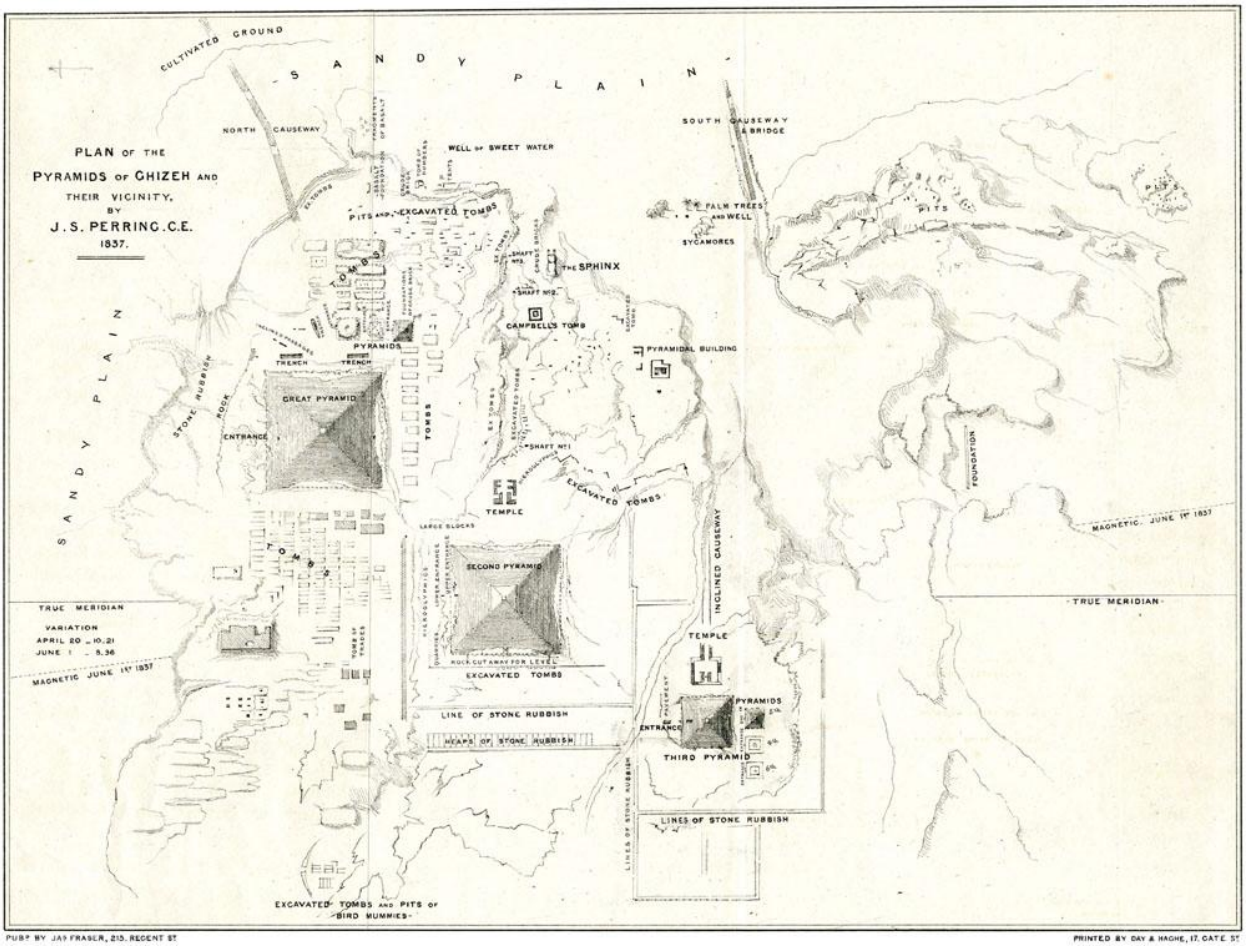
George Reisner would do extensive excavations on Menkaure's pyramid complex; though his focus was primarily on the temples of the complex; he appears to have been satisfied with previous explorer's findings on the pyramid itself. He published his findings in *'Mycerinus, The Temples of the Third Pyramid at Giza'* 1931.

[4] Ibid, Vol 1, page 13
[5] Ibid, Vol 1, page 151

The Italians Maragiolio and Rinaldi (M&R) as part of their multi volume set on the pyramids, made some observations on the Menkaure complex and produced several large scale drawings. Their findings were published in *'L'Architettura Delle Piramidi Menfite, Parte VI'* 1967.

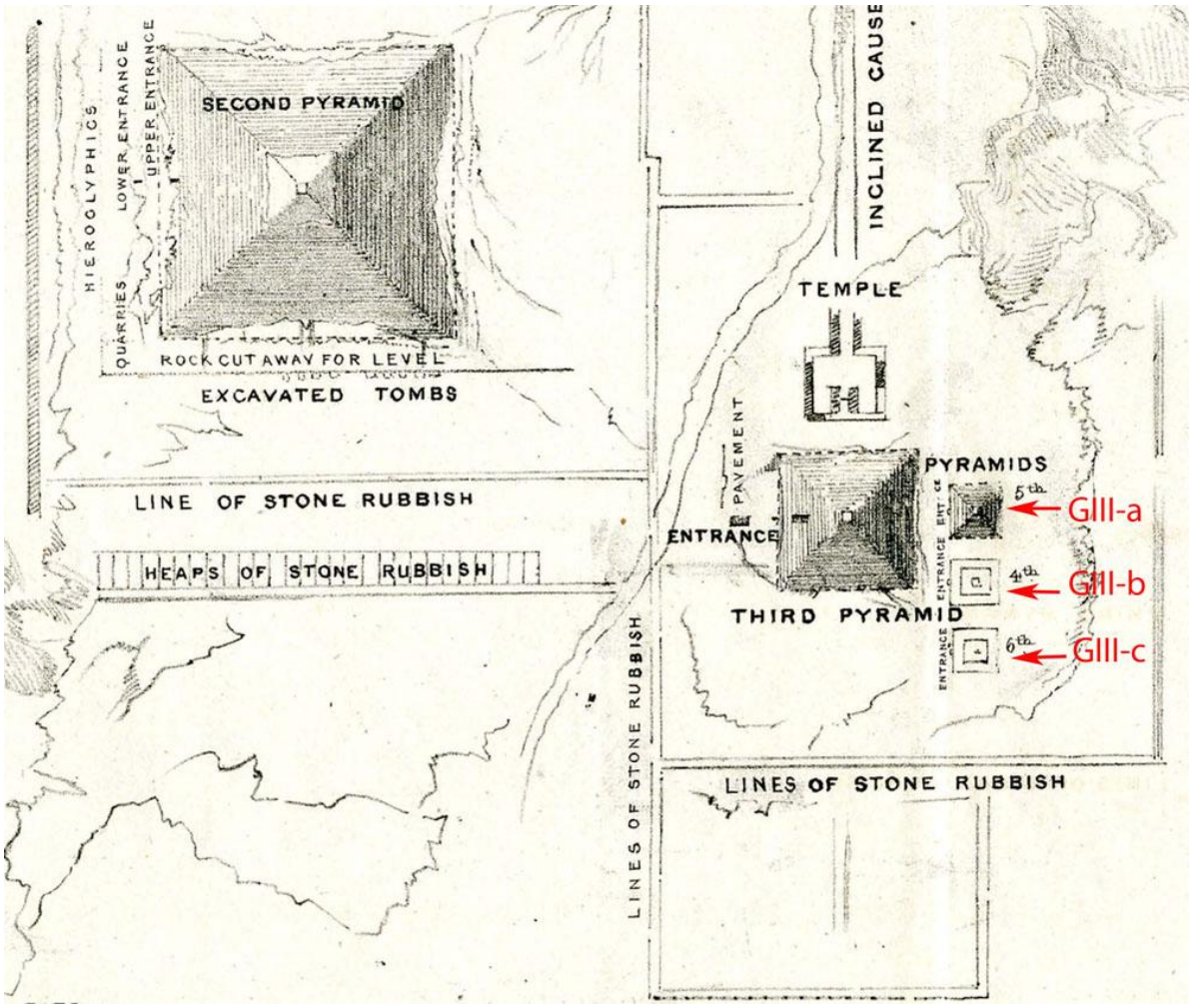
The above authors are largely the primary information on the Menkaure complex, and to which this guide is largely based on.

The Site



Above we have Perring's plan of the Giza plateau, dated 1837, with the top of the plan facing east. Menkaure's small pyramid is easily picked out compared to its giant neighbours. The chosen site is at the southwest limit of the Moqattam formation; beyond this the ground falls into a large wadi, which runs west-east: flooding from this wadi would seriously damage Menkaure's valley temple, which

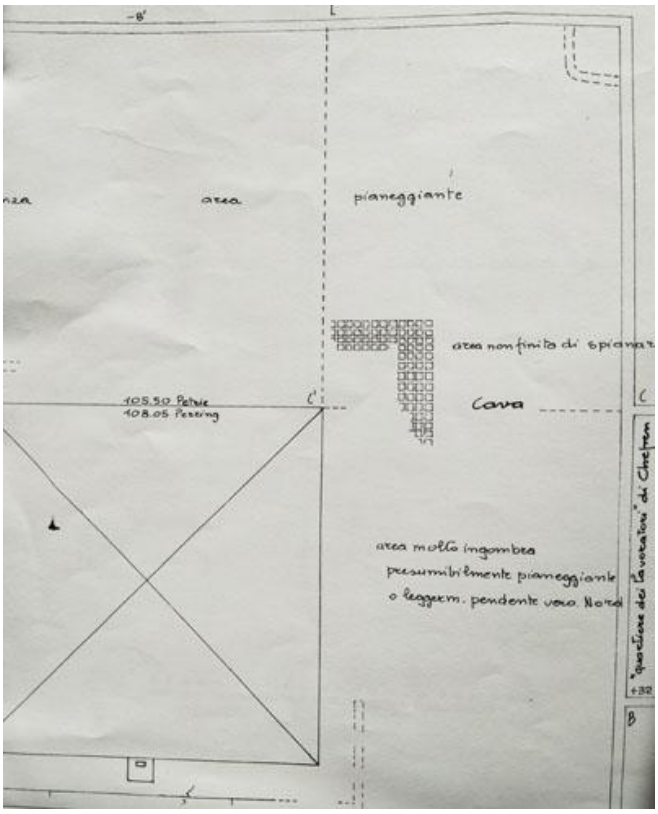
is not visible on the map above (it is located southeast of Khentkawes tomb, labelled *Pyramidal Building* in the plan above.



Zooming in on Perring's plan, we get a closer look at Menkaure's complex; a part of the pyramid temple is visible and some of the causeway that leads to the valley temple. Three small pyramids line up along the south side of the pyramid; Vyse would number these small pyramids in a strange sequence, the middle of the three was numbered 4, with the pyramid east of it being numbered 5, and the pyramid west of it being numbered 6: they have since been given a simpler system, and are now referred to as GIII-a, GIII-b & GIII-c.

The rock formation on which the Giza pyramids reside is not a level site, the whole plateau slopes down from west to east and from north to south; this necessitated

significant levelling works. M&R would state; *"In fact, the foundation on which the pyramid and upper temple stand was obtained partly by cutting into the rock and partly by a terracing work of enormous blocks of coarse limestone. The rock was removed in the NW corner of the pyramid with the same system we have already seen in Chephren."*[6] (Khafre). This quarrying in the NW corner is barely noticeable today, and was so in M&R's time due to sand; but they report that it was clearly visible from the top of the pyramid.

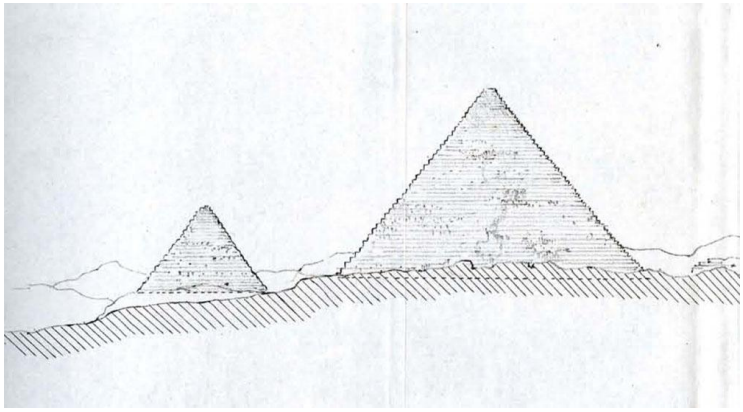


In the partial scan above from M&R's Tav 4, we can see the cuttings of the quarrying activities in the NW corner of the pyramid. M&R report that the cutting trenches where about 0.7m wide, with the single blocks about 3.0m long in a north south direction and 2.5m east-west. It is believed that the quarried blocks would be used to terrace the site to create a level platform on which to construct the pyramid. At the opposite NE corner, they report that terracing of over 3m high was required, using two courses of local limestone. Travelling south from the NE corner they report that the amount of terracing decreases: the south side of the pyramid and the southern parts of the east and west sides they could not observe. They describe the

[6] *L'Architettura Delle Piramidi Menfite, Parte VI,* 1967, page 32

levelling blocks as being of enormous size; with many having red levelling lines with triangles. Extensive levelling operations were also required along the north side of the pyramid temple, with a possible three courses required at its NE corner.

This view looking into the NW corner of Khafre's pyramid complex shows a more massive undertaking, than was done at Menkaure's pyramid. Extensive debris unfortunately still cloaks a lot of Menkaure's pyramid, so it's difficult to ascertain the amount of levelling work, which was required on the site.



This view looking west is a small part of a fold out section of the Giza pyramids made by Perring[7]. It shows Menkaure's pyramid, and how the ground falls away to the south; indeed the small pyramids to the south are at a lower level than Menkaure's pyramid. On the same section, Perring has the base of the third pyramid as being 41feet 7 inches (12.68m) above the base of the great pyramid; this is at a higher elevation than Khafre's pyramid, which he gives as 33 feet 2 inches (10.11m). It would be interesting to compare modern readings; unfortunately I have been unable to source any.

[7] Operations Carried on at the Pyramids of Gizeh in 1837, Vol 2, fold out section of Giza pyramids, opposite page 148

The Superstructure

The intended size of the pyramid is problematic and I have come across quite varied readings from different authors. A major problem is in the unfinished nature of the complex, best demonstrated in the temples, which clearly suggest that Menkaure did not live long enough to see his complex finished. The pyramid itself appears to have been largely completed, with early explorers appearing to suggest that the casing was intact.[8] The major obstacles in determining the intended size of the pyramid are the significant amounts of debris which still cloak some sides of the pyramid and the nature of the granite casing which covers a significant portion of the pyramid.

In this image we see the wooden steps leading to the entrance on the north face, which is in the 5th course of granite casing. In the foreground we can see surviving granite casing extend up to the 8th course; here we see that the sides, top and bottom of the casing are carefully dressed, with a significant stock of undressed

[8] The pyramids and Temples of Gizeh, Petrie, 1883, page 114. See also Vyse's appendix on accounts of early travellers in his Volume II.

stone left on the front faces: an inclined line on the dressed side is visible on the upper stone (the arrow aligns with it).

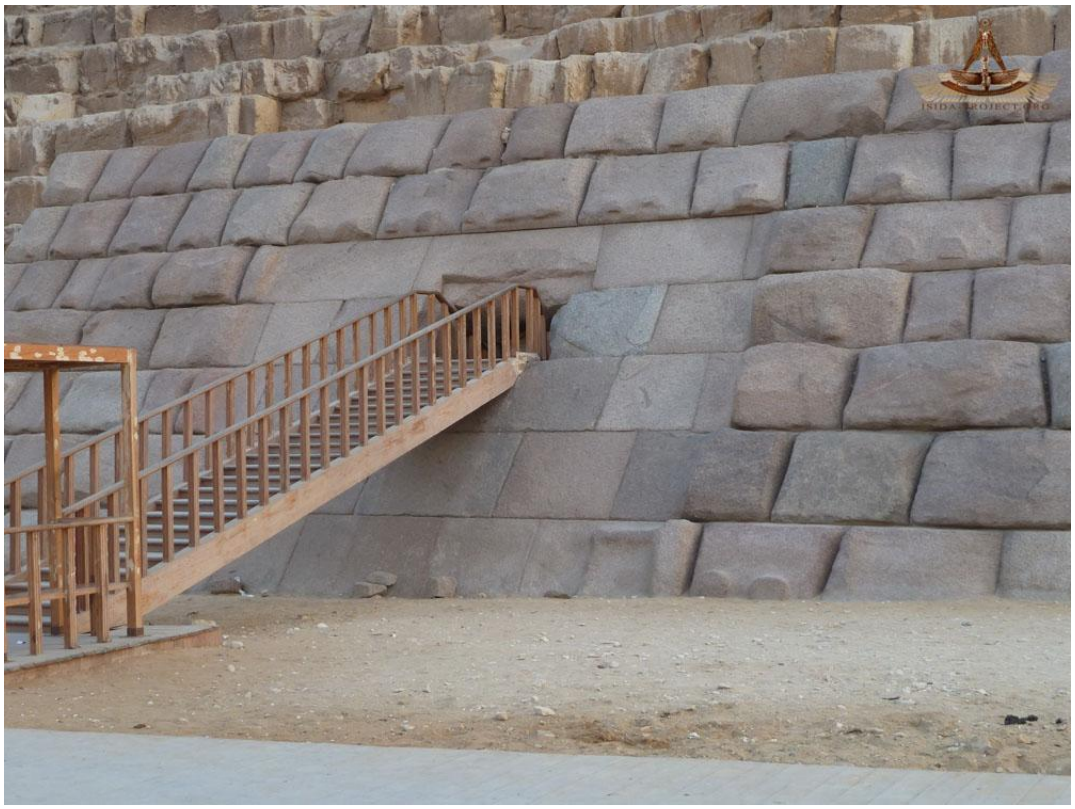
This view taken further back, shows the top of the 6th course;[9] here we can see a faint dressing line along the front edge: if it was intended to fully dress the pyramid, then all the material to the left of this line would have to be dressed away, a huge amount of work in a hard material. It is generally viewed that had Menkaure lived long enough, all this casing would have been dressed smooth; though it might be the case that it was always intended that it maintain this rustic finish. Large amounts of granite casing were used at the Abu-Rawash site; a structure with a similar base size, and here we also find granite with undressed front faces: though the lowest course of Khafre's pyramid was cased in granite and here the front faces were dressed.

[9] There is some confusion on course numbers, Petrie gives the entrance as being in the 4th course, but others such as M&R make it the 5th course, as shown in their TAV 5. Petrie gives the entrance threshold as 4.2m from the base, and as he states that the granite courses were intended to be 2 cubits high i.e. 1.05m, we should see 4 courses below the entrance. Today's images only show 3 courses, though the missing course may reside under the desert sand. It's unclear how far the authorities partially cleared the north face of the pyramid.

The above image shows granite casing blocks at Abu-Rawash; the block on the right shows the inclined dressing line, with the front face left rough. In my guide on the Abu-Rawash site I could find no reports of granite blocks with their front faces dressed; one could always argue that this king died early as well, but I thought I should inject a degree of caution as to whether it was intended for all granite casing to be dressed smooth.

The granite casing on Menkaure's pyramid has been dressed in two locations; one area around the entrance, with the other by the pyramid temple; however, there may have been another location on the west face, as M&R report some well finished casing blocks removed by the stone robbers in this location.[10]

[10] *L'Architettura Delle Piramidi Menfite, Parte VI,* 1967, page 36



Here we see a small area of the granite casing smoothed around the entrance. The bottom of the lowest course is believed to end in a rough termination, which would be worked into a vertical foot;[11] though not visible above due to the sand. Petrie would suggest that had any paving been fitted, it would abut against this vertical foot much like we see at Khafre's pyramid. The full height of the bottom course varied where it was available to be measured; Petrie would give 45.5 N.E., 55.3 S.E, and 43.7inches S.W.[12] Petrie gives the entrance as being in the 4th granite course some 165.3 to 202.1 inches vertically above the base (4.2 to 5.1m)[13]; however, M&R give the entrance in the 5th course, a view repeated by other authors such as Lehner & Hawass[14]. Given that Petrie viewed that the granite courses were intended to be equal "*and a rather short two cubits each",* and the entrance threshold was 4.2m then four courses of 1.05m (2 cubits) means that Petrie appears to have made a typo error and that it is the 5th course. The image above shows 3 courses below the entrance, but another must reside under the

[11] The pyramids and Temples of Gizeh, Petrie, 1883, page 111.
[12] Ibid, page 113
[13] Ibid, page 117
[14] Giza and the Pyramids, Lehner & Hawass, 2017, page 247

desert surface (it would be nice to have this course discrepancy clarified). What we see today in the image above was not available to Vyse, M&R or Petrie; in their time the debris was only cleared sufficient enough to gain access to the pyramid.

(*b*) ENTRANCE TO PYRAMID OF MYCERINUS *Photo : L. V. Grinsell*

The above image by Leslie Grinsell published in his '*Egyptian Pyramids' 1947,* shows the entrance in his time; much debris surrounds the entrance and according to M&R's TAV 5, this is how they found the entrance. The ancient Greek historian Diodorus Siculus stated that the name of the builder was inscribed on its north side; this inscription close to the entrance was only discovered shortly after M&R's publication, when the authorities cleared part of the northern face. The inscription is not very legible, though a part seems to state that the king died on the 23rd day of summer; no year was given. According to I.E.S. Edwards, the inscription is of a later date, possibly from the time of prince Khaemuas, son of Ramesses II: he would also suggest that the smoothing of the casing stone was done at the same time.[15] The smoothing of the casing stone at a later restoration date would appear logical as it would seem strange to originally highlight the entrance into the pyramid. The faint inscription below and to the left of the entrance is shown overleaf.

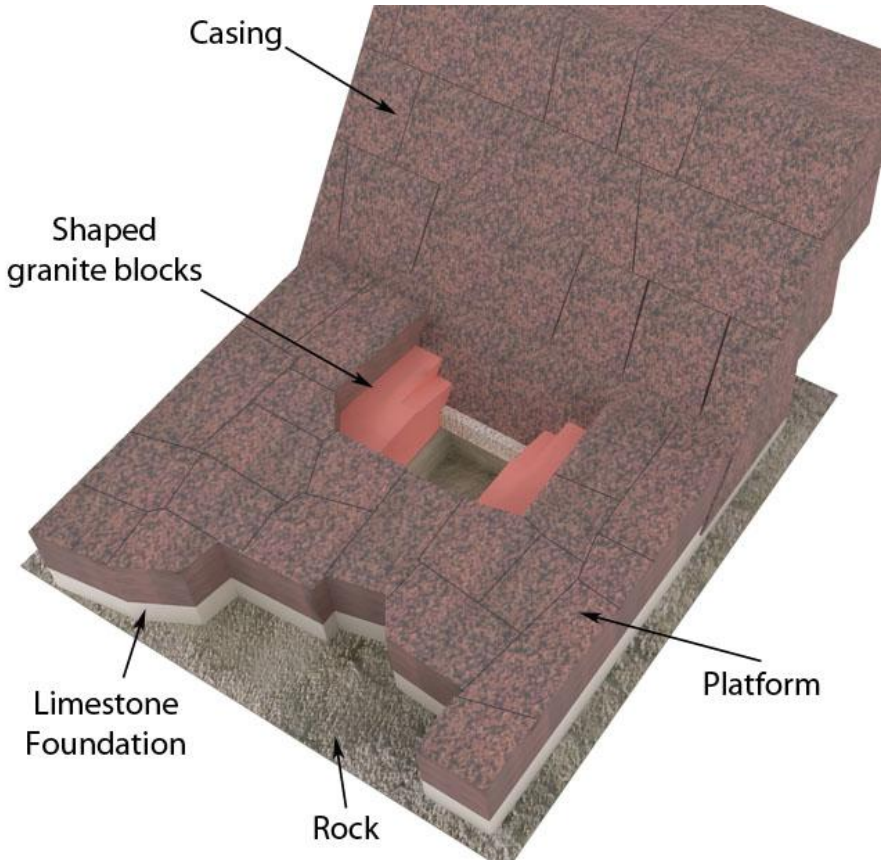
[15] The Pyramids of Egypt. I.E.S. Edwards, revised edition 1986. Pages 152-153

Image courtesy of Jon Bodsworth

The second area that exhibits smooth casing is in the middle of the east face of the pyramid. Immediately in front of this casing we can see a squarish platform made from granite blocks; the blocks which abut the smooth casing of the pyramid, carefully follow the casing angle. M&R would report that the smooth granite casing in this area is fully worked to the limestone foundation stones. i.e. it does not display a vertical foot.[16] In the image above, a sand filled void exists in the platform next to the casing; it was Reisner's and M&R's view that this void probably held a stele. This granite platform M&R give as some 14 cubits N-S, and possibly the same E-W, though this area is badly damaged. In their reconstruction they have this platform as an open standalone area detached from the main pyramid temple, with a short flight of steps leading up to it; they show a single stele on the platform with an altar in front of it. Subsequent later additions possibly from later 5th and 6th dynasty rulers have greatly expanded this area and connected it to the main temple. The large temple is a complex area, along with the valley temple, and worthy of a separate guide; this guide will concentrate mainly on the pyramid itself.

[16] *L'Architettura Delle Piramidi Menfite, Parte VI,* 1967, page 38, and Tav 9, fig 2

The void in the platform is an area of disagreement between M&R and Reisner; M&R state, *"The pit penetrates right through the platform down to the rock and a quadrangular hole, about 3 cubits wide and long and about a cubit and a half deep was dug in the rock itself. The hole was obtained by making two lateral incisions and then removing the rock thus delimited, which was the method used by the ancient Egyptians. So we do not think Reisner's hypothesis justified when he says that the excavation was the work of Arabs in search of treasure."*[17] M&R would go on to elaborate on the unusual cuttings on some of the granite blocks that line this pit; unfortunately this pit is now sand filled and I could find no images on the Giza project website that show the inside of this hole, so the 3d images are based on M&R's drawings.



Looking down into the pit, the casing is smoothed and rests on a limestone foundation, as do the blocks which make up the platform. On the north and south sides of the pit are two specially shaped granite blocks; these blocks do not rest on a foundation but are laid edgewise on the excavated rock: three quarters of the

[17] Ibid, page 54

upper surface is horizontal, with one quarter sloping down towards the pyramid casing; the horizontal surface is about 50cm below the platform. The space between the two shaped blocks is around 1.60m (3 cubits?); the bottom of the rock cut hole is around 2.1m (4 cubits?) below the platform.

At just over 2m deep, the pit is a fairly good seating to allow a tall stele; the ramp sides of the specially shaped blocks M&R suggested was to prevent the support block behind the stele from sliding up the inclined face of the pyramid.[18] Reisner himself believed that a stele of granite or alabaster fitted in this location, the disagreement between him and M&R is in the depth of the hole in which the stele resided; Resiner thought the seating for the stele was no deeper than the top of the shaped granite blocks, with the rest of the hole done by searchers[19]; whilst M&R though this was too shallow, and their observations convinced them that the rock

[18] Ibid, page 112
[19] Mycerinus, The Temples of the third Pyramid at Giza, Reisner, page 28

cut pit was the seating of the stele. Regardless of the correct interpretation, the stele would appear to be 3 cubits wide by 2 deep, and of unknown height.

The Size of the Pyramid

The size and angle of Menkaure's pyramid is very problematic; the huge amount of granite blocks and debris that cloak its base prevent detailed examination; which might furnish important clues to the intentions of the builders. Several authors have made attempts to measure the structure, with the best attempt being undertaken by Petrie. The lowest granite course had a rough ending and varied in thickness (see page 11), so the only level reference mark he could work to was the finished top surface of the first course. As the granite courses appeared to Petrie as being intended to be equal, at about 2 cubits high; he took the mean height of the granite courses 40.3 +/- 1.5 inches, and taking a clue from Khafre's pyramid which has a first course of granite 2 cubits high,[20] he projected this height from the top surface of the lowest course as a best guess as to the intended base level of the unfinished pyramid.

80. At this level, then, the various data of the intended surfaces give the following size for the base, reducing those data that are on higher levels by the angle 51° 0′:—

	Length.	Difference from Mean.	Angle.	Difference from Mean.
N. . .	...	...	+16′ 48″	+2′ 45″
E. . .	4149·2	−4·4	+12′ 23″	−1′ 40″
S. . .	4157·8	+4·2	+12′ 57″	−1′ 6″
W. . .	4153·9	+ ·3	...	...
Mean . .	4153·6	3·0	+14′ 3″	1′ 50″

The N. end of the W. side could not be reached, after several attempts; and hence the lack of knowing the length of the N. or azimuth of the W. side.

The above table summarises Petrie's findings; unfortunately he was unable to obtain a value for the north side.[21] For the angle of the pyramid, it is just as problematic.

[20] The Pyramids and temples of Giza, 1883, page 98. He gives Khafre's granite course as 41.52 +/-.05 inches
[21] Ibid, page 111

81. For the angle of the Pyramid, the data are rather divergent; and not only do different methods vary in result, but the measures of similar stones vary far beyond the errors of measuring the angle or judging of the surfaces.

By 7 measures on finished granite, *in situ*	50° 57′ ± 28′
By 1st and 4th courses, *in situ*, at S.S.W.	50° 42′ ± 7′
By 6 single blocks of granite, shifted	51° 0′ ± 9′
By 9 pieces of limestone casing (brought to England) ...	51° 58′ ± 15′

Considering the various sources of error: that the dressed granite *in situ* is very irregular; that the 1st course joint at S.S.W. may easily be estimated too far out; and that we have no guarantee in the moved granite blocks, or the limestone from the upper part, that the courses were horizontal (on the contrary, one granite block has two different joint surfaces, 1° 40′ different); the best conclusion seems to be 51° 0′ ± 10′. But from a consideration of the granite courses (see below), the angle would be 51° 10′ 30″ ± 1′ 20″; and this might well be adopted, as being close to the very uncertain result from the measured angles.

Hence the height of the Pyramid would have been 2564 ± 15; or 2580·8 ± 2· by the granite courses.

Petrie's findings on the angle of the pyramid are shown above,[22] and highlight the difficulty in establishing intended dimensions, of often very dilapidated ancient monuments. I have seen some authors give the pyramid the same angle as the great pyramid (tangent 14/11), some suggest tangent 5/4, and yet others could be added to the list. These mathematical puzzles have always been of interest to many; an early example was attempted by a Mr Agnew, who during the weary days of quarantine during the great plague of Cairo in 1835, took it upon himself to measure the pyramids of Gizeh with a homemade sextant on a hot July. His findings[23] would give the Great Pyramid a tangent of 5/4, and for Menkaure's pyramid, he would state; *"its perpendicular was the radius of a circle, the circumference of which was equal to the square of its base."*[24] As far as I am aware, this is the first suggestion of using the PI ratio as a design for a pyramid. This ratio was subsequently adapted to the Great Pyramid by the publisher John Taylor, in his book *'The Great Pyramid; why was it built & who built it?* 1859. This publication of Talyor would attract the attention of Piazzi Smyth, and the rest as they say is history.

[22] Ibid, page 112
[23] On the application of the quadrature of the circle in the configuration of the Great Pyramids of Gizeh. 1838
[24] Ibid, page 11

Image courtesy of Greg Slater

Diodorus Siculus stated that the pyramid had 15 courses of granite, though Petrie thought that the lowest course may have been covered in his day. Petrie's conclusion that there were 16 courses of granite was based on the highest remaining fragments being found at the same level on all four sides; moreover, he states, *"there is a thicker course next over this, as if some great change took place there, and a fresh start was made; the 17th course is thicker than any other course of the whole pyramid and is followed by a course thinner than any that underlie it"*[25] Petrie also noticed that the granite appeared to be one quarter of the height.

> **This being settled, it is worth notice that the granite just covered one quarter of the height of the Pyramid, the total height being 4×641±4. Conversely this may be taken as giving a determination of the original total height, perhaps more accurately than by the varying angles of the casing, thus :—**
>
> **645·2 (±·5 (?) for uncertainty of paving) ×4=2580·8±2·**
> **And this yields an angle of 51° 10′ 30″±1′ 20″.**

In the image above I have highlighted the area once covered by the granite casing.

[25] The Pyramids and temples of Giza, 1883, page 113

The top of this casing appears to coincide with the start of a huge gash on the north face; this wound has been attributed to Malik Abd al-Aziz Othman ben Yusuf, in the 12th century. Its start might be related to the granite casing, as the limestone casing was probably a softer target; the casing of the pyramid appears to have been relatively intact in the time of Belon (1548) and Villamont (1589)[26]: the following century would not be so kind.

So what can we say about the size of the pyramid? It is a complex puzzle, with practically every publication publishing a different finding; for example in Lehner's *'Complete Pyramids, page 134'* he strangely gives the base as 335 x 343 feet: this is amended in his latest *'Giza and the Pyramids, page 244'* with Zahi Hawass, who give 346 feet/201 cubits, and an angle which relates to a tangent of 5/4. Other authors see the angle of the pyramid as that of the Great Pyramid tangent 14/11, by using the finished limestone fragments as reflecting the intended angle. Others suggest that the structure was simply intended to be a base of 200 cubits; the list of permutations can be quite lengthy. John Legon who has done several articles on pyramid geometry, including a Giza site plan, which brought forward interesting geometric relationships, suggested that the pyramid base was 201.5 cubits.

If we take Petrie's belief that the granite cloaked one quarter of the pyramids height, and that each course was intended to be 2 cubits high, we would have a height of 16x2=32 cubits for the granite, and therefore 4x32=128 cubits for the height of the pyramid. The entrance threshold at 8 cubits above base would be one quarter the height of the granite portion and one sixteenth of the pyramid height. If we follow this model and accept an intended height of 128 cubits, what would be the likely angle of the pyramid? Taking tangent 5/4 this would give a base 204.8 cubits; in contrast, if we use tangent 14/11 we obtain 201.1 cubits,[27] which is within the boundaries of Petrie's measures. It would be nice if cranes could be brought in and place these fallen blocks back on their steps and clear the debris from the base of this pyramid, in the hope that some clues emerge which might solve the puzzle; but until then, caution is required, and the size of the pyramid may always remain a mystery.

[26] Ibid, page 114

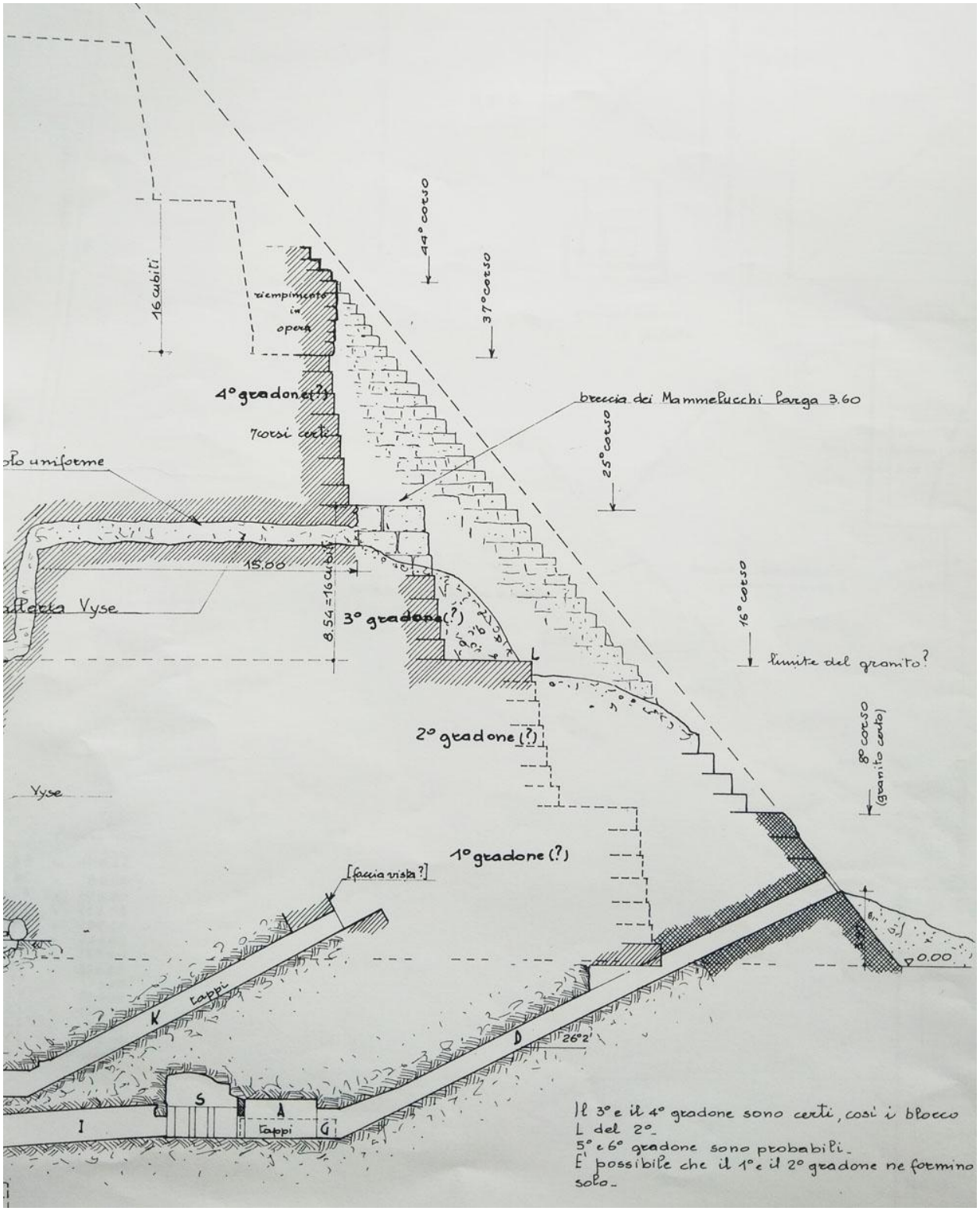
[27] 14/11 is equal to Egyptian seked of 5.5 (7 palms vertical: 5.5 palms horizontal) Height 128 Cubits (896palms) semi-base is 704 palms, therefore base is 1408 palms, or 201 cubits and 1 palm.

A Stepped Core?

The huge gash on the north face affords us a rare glimpse inside a pyramid core, and here the dismantlers of the pyramid appear to have come across a stepped core.

Looking into the gash, we can see the start of Vyse's tunnel, which goes down to the base of the pyramid; M&R managed to penetrate some 15m into this tunnel and could find no evidence of layers, as seen at the Meidum pyramid.[28] M&R state; *"the nucleus of the pyramid is made in large steps. It is possible to identify the inner or outer top edges of three of these steps, which are probably the 2nd, 3rd and 4th. Above these there were perhaps another two steps".* In the image above we can see the front face of M&R's 4th step above the tunnel, made up of 7 courses of well fitted stone, each course slightly set back from another. They give the course as some 2.5 cubits high and the width of the step, as some 9-10 cubits.

[28] *L'Architettura Delle Piramidi Menfite, Parte VI,* 1967, page 34



The partial scan above of M&R's TAV 4 shows the steps that were visible to them, along with the possible format of the invisible steps.

In this view, taken further back, we can see part of M&R's 3rd step (I have highlighted the faces of the 3rd & 4th steps). The masonry inside and outside of the faces is not as well constructed, with M&R commenting that the masonry outside the faces being somewhat better than the inside.

Above view looking into Vyse's tunnel. The core masonry of pyramids is not as well constructed as many suppose, various breaches in monuments often paint a different picture. The carefully constructed faces are very similar to what we see at Queen Khentkawes tomb; located near to Menkaure's Valley temple.

On top of Khentkawes rock pedestal we see a masonry superstructure, whose outer face is constructed with well fitted masonry; again, each course slightly stepped back as we see at Menkaure's. This is not replicated in the inside, were M&R state; *"the inside of which consists of very irregular blocks both as regards size and manner of laying: these do not correspond to the outside courses and very large joins may be seen that are not always filled with chips and mortar."*[29]

In my Bent pyramid guides I suggested that a stepped core might reside under the casing, with its face coinciding where most authors believe settlement occurred in the north entrance passage. It is possible that all pyramids have a stepped core built first, and when completed, a casing phase would be built against it. Given that we have several stepped cores visible in Old Kingdom pyramids, it is a possibility that needs to be better explored.

[29] Ibid, page 170

Image courtesy of Greg Slater

In the view above of two pyramids at Abusir, we can see the steps clearly visible on the pyramid of Neferirkare; Lehner would say of this pyramid; *"Evidence suggests that it was planned as a step pyramid, rising in six tiers of well-laid, limestone retaining walls. However, on the south and west sides some of the loose masonry remains from what must have filled in the steps, suggesting that the step pyramid might have been transformed to a true pyramid. It is certain that at a later stage the builders began to enlarge the pyramid by adding a girdle of masonry and a casing of red granite. It seems the lowest course was laid, but not smoothed, and the pyramid was never finished."*[30] The question needs to be asked as to whether this structure was ever planned as a step pyramid, to be later converted; or this was its natural construction sequence, with the stepped core laid first and then the casing started after completion of the core. It can be difficult to spot these cores, due to the level of debris, which may reside on the steps of the core.

[30] The Complete Pyramids, M.Lehner, page 144

In this view we are looking down at the queen's pyramids, laid out along the south side of Menkaure's pyramid. The same question arises as to whether all three were intended to be smooth pyramids. GIIIa clearly stands out, and remains of its casing still remain at the base; its lowest was of granite, but does it have a stepped core similar to its neighbours? Lehner would state; *"It is likely that the innermost core of GIII-a is also built of large blocks in step form and that the smaller masonry we see today is the blocks the builders used as fill between the packing that covered the steps to create the slope of a true pyramid and the casing, now removed."*[31] If we go to the other side of the Giza plateau and compare the queen's pyramids that flanked the east side of the Great pyramid; surviving casing suggests that all three were cased, but here the destruction of these small pyramids appears to reveal steps.

[31] Giza and the Pyramids, Lehner & Hawass, page 261

Image courtesy of Greg Slater

The view above shows the queen's pyramids by the Great pyramid, the worst preserved is G1-a, partially visible on left; here M&R state that only the lowest step and part of the second are preserved.[32] In the middle we have G1-b, here M&R say that it was built in 3 steps, with the lowest almost completely concealed by the filling stones.[33] The best preserved is G1-c, where 3 steps are noted.[34] That such steps may exist in pyramids brings further issues to consider, especially in the construction process and whether ramps were utilised in the superstructure; or do we follow the machines of Herodotus?

If we accept that a stepped core exists inside Menkaure's pyramid, could this construction process be replicated inside the larger giants? The answer might be yes; at the Red pyramid at Dahshur, casing fragments with date marks have been used to determine the build rate of the structure. However, this exercise appears to

[32] *L'Architettura Delle Piramidi Menfite, Parte IV,* page 76
[33] Ibid, page 84
[34] Ibid, page 90

have been done by assuming that the pyramid is a homogeneous structure, with each course laid one after the other; the idea of a stepped core appears not to have been considered. Using these date marks, Lehner states; *"Many of these have graffiti inscribed on their rear faces by the work gangs. One from a corner bears the hieratic inscription mentioning 'bringing to earth year 15'. This refers to counting year 15, which, if biennial, is equivalent to the 30th year of Sneferu's reign. Some 30 courses higher Stadelmann was able to place a casing stone dated only four years later-this gives us a very clear picture of the length of time it took to build such pyramids."*[35]

This build rate using date marks is further elaborated by John Romer, who states; *"And that in turn shows us that the first year of building at the Red Pyramid witnessed an explosion of effort during which more than a quarter of the pyramids entire bulk, around a million tons of limestone, was cut and hauled and set precisely in position. And even though that titanic workload slackened off after the first furious year of building, demand for stone during the next eighteen months or so was hardly less intense. By the ending of the first three years of work half of all the stone required for the Red Pyramid's completion would have had to have been set in place,"*[36]

I have mentioned this build rate before in my Sneferu guides, though at the time I was unable to gain access to some of the resources, which the previous authors used (as an amateur layman it can be difficult to gain access to publications). One such publication that Romer uses to describe his build rates, is that by Rolf Krauss[37]; in this paper Krauss developed an equation to determine the build rate of the Red Pyramid on three date marks from three stones, one cornerstone and two backing stones. Only the cornerstone could be classed as being in situ, the others, Krauss states; *"According to Stadelmann, the blocks with dates B and C derive from courses that cannot have lain very much above where they were found."*[38] Using the height where the backing stones were found, Krauss would use his

[35] The Complete Pyramids, M.Lehner, page 104
[36] The Great Pyramid, John Romer, pages 72-73 (I have been unable to source the data which the authors use)
[37] The Length of Sneferu's Reign and How Long It Took to Build the 'Red Pyramid'. The Journal of Egyptian Archaeology, Vol 82, (1996) pages 43-50.
[38] Ibid, page 49

equation to create a build rate table; this would suggest that 20% of total pyramid volume was constructed on 0.6 years; 60% in 3.5 years and 100% in 10.6 years.[39]

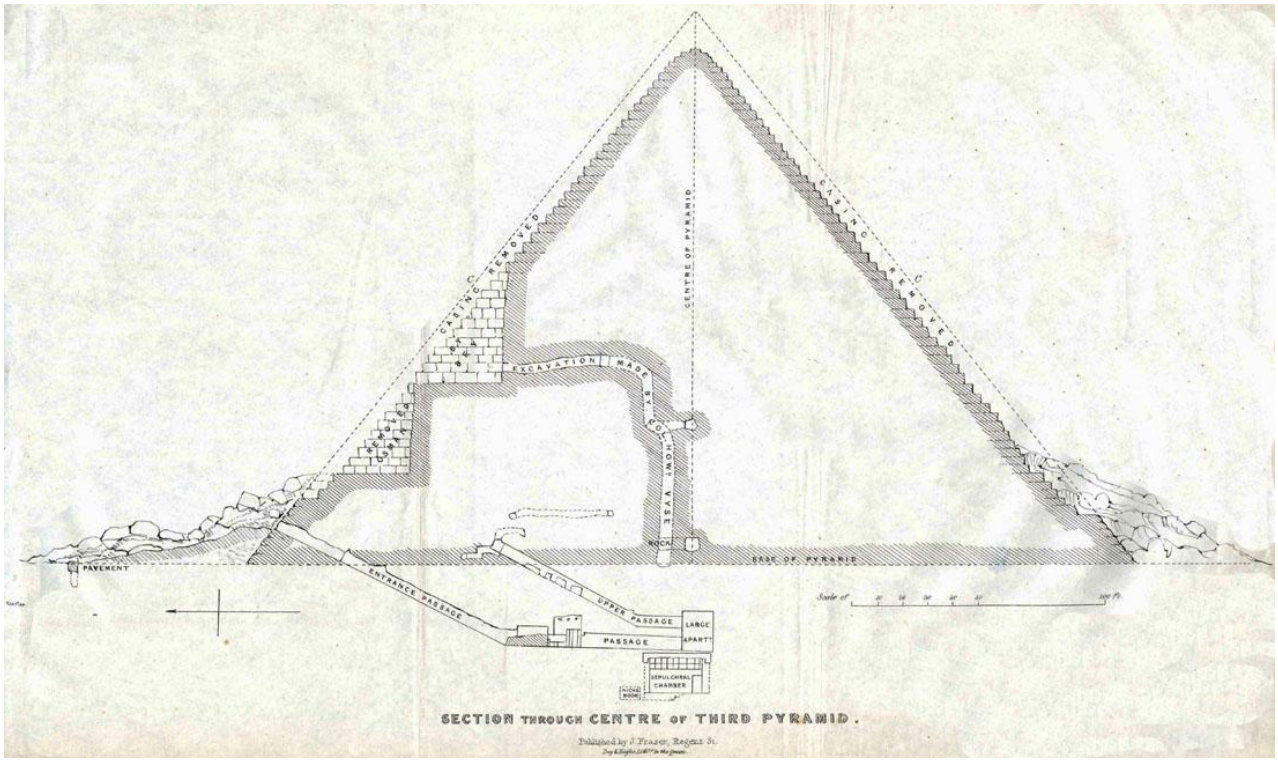
Given that two of the date marks were not in situ, then caution is required; indeed, Verner would comment on Krauss's paper, he states: *"Albeit interesting and stimulating, the calculations raise caution since their premises are based on some data and considerations which are not quite exact:"* Verner would go on to list various points, and conclude; *"Therefore, these dates can hardly be seriously considered as evidence on which any precise calculations of the time needed for the construction of the pyramid would be safely based."*[40]

As a layman I find such build rates somewhat incredulous, (Romer using these rates would suggest that the Great pyramid would take 14 years to build) and so I feel it likely that these dates if correct, would more likely refer to the casing phase of the pyramid as they filled the steps of a stepped core. This can have major implications, whilst the year 15 is often used to suggest the start date of the Red Pyramid, it could equally apply to the start date of the casing phase: the untold years spent in constructing the stepped core could have been missed. If we accept Neferirkare's stepped superstructure as an inner core, how were such cores constructed? Do we use ramps, which would then have to be removed to allow the casing phase, and how was this casing phase constructed; yet more ramps? This would seem an illogical construction process and though many ramp designs and theories exist as to the construction of pyramids; maybe we should be looking for other solutions.

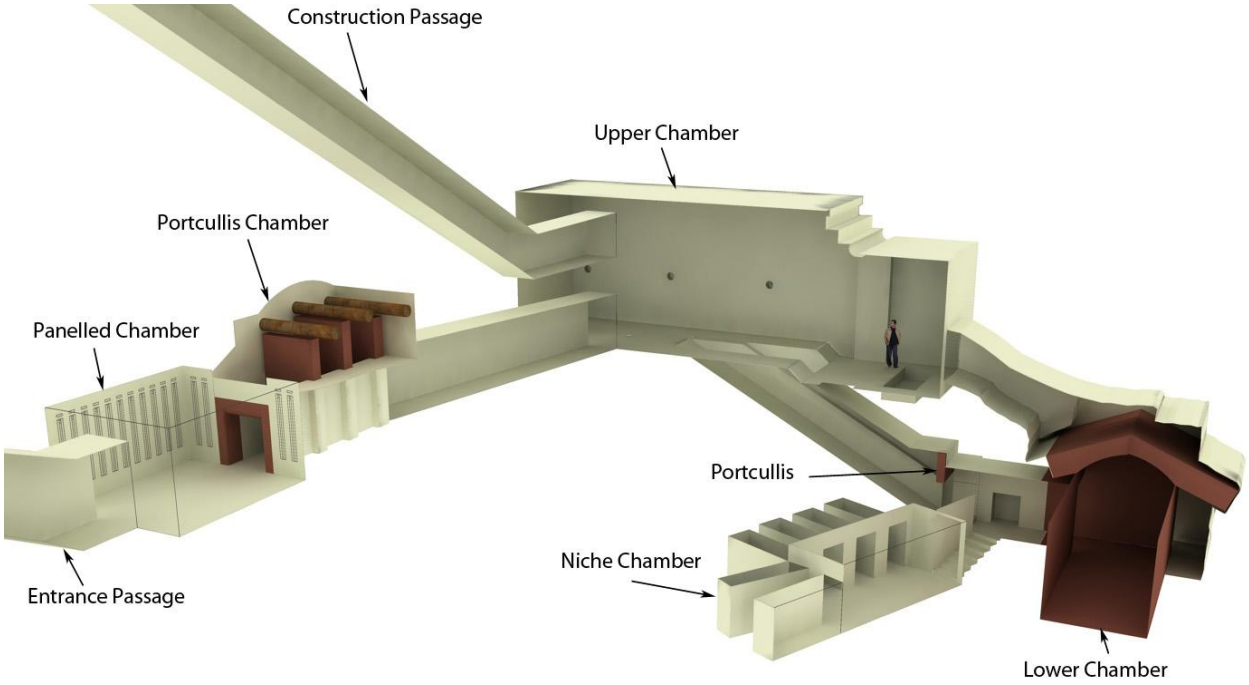
As well as possibly sharing a similar angle to that of the Great pyramid, Menkaure's pyramid appears to share another feature, which we see at the Great pyramid, M&R state; *"The upper part, on the other hand, corresponding to the limestone casing, has on all the faces – and particularly to the south – a marked concavity which seems intentional. The concavity appears greater in the lower part of the section and diminishes as it goes upwards. The thickness of the white limestone casing was thus greater towards the centre of the faces than towards the corners, as in Cheops."*[41]

[39] Ibid, page 50
[40] Archiv Orientalni, Quarterly Journal of African and Asian Studies, 2001, Vol LXIX, page 371
[41] *L'Architettura Delle Piramidi Menfite, Parte VI, page 36*

The Interior



The above section from Vyse's publication shows the layout of the substructure and various tunnels hewn through the superstructure. The longest tunnel was created by Vyse, with the help of gunpowder; this started from the breach in the north face and terminated at the base of the pyramid. It's not altogether clear why he choose this action, instead of following on where Belzoni had excavated (he would also cut a tunnel through the whole width of GIII-b); Vyse would give up on this tunnel and attack the north face, and soon discover the entrance. Notwithstanding the dangers of gunpowder, the removal of large fallen granite blocks had its own risks, as one of Vyse's assistants, a Mr Raven would painfully attest, when courtesy of a blow from a crowbar, he found himself five teeth short.



I have created the above 3d section of the substructure to provide a clearer layout of the numerous chambers, which were excavated out of the rock. The entrance passage enters into a panelled chamber and at its south end a granite framed doorway gives access to the portcullis chamber. Beyond the portcullis chamber a passage slightly slopes down to the Upper chamber; above this passage is another passage, which I have termed the *'Construction passage'*. At the west end of the Upper chamber a pit has been cut in the floor, and in the floor of the chamber a descending passage leads down to the Lower granite chamber and the Niche chamber. A passage has been made in the west wall of the upper chamber which leads also to the Lower chamber; this then is the basic layout of the substructure.

When Vyse cleared his way inside, he would find a decorated sarcophagus in the Lower chamber and in the Upper chamber the remains of a wooden anthropoid coffin bearing Menkaure's name (along with the broken lid of the sarcophagus): also in the Upper chamber where found human remains. However, the human remains and wooden coffin are not contemporary to the Old Kingdom; the wooden coffin would appear to be a later restoration effort, from the 26th dynasty, Saite era[42], placed there, some 2000 years after the reign of Menkaure. As for the human remains, Lehner states; *"The mystery deepens as radiocarbon dates on the human*

[42] Giza Au Premier Millenaire, 1991, Christiane M. Zivie-Coche, pages 97-101

bones suggest that the person died in late antiquity or even early Christian times."[43] The previously mentioned inscription by the entrance (see page 13) has also been further examined by Roman Gundacker, who suggests that the inscription was made by King Apries of the 26th dynasty.[44]

The drawing left from Vyse's publication, shows the remains of the wooden coffin, now in the British museum (EA6647). This Saite restoration has led some to question the sarcophagus itself; Peter Clayton would state, *"It would appear, therefore, that the coffin and almost certainly the carved sarcophagus itself were pious restorations carried out during the Saite Period in the later 6th and 5th centuries BC."*[45] This restoration would even lead to Ludwig Borchardt bringing forward the idea that the lower granite chamber, which contained the sarcophagus was built in Saitic times.[46]

Further confusion comes from the two northern passages which enter into the Upper chamber; Petrie would suggest that the upper passage was the original entrance to a much smaller pyramid which was subsequently enlarged.[47] Lehner would say of the upper passage, *"The upper passage was probably abandoned when the floor of the antechamber was lowered."*[48] More is forthcoming in his latest book, were he states; *"It certainly looks as if the builders intended this to be the main pyramid passage in an earlier plan and then abandoned it. If so, as noted above, the builders either designed the pyramid to have been much smaller or to have been positioned further south. A third possibility, however, is that they planned to continue the upward slope of the passage through the masonry some 15m (49ft) further north, so that it would have emerged much higher in the pyramids north face, and what we witness here is the decision to abandon an entrance high in the pyramid."*[49]

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[43] Giza and the Pyramids, Lehner & Hawass, page 250
[44] Ibid, page 251
[45] Chronicle of the Pharaohs, 1994, page 58
[46] *L'Architettura Delle Piramidi Menfite, Parte VI, page 108*
[47] The Pyramids and temples of Giza, 1883, page 120
[48] The Complete Pyramids, M.Lehner, page 136
[49] The Pyramids and temples of Giza, 1883, page 249

However, having reviewed the data available to me, and as a layman, I should like to present a fourth possibility; that what we see in the substructure can be explained as original and that no changes of plan are required to explain its form; notwithstanding unknown modifications made in the Saite era or other eras.

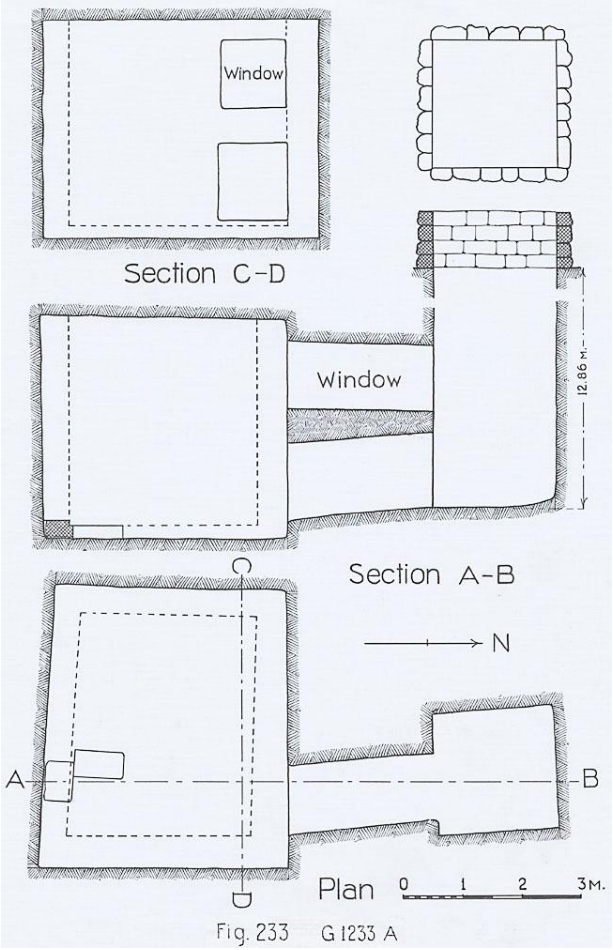


Fig. 233 G 1233 A

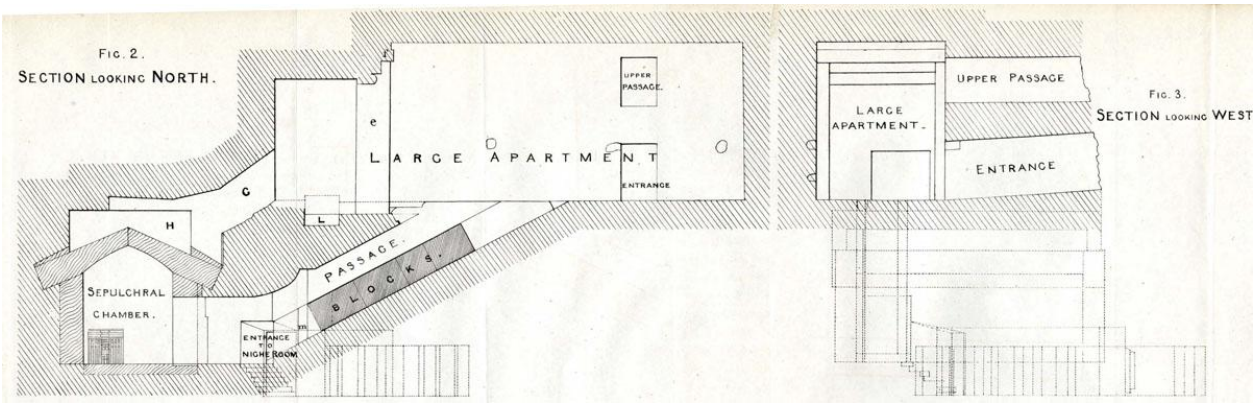
The two passages leading to the Upper chamber can be explained by observing some of the construction practice that we see in some of the mastaba's at Giza. The image left of mastaba G1233A, is an example of a burial chamber that has two entrances which enter into the north wall of the rock cut chamber; Reisner would label the upper passage as *'Window'*. Reisner would state; *"It is obvious from the first three examples that those 'windows' were blocked with masonry on the inside by the lining of the tomb and on the outside by the rougher masonry, and had therefore some function connected with the excavation of the chamber. I have mentioned above the difficulty presented by the cutting of chambers with passage entering the chamber low down in the north wall.....Thus the 'window' distributed in time from the reign of Cheops to that of Mycerinus does not represent a common practice and is, I believe, certainly to be interpreted as a device to facilitate the cutting of the chamber."*[50]

I would suggest therefore that the upper passage in the Upper chamber could be classified as a 'window'. Indeed, the chisel markings on the walls of the two passages show a logical cutting sequence. Petrie, talking first on the lower passage says; *"This passage has evidently been excavated from the South outwards; whenever the excavators ran wrong (and they did so several times) the false cut*

[50] A History of the Giza Necropolis, Vol I, 1942. Page 164, fig 233 is on page 409

goes deeper towards the N., and then ends abruptly when the error was seen. Also the direction of the pickmark points to its outward working. How the men got inside the rock to begin with, is plain from a second passage which runs above this; and which opens into the second chamber blankly, without any means of getting to the chamber floor, except by a ladder or other help. This upper passage runs through the rock up to the masonry, and was cut from the North inwards."[51]

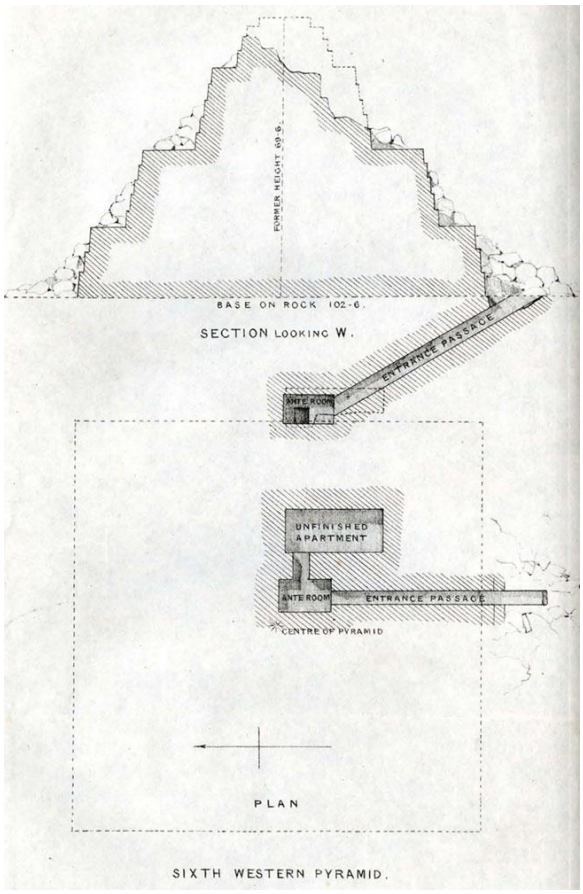
This upper passage I have labelled as *'construction passage'* and I feel it is quite probable that its function like the 'windows' in the mastaba's was to aid in excavating a sizeable chamber out of the rock; it would also aid ventilation.[52] That large amounts of excavated rock traversed this upper passage is highlighted by M&R, who state; *"The threshold of this opening is deeply scored as from the rubbing of ropes used to lower and raise heavy loads."*[53]



Above we have the sections of the Upper chamber (large Apartment) from Vyse's publication, and it's interesting to compare this to the mastaba section on the previous page. The chisel marks visible in the lower passage are interesting; was this it's intended finish? Should we not expect a finer scraping of the walls or even plastering of the walls; could it even be seen as incompletion of the substructure? Given the amount of traffic through this passage, one might expect that it would be one of the last elements to be plastered, after completion of the inner chambers. From the incomplete temples it seems clear that Menkaure did not live to see the complex completed; but how much of the pyramid inside and out was completed? It's difficult to ascertain what works were outstanding at the time of his death; fine

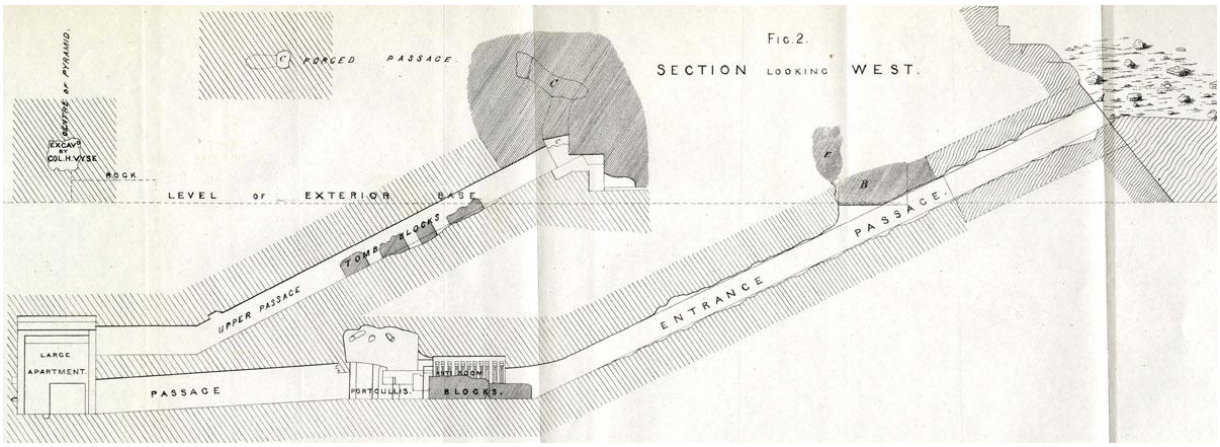
[51] The Pyramids and temples of Giza, 1883, page 118
[52] This suggestion I have made for some time; for example www.ianlawton.com/oc.html 03 Jan 2000
[53] *L'Architettura Delle Piramidi Menfite, Parte VI, page 42*

limestone casing fragments have been recovered and early explorers seem to report that the superstructure was complete, so one might be tempted to conclude that the substructure was completed, as in the scheme of things it would appear a small element, and yet, sometimes the substructure appears to lag well behind.



For example, in GIII-c, shown left, the builders had not even reached the stage of fully excavating the rock for the substructure; the burial apartment, excavated from the ceiling downwards, still had a majority part of its floor to be excavated, some 75cm high. In contrast the stepped core appears largely completed (Vyse would report that a lot of this pyramid core was destroyed by the French). There could be several reasons for this; access to the superstructure with many workers is largely unrestricted; however, inside, restrictions exist due to space, ventilation etc in which to work. Another example would be Shepseskaf's huge stone mastaba; this superstructure appears complete with fine casing, and yet inside, the granite chambers are largely undressed, with only the tympana being dressed: here, we appear to have a completed superstructure, and yet a huge amount of work was still required on the substructure.[54] So I feel it is possible that at the time of Menkaure's death, that some elements of the substructure may not have been finished.

[54] See my Layman's guide, The Mastabat el-Fara'un



Vyse's section above shows the two passages that lead to the Upper chamber; some of the stone blocking that filled the upper passage still survived. Petrie states; *"The blocking that remains is clearly ancient, as it consists of large blocks wedged in by chips, and worn by passing over the tops. On one block is a saw cut, 6 inches deep in part, running vertically on the face; this cut must therefore have been made by the Pyramid builders, before they used the block for filling."*[55] The end of the upper passage terminates in the core masonry of the pyramid, and a small mound of rock appears to exist above the pyramid base. Against this mound of rock sits a large lintel block which covers the passage; Petrie gives it as 11&1/4 x 8&1/2 x 7 feet, or about 50 tons. This block would remind Petrie of similar blocks over the entrance passages in the smaller Pyramids, and this would lead him to suggest that originally a smaller pyramid was planned.

But it might also mean that this upper passage had to be protected and kept open as the superstructure was raised around it. If we accept that a stepped core exists, this upper passage could be kept open for a considerable time, until the casing phase when the construction passage would be blocked with stone, and the entrance in the Upper chamber plastered over to disguise its existence. Keeping the construction passage open for as long as possible could aid substructure construction; but if it extended to the exterior face of a stepped core, how might it have looked? We could perhaps extend the passage to align with a step in the core, thereby providing a working platform at its mouth; or we could create a construction gap/passage which would run horizontally to a step face. A few construction gaps exist in pyramids, though unfortunately they are not well

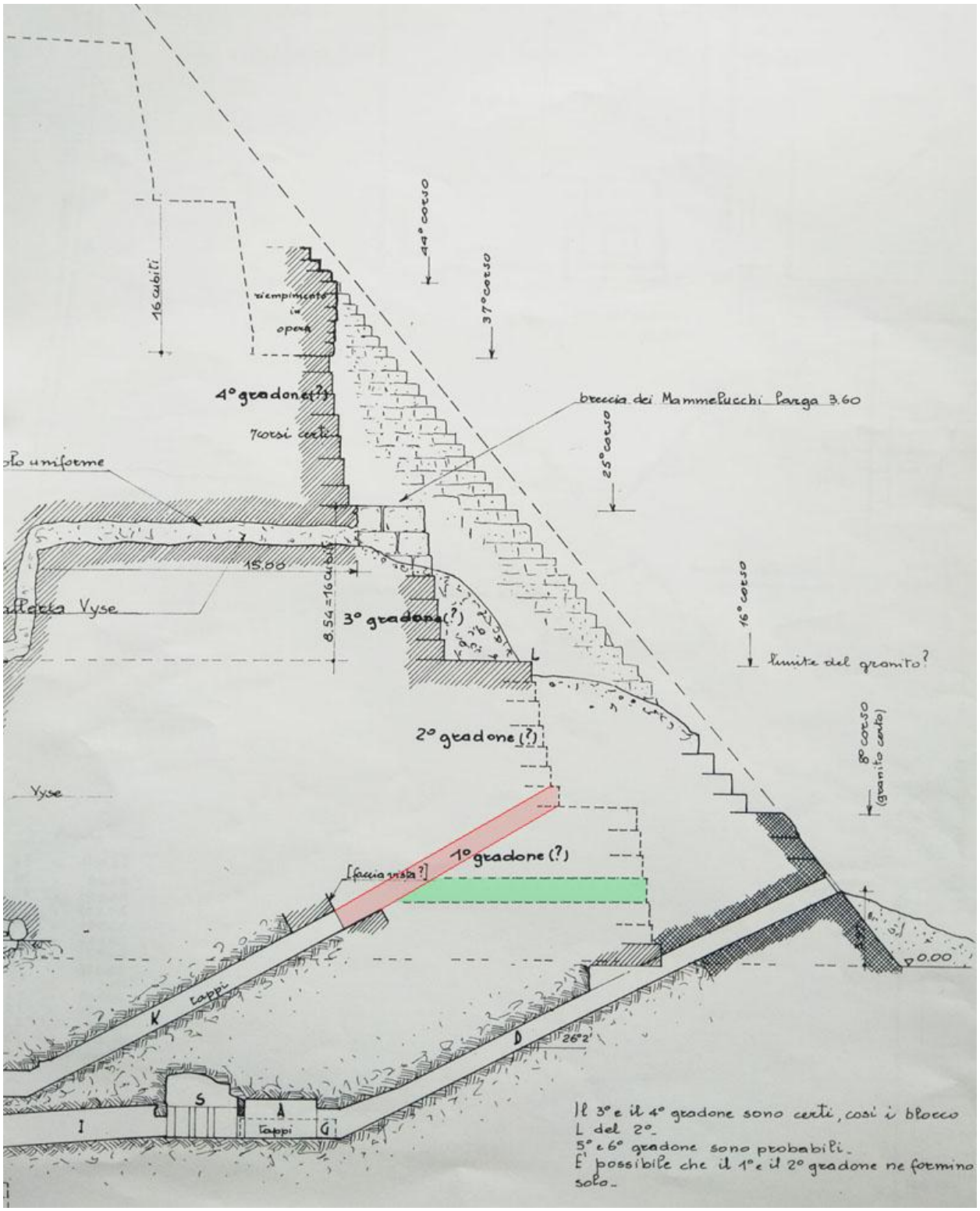
[55] The Pyramids and temples of Giza, 1883, page 120

studied.[56] Shepseskaf's large stone mastaba is also believed to have a construction gap on its north face, M&R state; *"As we have said, the large breach to the north presents a notable difference in the appearance of its walls. The first four courses at the bottom are regular, like the outer faces of the nucleus, while the upper courses are very irregular. From this one may conclude that the superstructure was begun when the internal apartments were still under construction and that in the nucleus a gap was left to a height of four courses to facilitate the transport of the blocks, the movement of the workman and the putting in position of the butting beams covering the crypt and the antechamber. Once the apartments were built and covered and the white limestone core was erected round them the gap no longer had any purpose: it was filled with blocks up to the level of the fourth course and the masonry above it was continued in a uniform manner over the whole edifice."*[57]

Such construction gaps do appear logical and allow the superstructure to be advanced without waiting on the construction of the substructure; both constructions can be advanced, with little conflict between the two. Though it does place a question mark on the great pit sites of Zawiyet el-Aryan and Abu-Rawash; these two sites have been attributed as pyramids: though in my guides to those two sites I have questioned such an attribution.

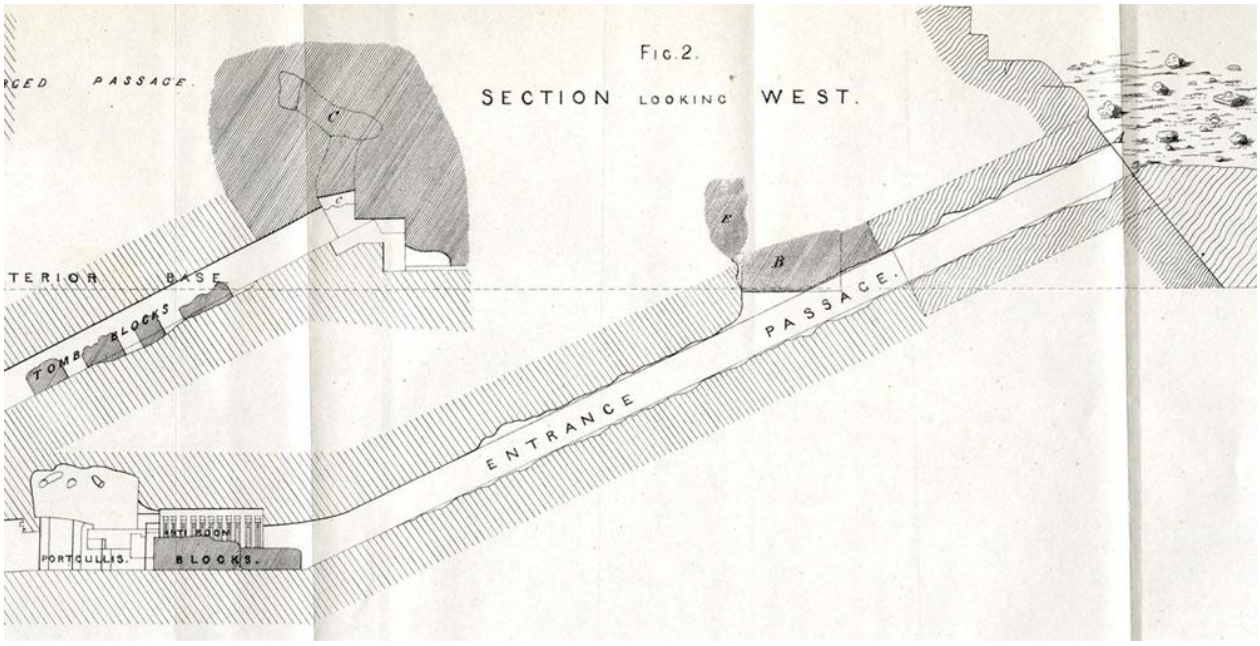
Where the upper passage ends in the core masonry, there is little data on the form of the masonry, other than the lintel reported by Petrie and numerous searcher tunnels that branch of it and reported by Vyse.[58] It would be beneficial to explore this area in greater detail, to establish if the passage continued, or if a construction gap existed. In the image overleaf I have highlighted two possible routes for the upper passage that extend to the exterior face of a stepped core. The green horizontal route could have been roofed with large beams to protect the passage and allow the core to progress; the construction passage would then be filled with stone prior to the casing phase of the pyramid.

[56] Building in Egypt, Pharonic stone masonry. D. Arnold, 1991, pages 179-181
[57] *L'Architettura Delle Piramidi Menfite, Parte VI, page 152*
[58] Operations Carried on at the Pyramids of Gizeh in 1837, Vol 2, page 123. Some of these tunnels are quite sizeable.



Possible routes for construction passage

The Entrance Passage



The entrance according to Petrie is in the middle of the north face; this is contrary to its giant neighbours were the entrance is displaced to the east. The initial section of the passage is constructed of granite and this granite continues to varying lengths were it abuts against the natural rock; the granite ceiling stones differ in abutting against a large limestone block placed across the passage (marked B above), which is held by the natural rock. This limestone block M&R offered two suggestions, first that it could be a foundation block for a possible stepped core (see image on previous page), and secondly that it was a masonry filling for a fault in the rock.[59] They also observed how the harder granite section of the passage appeared less preserved than the lower section that was hewn out of the rock; they suggested therefore that the granite portion of the passage was blocked with granite plugging blocks.

Vyse's view; *"The interior of the passage was rough and uneven, particularly near the entrance, where the joints of the masonry were open and defective, and the ceiling was cut in coves of unequal height. Much of this irregularity was no doubt occasioned by the violence that had been used in removing the blocks with which the passage, as far as the anteroom, had originally been closed up."*[60]

[59] *L'Architettura Delle Piramidi Menfite, Parte VI, page 98*
[60] Operations Carried on at the Pyramids of Gizeh in 1837, Vol 2, pages 72-73

Two large blocks were found in the panelled chamber and these can be seen on Vyses section (previous page). Vyse would also report on the large block 'B' spanning the ceiling of the passage; here he reports that an excavation had taken place here (marked 'E' on section), possibly by searchers suspecting that block 'B' concealed an entrance, and interestingly he states that the excavation; *"had been carried up into the solid building, on the outside of one of the steps or stages, of which the interior of this building is built."*[61] Unfortunately, we are unable to know if he observed anything that led to this conclusion, or if it was an educated guess. In comparison, M&R's section would suggest that this excavation would be on the inside of a step face (compare sections on pages 31 & 39).

It would be advantageous to reopen this excavated area 'E' to better observe the masonry and to determine if a stepped face exists in this location.

The drawing above from Vyse's publication shows the entrance into the pyramid; much as Grinsell found it some 110 years later (see page 12): partial clearance of the north side began in 1968. A cutting in the architrave and sides of the entrance are visible; this work according to M&R was not completed. The question arises as to whether the

[61] Ibid, page 73

smoothing by the entrance is contemporary to Menkaure or a later restoration, of which there may be more than one. It would seem more logical to leave the granite undressed and let the searchers work for their gains, than leave a large X marks the spot. It's likely the original violators knew the location and hacked through the rustic casing stone and any other barriers which lay in their way; there appear to be no trial excavations through granite on the north side to suggest that they were searching in the dark. Cutting through the rustic block would cause damage to its neighbours, so any attempt to simply restore the entrance by inserting a replacement block would not disguise the entrance as the damage to its neighbours would only highlight the location. Restorers may therefore have elected to smooth a sizeable area to remove the previous visible damage; ultimately we may never know.

The dimensions of the entrance passage mimic those found in its giant neighbours; Vyse gives a breadth of 41.5 and perpendicular height of 47.5 inches (a possible 2 cubits x 2 cubits 2 palms. Or 56 x 64 digits): this passage standard is first observed inside the Red pyramid at Dahshur. Passage length he gives as 104 feet (31.7m (60 cubits?), with an angle of 26°2´. When it comes to the internal dimensions, we have a bit of a mixed bag of inconsistencies between various authors; ideally the structure requires a modern survey to test earlier findings. M&R have accepted Vyse's dimensions in some areas and added their own in others; Petrie provides only a partial survey, for example , for the entrance passage , he only gives the azimuth as +13´16˝.

Towards the end of the entrance passage the ceiling rises slightly to a short horizontal passage some 1.3m long along the floor, 1,2m at ceiling, which leads into the panelled chamber; the vertical height of this short passage is given as 1.72m. This heightening of the passage at its end is likely to allow larger items more turning space.

The Panelled Chamber

This rectangular chamber cut from the rock, as are all the chambers, contained niche decoration on all four walls; eleven on its long walls and four on its entrance walls, two each side of the doorways, which are both centred on the north and south walls. The walls were all plastered including a thin layer for the niches which

were carved from the rock. The dimensions for this chamber vary between authors; Vyse gives 125 x 144 inches, 3.18 x 3.66m: M&R give 3.15 x 3.63m; Petrie mean of four measures gives 3.17 x 3.91m. Petrie's length is at odds with the other authors, whose measures suggest a chamber of 6 x 7 cubits.

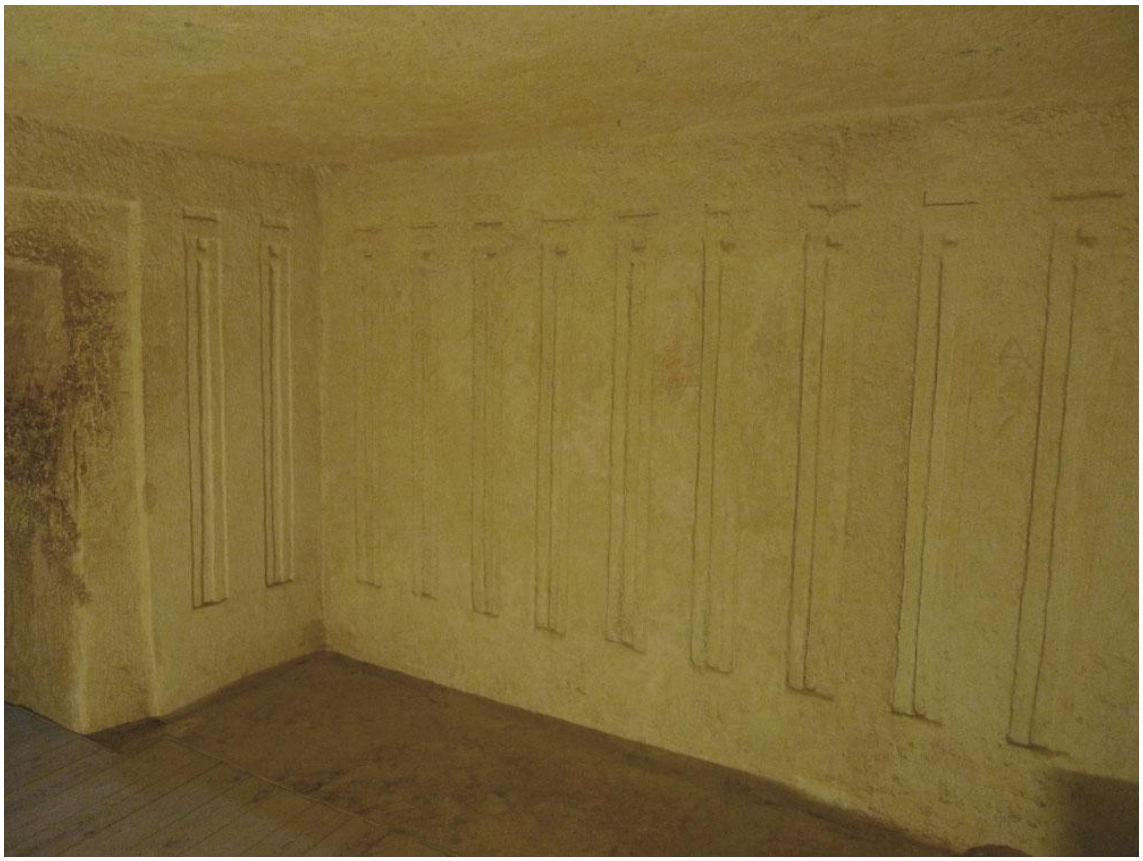


Image courtesy of Colin Reader

Looking into the NE corner of the chamber, we can see the doorway left, from the descending entrance passage; around this doorway a shallow cutting about 4cm deep is to be seen. The doorways at 2 cubits wide provide an equal 2 cubits either side, for a total of 6 cubits. The height of the chamber Vyse gives as 84inches, 2.13m, which is the value that M&R provide, or a possible 4 cubits (Petrie provides no measure).

Image courtesy of Jon Bodsworth

Looking into the SE corner we see the granite framed doorway which leads to the portcullis chamber. The granite architrave has a half round drum carved into it. When Vyse entered the pyramid this architrave was found on the floor; today this area has been restored, including the south wall to the left with the two niches, as this wall was cut into by searchers, possibly to circumvent the granite. I have not been able to source any information as to when this restoration was done, but possibly sometime after M&R's visit, as their drawing of the architrave does not match what we see today. Indeed they state of the above doorway; *"Now only a small part of the east jamb has remained and this is not in place, the west jamb has completely disappeared and the masonry too, on this side of the door, is damaged.*

We think that this damage was caused by Perring during the work of removing the sarcophagus."[62]

Image courtesy of Jon Bodsworth

Looking into the SW corner; what form the masonry took above the architrave is not known: it may have been granite for added security. Whilst the north, west and east walls of the chamber have their decoration carved from the rock; the south wall was largely made of masonry. M&R state; "*Originally it was not all of rock, but both above and at the sides of the door, from a certain distance from the ceiling, it was of masonry and consisted of blocks of limestone that were evidently plastered over."*[63] The masony from M&R's TAV 7 shows the masonry west of the door at around 54cm thick, and 46cm thick, east of the door.

[62] *L'Architettura Delle Piramidi Menfite, Parte VI, page 40*
[63] Ibid, page 40

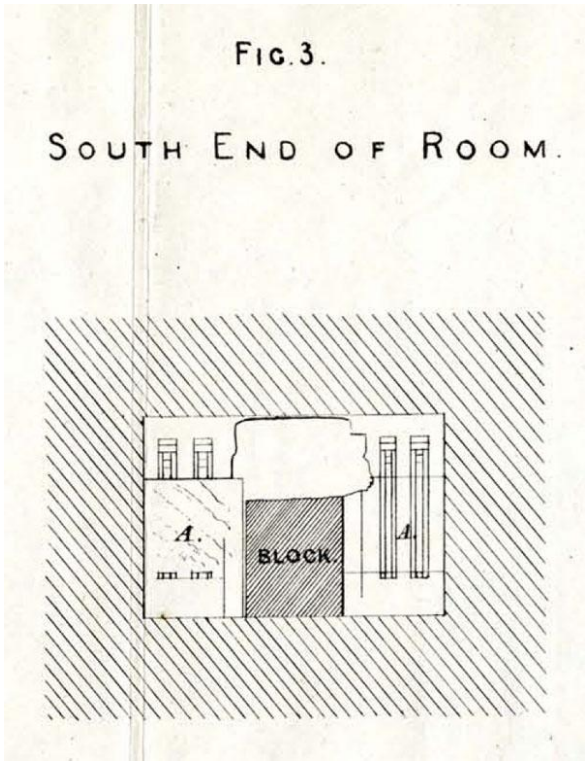
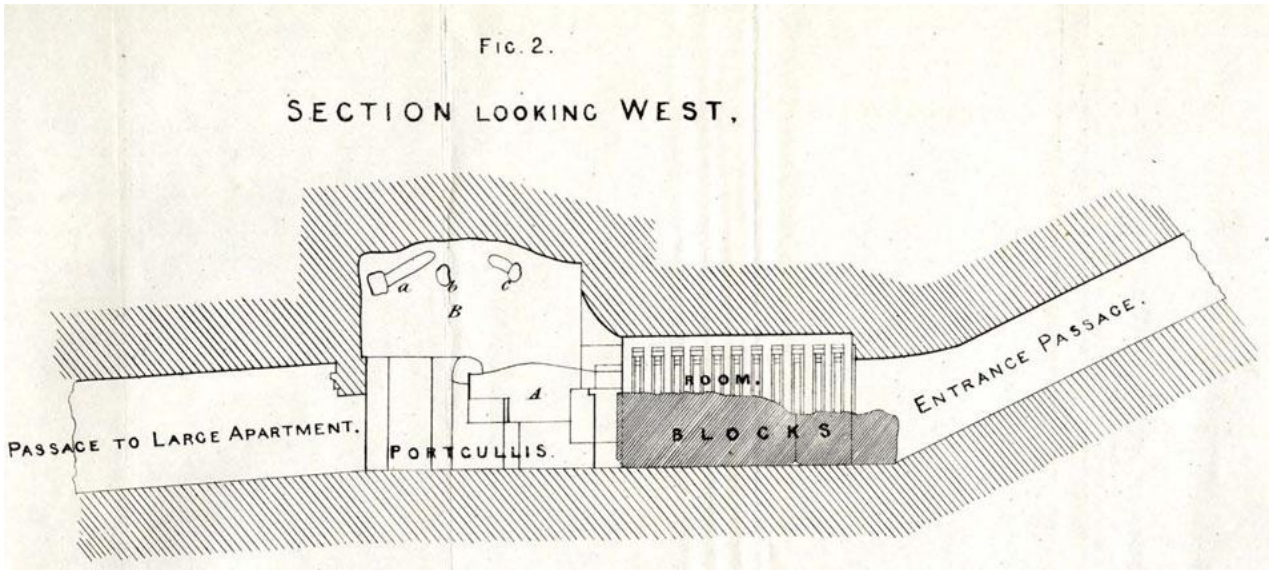


Fig 3 from Vyse's publication shows the condition of the south wall as he found it; though according to M&R it was less damaged than they found it. The section shows the architrave missing, along with the masonry above it. The best preserved section is west of the door, with the niche decoration complete. On the east side masonry has been removed, and only a small bottom portion of the niche is visible, along with a greater portion at the top. The excavation on the east side, Vyse suggested was made by robbers who tried to avoid the granite portcullises; though it does not bypass all the portcullises. The breach gives the appearance of bypassing the large block in the doorway and gaining access to the portcullis chamber.



In fig 2, we see the two blocks found by Vyse, which prevented access to the portcullis chamber; these hefty blocks were removed by Vyse in order to extract the sarcophagus. But when were such blocks fitted; are they original or restoration? We have to keep in mind the wooden coffin introduced during the Saite period, and how was this introduced?

The Portcullis Chamber

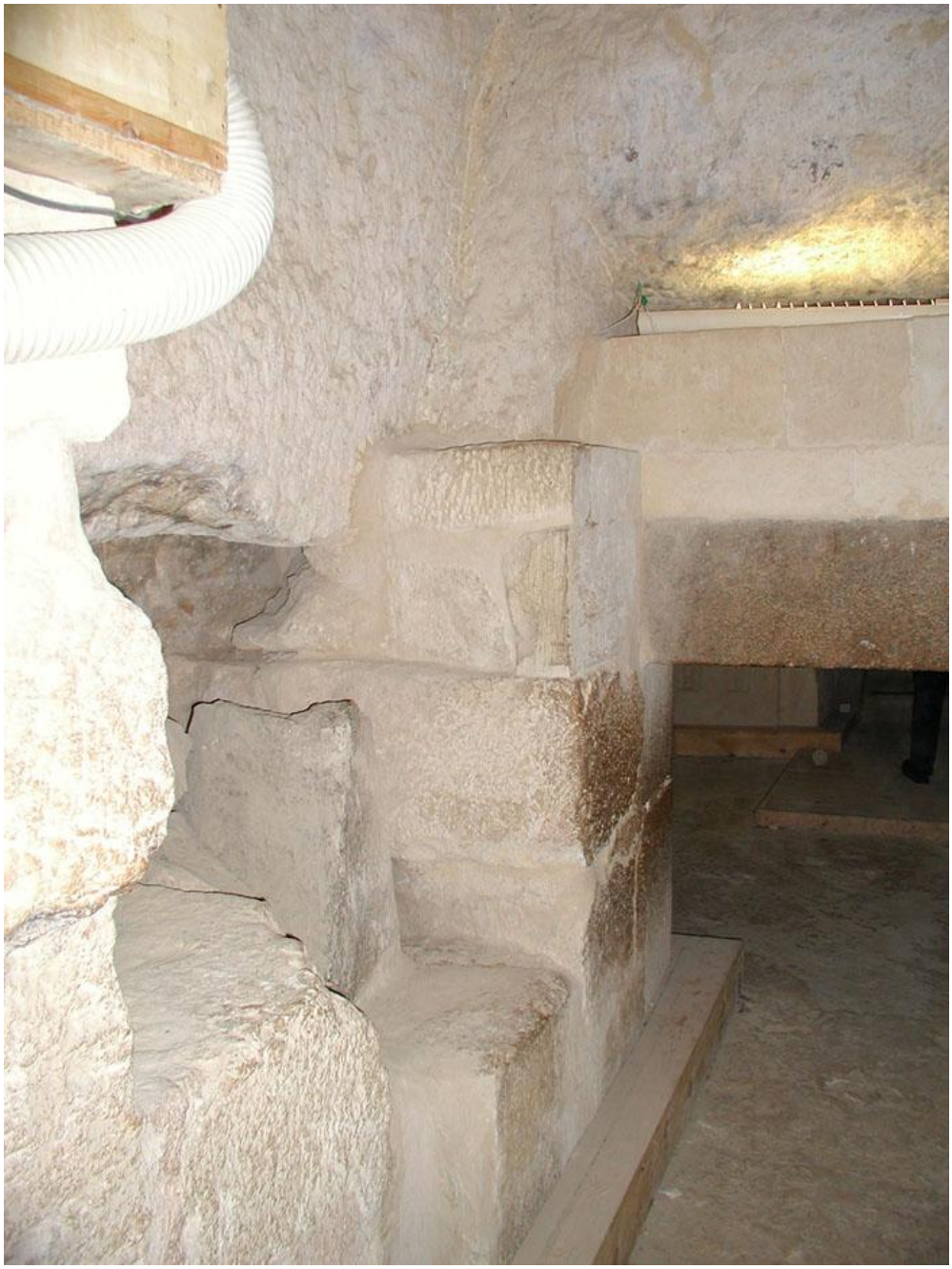
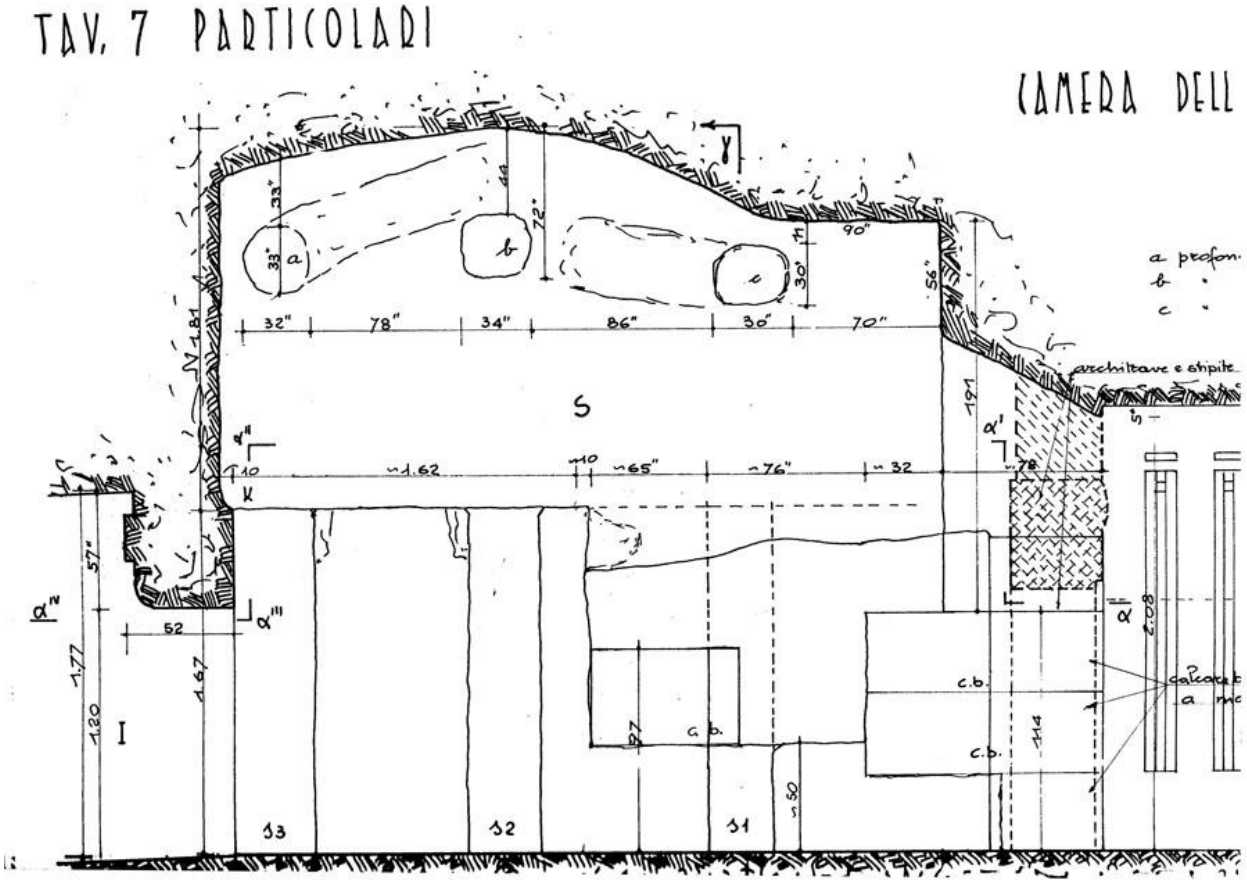


Image courtesy of Jon Bodsworth

This view looking north from inside the portcullis chamber, here we can see the rear of the granite architrave; above it the rock has been cut in a slope, probably to assist in portcullis installation. The chamber is much damaged; the first portcullis groove is just visible, bottom middle of the image above.

The first portcullis position is made from a mixture of rock and masonry, a lot of this masonry is now lost; but the use of masonry in this position was possibly to allow easier insertion of the first portcullis: the portcullis would be introduced and then masonry would build up the north face of its groove. The remaining portcullises have their grooves cut from the rock.



The above partial scan of M&R's TAV7 shows the west wall; compare with image on previous page: the architrave would appear to be lower; the south door of the portcullis chamber appears to have a half drum feature carved from the rock, this is set at 1.20m from the floor. The portcullises which would have slid down these grooves don't appear to have a uniform thickness; unfortunately we have inconsistency in the measures: Vyse would only provide a length for the chamber of 161 inches (4.1m). Petrie would provide a sequence of measures highlighting the location of the grooves and a chamber length of 161.5 inches. Petrie's measures show first groove as 11.1 inches (28.2cm) wide; second grove as 13.3 inches (33.8 cm) wide, and third groove as 12.2 inches (31 cm). However, this is at odds with

M&R's TAV7, which shows measures for the grooves on both sides of the chamber as 1st = 30cm, 2nd = 34cm, and 3rd = 40/41cm; with a length for the chamber, from the front face of the granite jamb as 4.21m (8 cubits?). Between the two authors, the third groove has a major discrepancy; but given the more detail drawings by M&R, one would be inclined to think that Petrie has made an error somewhere: but it does highlight the need for a more modern survey. If M&R are correct, it shows an increasing thickness of portcullis from north to south.

Image courtesy of Jon Bodsworth

This view of the east wall shows a restored first groove, with the remaining grooves which were cut from the rock still visible; a part of the southern doorway is also visible. The depth of the grooves is around 16-18cm, and a small shelf is left on top of the grooves which may have supported ceiling stones in the gaps between the portcullises. The shelf on the west wall, though irregular extends up to

1 metre, and as the head height above the shelf extends to 1.8m, it allows workman space to go about their work.

Image courtesy of Jon Bodsworth

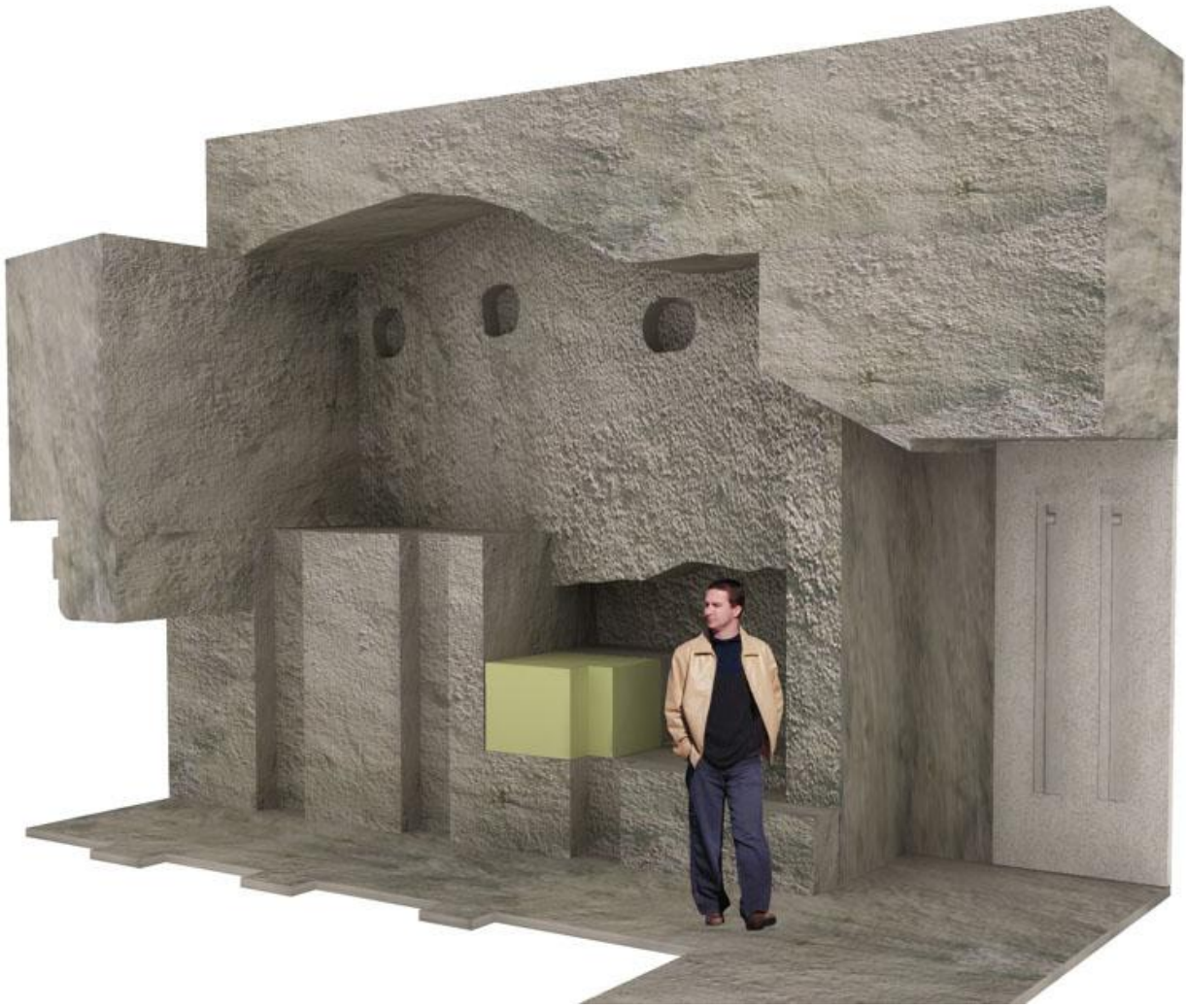
Looking up into the roof of the chamber we can see two of the holes on the west wall (these are labelled a & b in M&R's drawing, see page 48) which would have held wooden beams. Shallow cuttings have been made in the wall which leads to the holes; these are to aid in inserting the beams. Opposing holes are to be found on the east wall; the pairs of holes vary in depth, one being deeper than the other; this allows the beam to be inserted at an angle and then withdrawn into the opposing hole on the other wall: the holes are quite rough and the beams would be smaller to allow clearance.

How then were the portcullises fitted? M&R would state; *"First the southern sliding block was put ready, and then hauled up until it reached the vertical*

position with the help of a beam fixed in the corresponding pair of holes and slipped into the sliders from above. After having shored it up in the waiting position with wooden props, a large horizontal transverse slab (perhaps of granite) was put in position, and formed the ceiling of the room between the third and second portcullises; the manoeuvring beam was then perhaps removed and masonry was constructed above the slab as far as the ceiling, but so as to leave the seating of the sliding block free. The second portcullis was then inserted and the operations were repeated in the same order."[64]

Here M&R suggest that the portcullises were inserted from above, which is logical; indeed the shape of the ceiling of the chamber lends itself to the turning of a portcullis from horizontal to vertical. Both the 2nd & 3rd portcullis would be fitted in a similar manner; the first would have been fitted different as its groove was partially constructed of masonry and so did not require the greater ceiling height. However, using the *manoeuvring beam* to bring the portcullis vertical and lowering the portcullis into the groove is questionable, as the size of the portcullis could be in the way; indeed, the beams may only have been fitted after the portcullis was inserted, and this in turn could suggest that the beams were used to lower the portcullises at the time of sealing the pyramid, and that they were not a temporary feature for the insertion of the portcullises. The following series of images highlights some of the options.

[64] *L'Architettura Delle Piramidi Menfite, Parte VI, page 102*



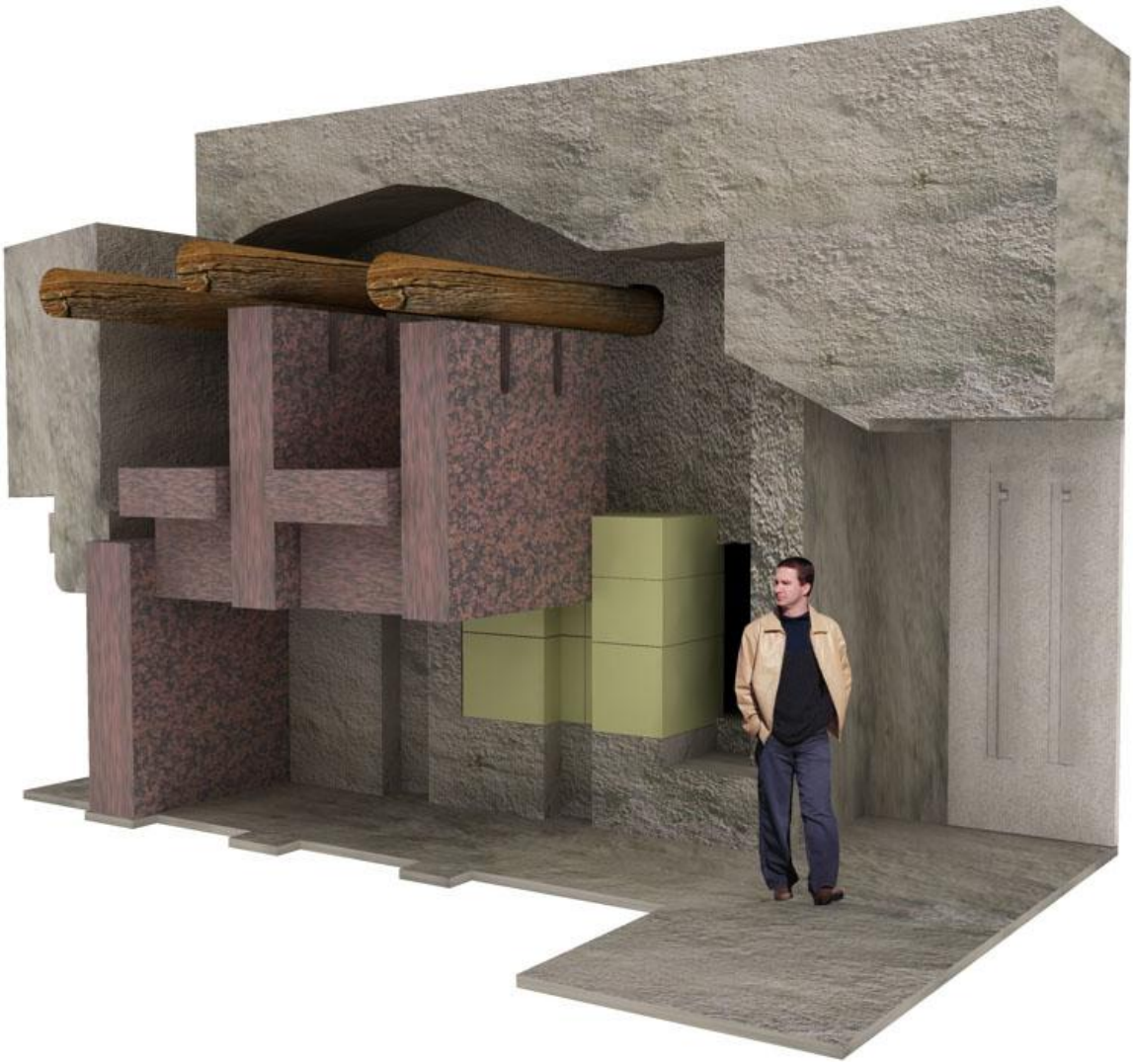
In the section above we are looking at the west wall; I have removed the architrave and south wall masonry of the panelled chamber. The highlighted masonry block creates a portion of the first groove; a sizeable excavation had also been made into the back of this wall.

In the above option we have a portcullis that takes up the whole height of the groove; this is the maximum height of the portcullis as there is insufficient head height above to upright a taller stone. The beam would be in the way of up righting such a stone. To install such a stone they may have filled the grooves with small flat stones, then turn the stone upright, then by using a prop underneath, gently lever the portcullis up to remove the small stones and gradually walk the portcullis down into its resting position: once clear of the holes a beam could be inserted and rope used. I have placed two holes in the portcullis for the passage of rope, and created rope guides, in case any transverse ceiling slabs were fitted. Such a portcullis above is around 0.8 cubic metres, about 2 metric tonnes. In the fully raised position, we have a space beneath the portcullis of just over 1m.

I have assumed that the portcullises are granite; though Vyse only reports fragments of granite, there is nothing in the report which suggests that he found pieces of the portcullises.

The above shows options for transverse ceiling beams; a plain flat beam, or a ‘T’ shaped beam. The ‘T’ shaped beam matches the height of the south doorway.

Using the beam to install the portcullis significantly reduces the height of the portcullis, as shown left; the resulting size would not even cover the south doorway. This suggests that any portcullis would extend past the beams; moreover, the profile of the ceiling suggests that portcullises of a sizeable height were used, as they were rotated to the vertical position



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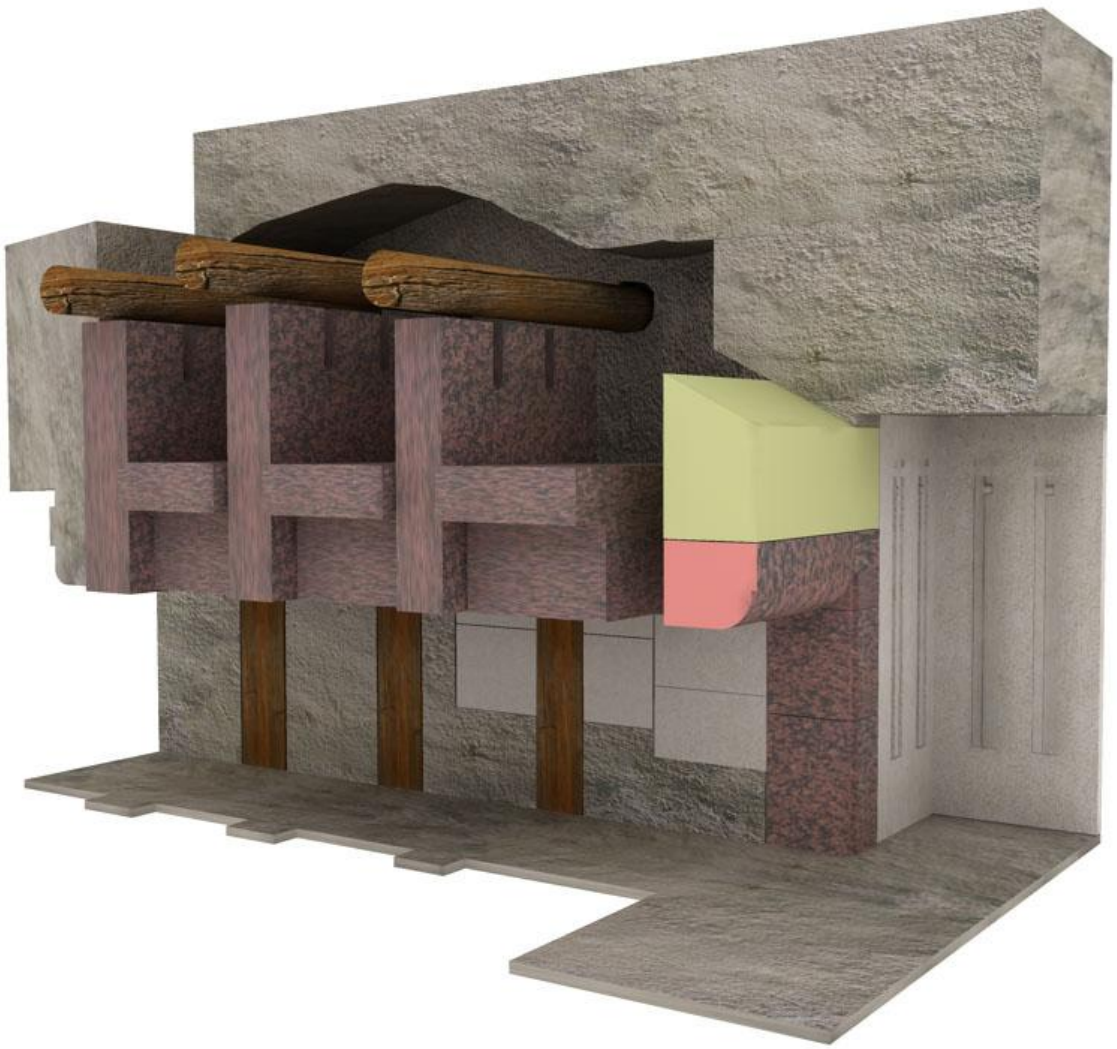
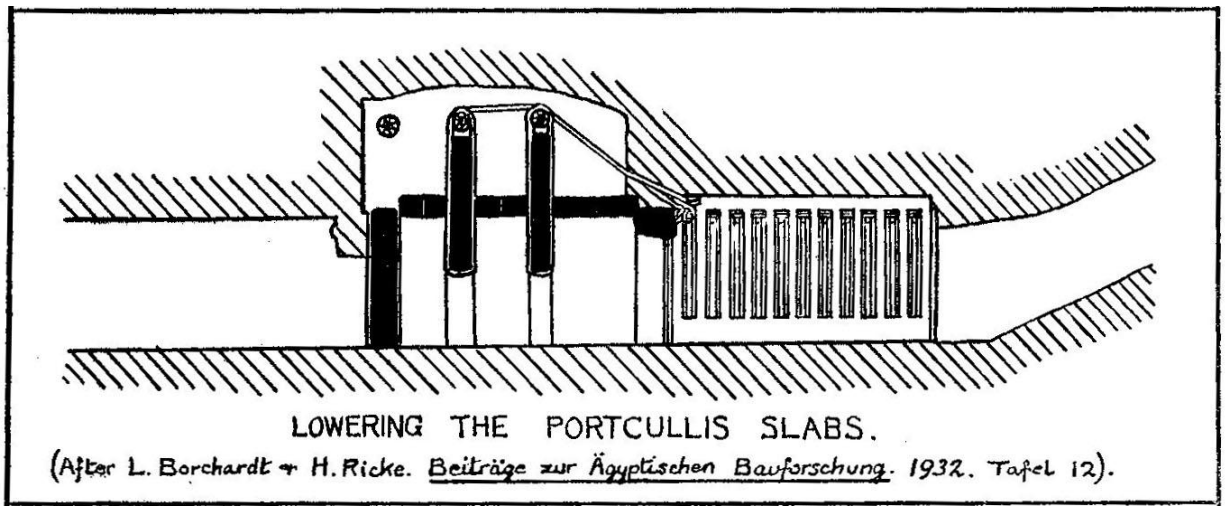
If ‘T’ shaped transverse beams were used, the height of the portcullises could be reduced slightly, so that in their stored position, we would in effect have a flush granite ceiling matching the height of the south doorway of 1.20m. This configuration reduces the 3rd portcullis to 0.74 cubic metres, with the 2nd - 0.64, and 1st- 0.54. The first portcullis is easier to install as its groove is partially constructed of masonry; here they could use the beam to assist fitting: the southern masonry blocks would be fitted first, then the portcullis raised to clear the rock portion of the groove and fitted into the groove, then the northern masonry blocks fitted to complete the groove.



The granite doorframe and architrave would be one of the last items in the portcullis chamber assembly; the masonry above the architrave is unknown, though one would favour granite for security purposes. If it was intended to lower the portcullises with some sort of rope rigging, they may have rested the portcullises on temporary timbers fitted inside the grooves (or small slabs of stone), until the time of closure. Access to rigging and operation of portcullises might have been through a gap left between a ‘T’ slab and architrave, then sealed afterwards. The above can only be a guess, ultimately we may never know what portcullis design was used, as there are so many permutations.



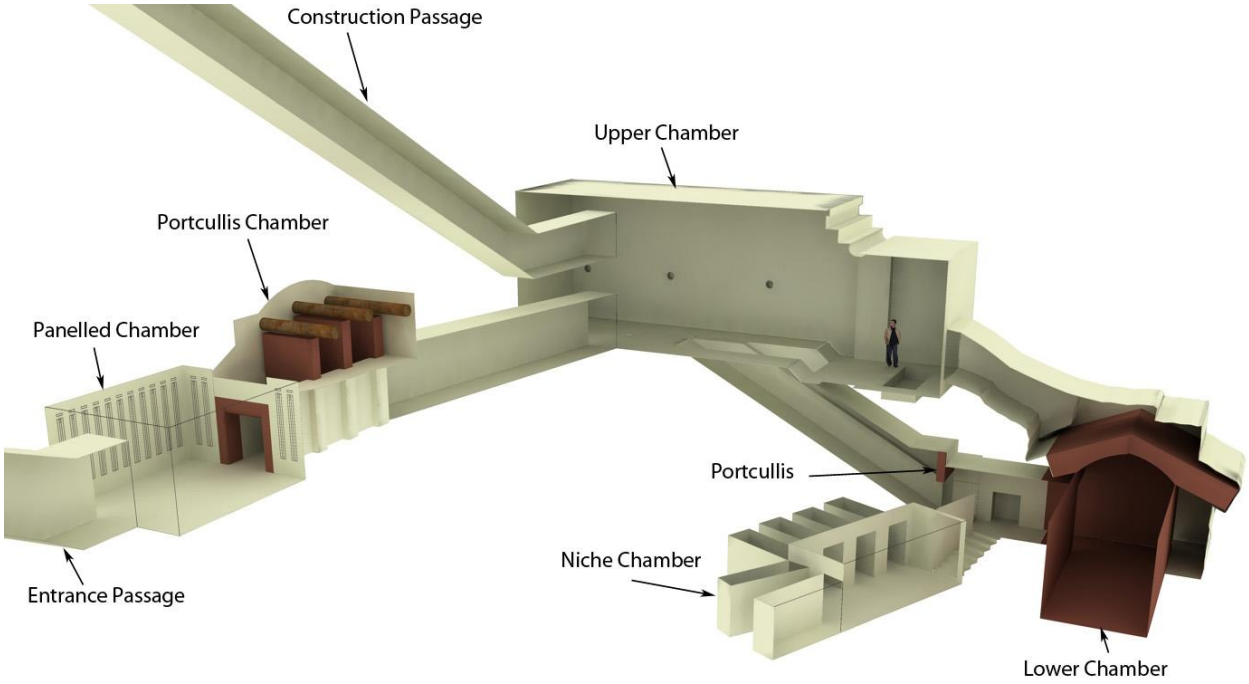
The above reconstruction[65] shows one option; here rigging is passed through a gap in the masonry above the architrave, to enable portcullis operation from inside the panelled chamber. At what time of construction the chamber was assembled is unknown; masonry size for the inner chambers is restricted by the south doorway which is created out of the rock, and is some 1.05m wide by 1.20m high. The chamber space may have been excavated and left devoid of its masonry elements, to allow workers more space to transport heavy masonry through the south doorway, and then assembled later once the granite burial chamber had been constructed.

The Passage from the Portcullis chamber to the Upper Chamber

Passing under the low south doorway of the portcullis chamber, the workers would be glad to see that the architect has greatly increased passage height; Vyse gives this passage as 70 inches high, 1.78m: Petrie gives the passage as 71.1 inches, 1.81m, by the door of the upper chamber. It may have been intended that the passage be a third higher than the descending entrance passage at 3 cubits 3 palms (Petrie would note that this passage matches that found inside Khafre's pyramid); the passage width is maintained at 2 cubits. The workers would also be glad to see that the architect has given the passage a downward slope of 4 degrees (Vyse). Vyse would give the length of the passage as 41 feet 3 inches, 12.57m (24 cubits?).

[65] Egyptian Pyramids, Grinsell, 1947, page 75

The Upper Chamber

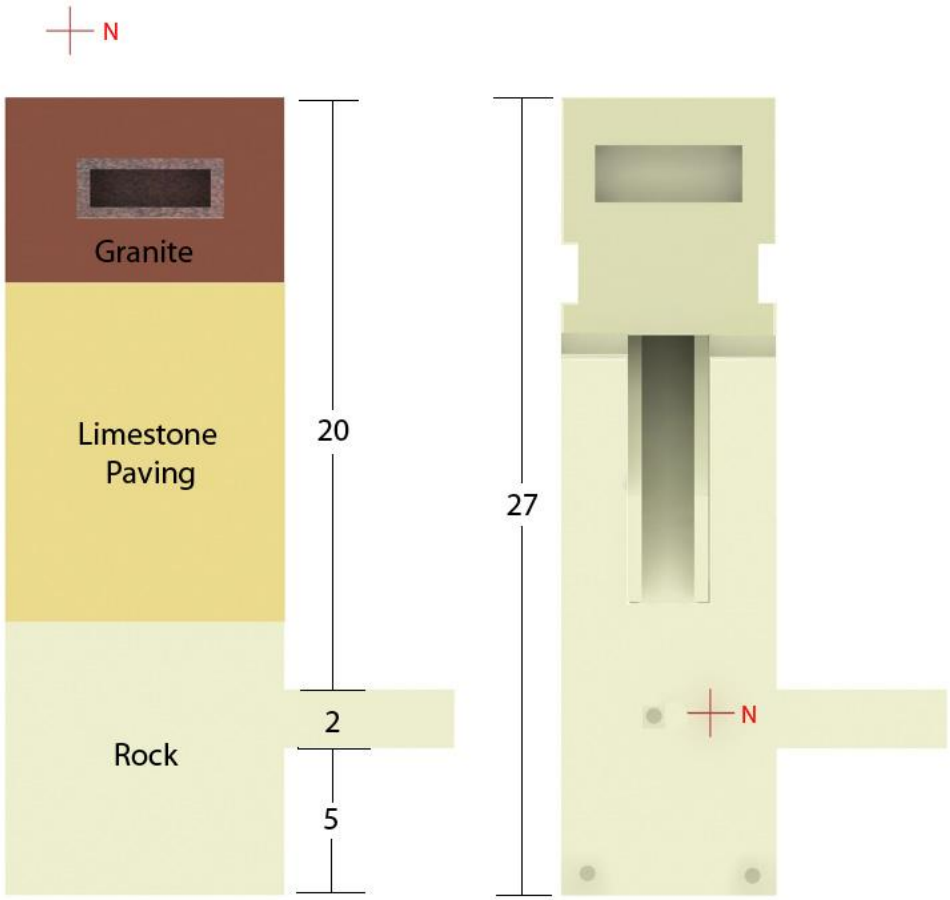


The upper chamber is the largest chamber, and a hub for all the passages. In its west wall a passage leads down to the roof of the lower chamber; this is like another 'window' to help excavate the lower chamber, and to assist in introducing the granite masonry. With the lower chamber completed, the opening in the west wall of the upper chamber would be closed with masonry and plastered over to hide its presence. At time of burial, access for the funerary procession would be by a sloping passing in the floor of the upper chamber; this had space for a portcullis at its end, and Vyse found masonry blocking in the passage.

As Petrie had noted, the upper chamber has similar divisions to Khafre's burial chamber.[66] Both chambers appear to have the same length, though Khafre's is wider, and because Khafre's is built in a shallow pit, it is roofed over by large pent beams.

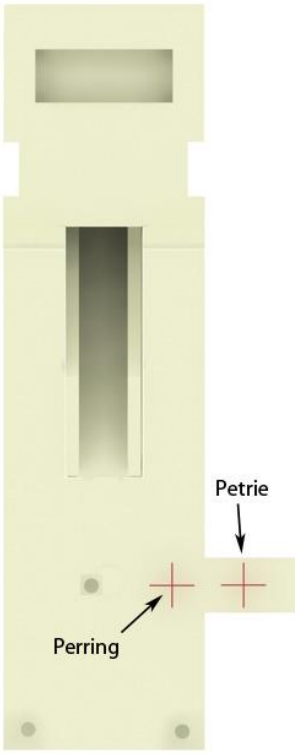
Petrie gives mean chamber length as 14.22m; M&R give 14.20m N.wall & 14.25m S.wall: Vyse gives 14.1m. For chamber width, Petrie's mean is 3.87m, M&R give 3.84m; and Vyse 3.84m.

[66] The Pyramids and temples of Giza, 1883, page 118

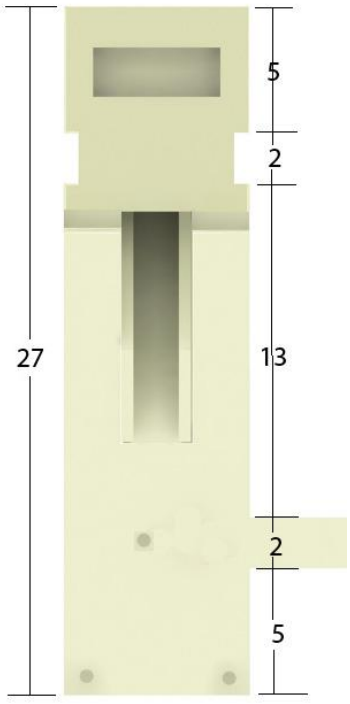


The above image compares the floor plans between Khafre's and Menkaure's chambers (units in cubits). The red crosses denote approximate position of pyramid centres; given the uncertainty on pyramid dimensions they are subject to change. Khafre's floor was made up of three sections, natural rock, limestone paving and granite paving, of which the sarcophagus was embedded. Both structures share a similar sized passage entering in the north wall, and both are placed 5 cubits from the east wall. In Khafre's chamber a fine granite sarcophagus was sunk at the west end, whilst at Menkaure's a rough pit, some 1.02 x 2.62m (2 x 5 cubits) and up to 40cm deep (M&R) was made. No sarcophagus was found in this pit, though it may have contained one: in Edrisi's account of the Great pyramid he appears to report that a second sarcophagus existed inside the so called Queen's chamber.[67] The idea that two sarcophagi might have existed in some pyramids may appear strange, but it should not be discounted.

[67] Operations Carried on at the Pyramids of Gizeh in 1837, Vol 2, page 335.

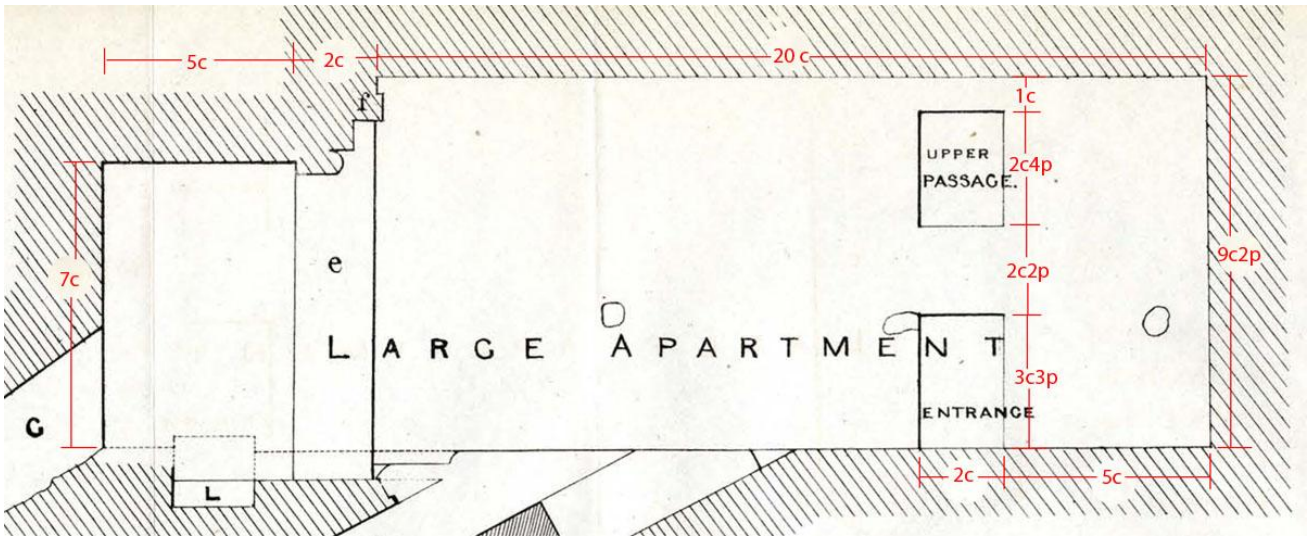


Using the available data, the dimension's in Vyse's publication, M&R, and Petrie (in Autocad); we find that Perring's pyramid centre is on the floor of the chamber, whilst Petrie's is in the passage. The difference is mainly due to the longer base that Perring gives for the pyramid, of 108.05m, combined with a casing angle of 51 degrees. The Petrie centre, is based on his mean base of 105.50m and seked of 5.5, or 14/11. Given the often conflicting measures between authors, the size and angle of the pyramid, it's not possible to accurately locate pyramid centre; though it is possible that the architect intended the upper chamber to be located in the southern half of the pyramid, with a sizeable portion of the lower granite chamber being in the north. So if two sarcophagi were fitted, both would reside in the west, but one north and one south. Petries CAD model suggests that the floor of the chamber is 10.59m below base



This division of the chamber, with the entrance being 5 cubits from the west end is mirrored at the east end, were we find the pit located in a section that is 5 cubits to the pilasters, with the pilasters being 2 cubits wide.

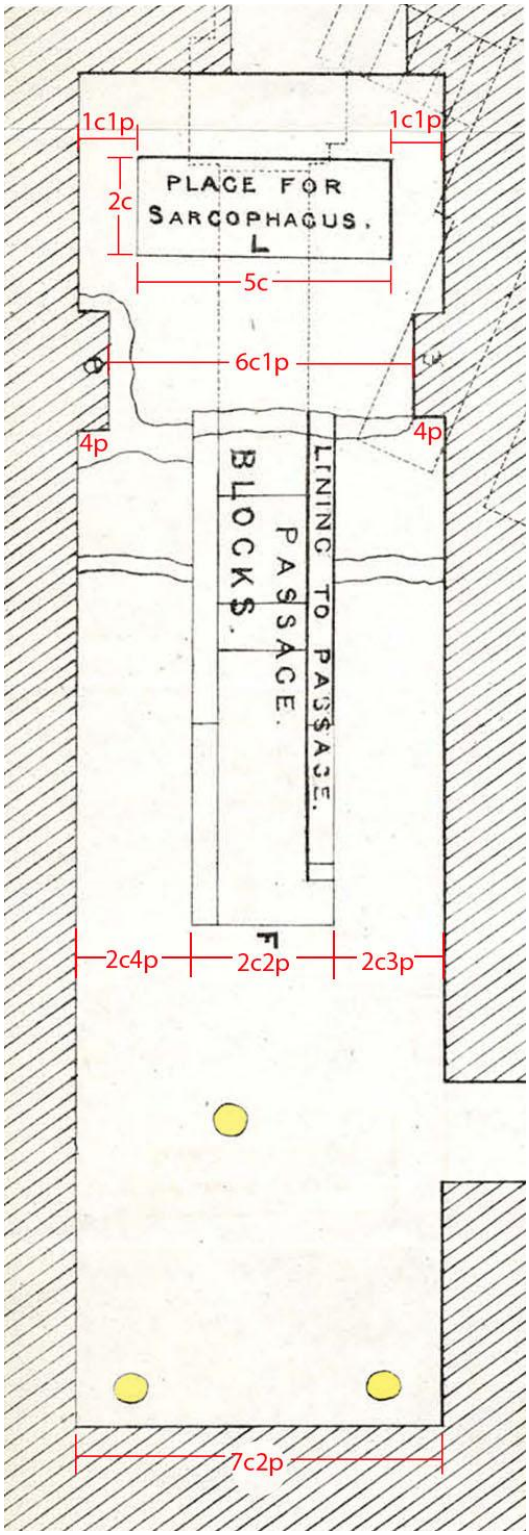
The ceiling height varies in the chamber, with the greater portion extending from the west wall to the pilasters, a distance of some 20 cubits.



The above section from Vyse's publication shows the upper chamber. Inconsistencies in measurements between authors exist here also; but my best guess on a possible scheme for the chamber is shown above in Egyptian Royal cubits and palms (1 cubit = 52.4cm; 7 palms in one cubit). The upper passage extends north for some 5.15m, before inclining upwards at some 27°34´ (Vyse) and terminating in the core of the pyramid. The descending section of the upper passage matches the dimensions of the descending entrance passage, and the horizontal section of 5.15m starts at 1.25m high, though increasing in height as it approaches the north wall of the Upper chamber: the ceiling is level, whilst the floor slightly slopes down, probably due to the large amount of excavated rock which had to be transported along the floor of this section. As previously mentioned some surviving blocking stones exist along its length; also to be seen on M&R's TAV 5 is a series of 'D' holes on the side wall near the ceiling at the upper end of the passage; which possibly held cross beams to assist in hauling excavated material from the inner apartments, or rope attachments to assist access for the workers (there is little data on these holes).

In the section above, three holes have been made in the wall; the middle one cleverly uses the entrance passage side wall to aid beam insertion. Similar holes exist also on the south wall, though not always matching their northern counterparts. M&R describe the eastern holes as opposite each other, about 35cm in diameter and of different depths. They mention a hole low down on the south wall opposite the entrance, with no corresponding hole in the north wall. The next pair of holes by the entrance is around 30cms in diameter, and the last pair above

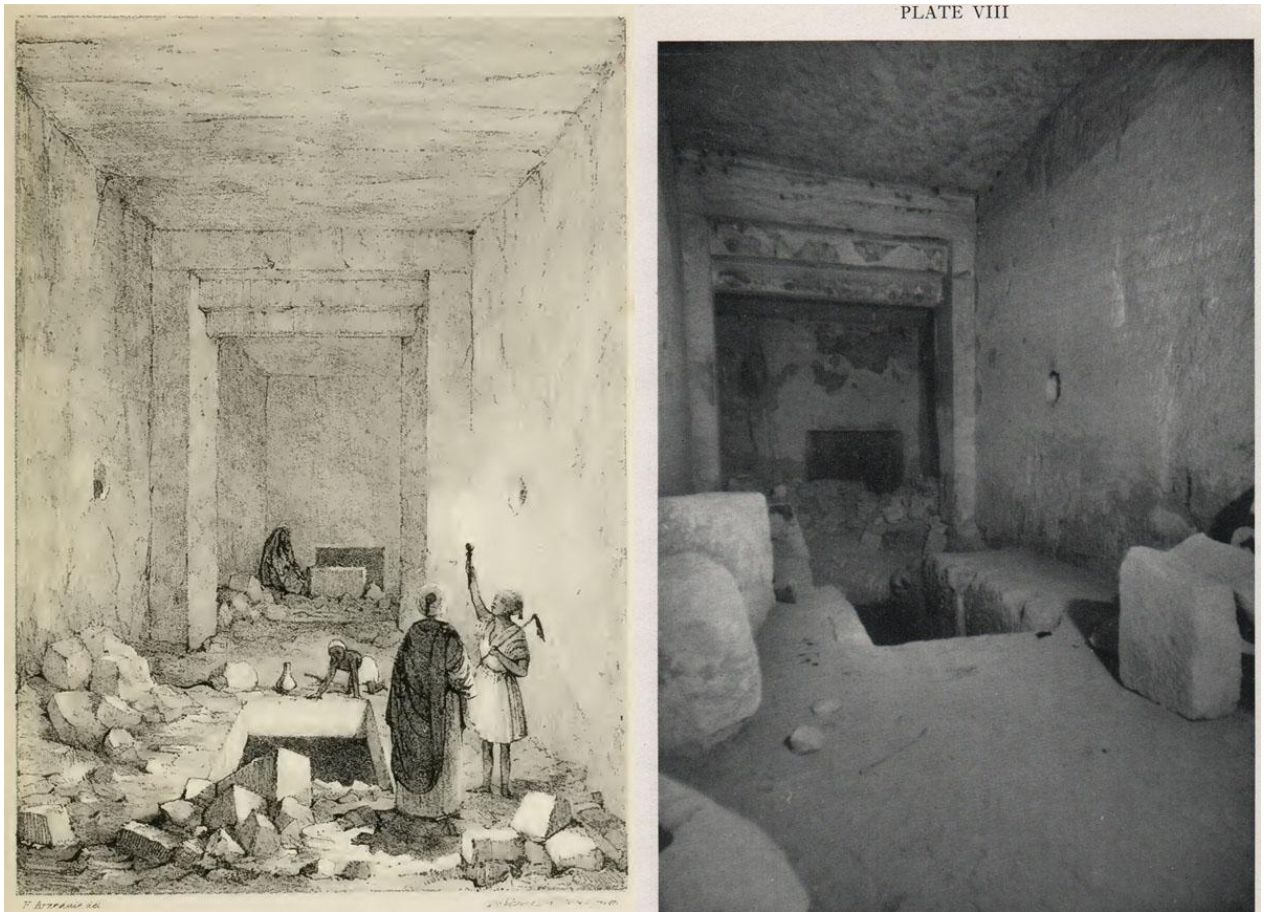
the passage leading to the granite lower chamber is around 34cms in diameter, with the north hole being lower.[68]Three further holes are to be found on the floor at the east end, highlighted left. It's not known if the holes in the wall and floor are original features; it would seem an unsightly thing to breach the carefully prepared walls with such holes: they might more likely be the work of violators to aid in removal of masonry from the passage in the floor of the chamber.



The start of the passage in the floor appears to begin midway in the largest section of the upper chamber, being 5.20m from east wall or 5.38m from pilasters (M&R). The passage opening appears to be offset slightly to the north.

The 'place for sarcophagus' at the west end has all the characteristics of sarcophagus emplacement inside Khafre's pyramid; here the granite sarcophagus is embedded in the floor of granite blocks, such that only the lid is proud of the floor, as it had to be slid along a groove on top of the box. It seems unlikely that the highly decorated box found in Menkaure's lower granite chamber was intended to be placed in this pit, were the decoration would not be seen. The pit would lend itself more to a plain sarcophagus such as seen in Khufu's and Khafre's; it's interesting to note that Khafre's sarcophagus which is sunk in the floor also shares a floor footprint of 5 by 2 cubits

[68] *L'Architettura Delle Piramidi Menfite, Parte VI, page 42*



The drawing left is from Vyse's publication, whilst the image right is from Grinsell's 1947 publication. It's unclear how much debris Vyse encountered inside the pyramid, he states; *"The passages of the Third Pyramid were at length practicable, although a quantity of sand and rubbish yet remained in them. Indeed, the anteroom* (panelled chamber), *the chamber with the portcullis, and a considerable part of the long passage proceeding from them, were filled up with sand to within two feet of the ceiling; but the large apartment, and the rest of the pyramid, were only encumbered with stones and rubbish, produced by former excavations and decay."*[69] Vyse would later report that the rubbish was entirely removed from the chamber[70]; whether the drawing he produces reflects the debris he found is uncertain, and it's a pity we do not have a clearer picture of what he found, as it could aid in reconstructing the history of the structure. For example, much debris should be expected from the 'construction passage' as blocks which filled this passage were extracted over some 19m; on top of which we have

[69] Operations Carried on at the Pyramids of Gizeh in 1837, Vol 2, pages 77-78
[70] Ibid, page 81

considerable debris from the searcher tunnels at its end, which took various routes into the core of the pyramid. All this debris would end in the upper chamber; did such debris exist in Vyse's time, or was it removed during Saite era restoration? Certainly Saite era builders were very competent; they left behind many fine works and were more than capable of doing a good restoration job: would they just introduce a wooden coffin; amongst a pile of debris caused by earlier violators? It's likely the pyramid was violated shortly after its construction, and several times during its history; indeed, it may have been subject to several repairs/restorations during a vast time span. What the Saite's found is anyone's guess, but I could imagine that they would clean the chambers of debris; what state the portcullis chamber was in, is a mystery: if the architrave was intact for instance, how did they get the coffin in, unless it was the Saite's who introduced the large blocks into the panelled chamber. The permutations are endless and caution has to be exercised in interpreting the remains left to us and not assuming that everything is contemporary to the Old Kingdom.

The previous images show the 'window' on the west wall, which would aid in excavating the lower chamber and in introducing the granite masonry; according to Vyse this window had been closed up with solid masonry, and concealed by a coating of plaster.[71]The chamber appears largely plastered and this might provide clues to the introduction of the holes in the walls; for example, if plaster was found inside the holes it would suggest that the holes were made before the walls were plastered, and if devoid of plaster they were more likely introduced after the walls were plastered. If such holes were original, one would think that they would have been filled and plastered over, as leaving them exposed would only offer clues to robbers.

The pyramid appears to have been open for some time in its history as Vyse reports a quantity of *"black dust, apparently the exuviae of insects and of bats"* in both chambers, along with the dung of large birds, on which the sarcophagus appeared to be their favoured perch.[72]

[71] Ibid, page 80
[72] Ibid, page 82

Image courtesy of Jon Bodsworth

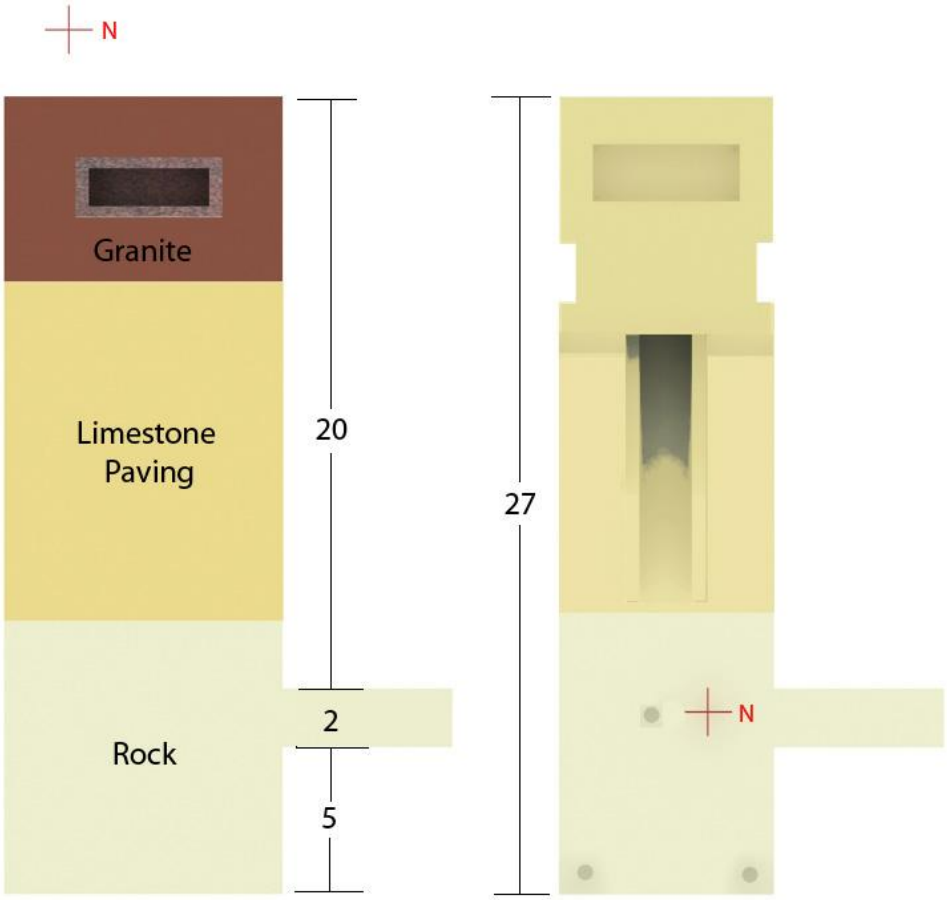
In this more modern image, a safety barrier has been placed around the passage opening and a grill over the window. Large blocks in the corner I have no data on, possible plug blocks that Vyse extracted from the passage? The lower floor area

that surrounds the pit extends beyond the pilasters and into the main section of the chamber; indeed, it has a somewhat unfinished look, exhibiting a bit of a step; there appears to be no defined edge that paving from the east end would abut against (see Vyse's drawing on pages 61&62). The impression is that cutting of the floor for insertion of paving was interrupted; it's unclear from Vyse's reported if they found any paving, he merely states, *"The pavement had been entirely destroyed".*[73]

The problem arises as to how the passage opening in the floor was to be concealed, as it largely occupies a portion of the chambers rock floor. After blocking the passage they could fill the passage opening with masonry to the level of the rock floor, but it's hard to see how they could disguise this opening from robbers: one could plaster over the floor to disguise it; however, this would run the risk of some plaster breaking away under foot and exposing the masonry fill, which would certainly alert robbers. A better solution would be to cut down the floor to the east side of the opening and pave this section of the chamber, and just leaving a small rock portion of the chamber on the east side; similar to what we see inside Khafre's pyramid. This may have indeed been the builders intention; possibly the king died and they were unable to complete their planned work of paving the floor to conceal the passage to the lower chamber, and so had to improvise.

This opening in the floor for the passage led to Perring paying a visit to Khafre's burial chamber, were he tore up the paving in the hope of finding a similar hidden passage.

[73] Ibid, page 81



Above left, we have Khafre's burial chamber floor makeup; here we had three different floor types, granite around the sarcophagus, then a portion of limestone paving, which Perring removed, hoping to find a hidden passage, and finally a portion of rock flooring. At the boundary between the rock and limestone floor, holes were found on the wall, which some have suggested as the start of unfinished shafts such as we see in Khufu's; however, they more likely held a beam as part of a doorway, before entering the paved area of the chamber. On the right we have the floor plan of Menkaure's Upper chamber; here they may have originally intended to cut back the floor and pave in a similar proportion as we see in Khafre's; in this scenario the pavement would neatly conceal the lower passage leading to the granite chamber. Whether a sarcophagus was installed in the Upper chamber we may never know; it may have been removed at some time in its history. The decorated sarcophagus was protected somewhat from removal, though according to Vyse the greater part of its lid was found in the Upper chamber near the floor

opening, and close to it, fragments of the mummy case.[74] Vyse was not present when the board and human remains were discovered so he asked Mr Raven (minus 5 teeth) to write an account.[75]

"SIR, "*London*, 11*th July*, 1838.

"By your request, I send you the particulars of the finding of the bones, mummy-cloth, and parts of the coffin, in the Third Pyramid. In clearing the rubbish out of the large entrance-room, after the men had been employed there several days, and had advanced some distance towards the south-eastern corner, some bones were first discovered at the bottom of the rubbish; and the remaining bones and parts of the coffin were immediately discovered altogether: no other parts of the coffin or bones could be found in the room; I therefore had the rubbish, which had been previously turned out of the same room, carefully re-examined, when several pieces of the coffin and of the mummy-cloth were found; but in no other part of the pyramid were any parts of it to be discovered, although every place was most minutely examined to make the coffin as complete as possible. There was about three feet of rubbish on the top of the same; and from the circumstance of the bones and part of the coffin being all found together, it appeared as if the coffin had been brought to that spot, and there unpacked.

"I am, Sir,

"Your most obedient servant,

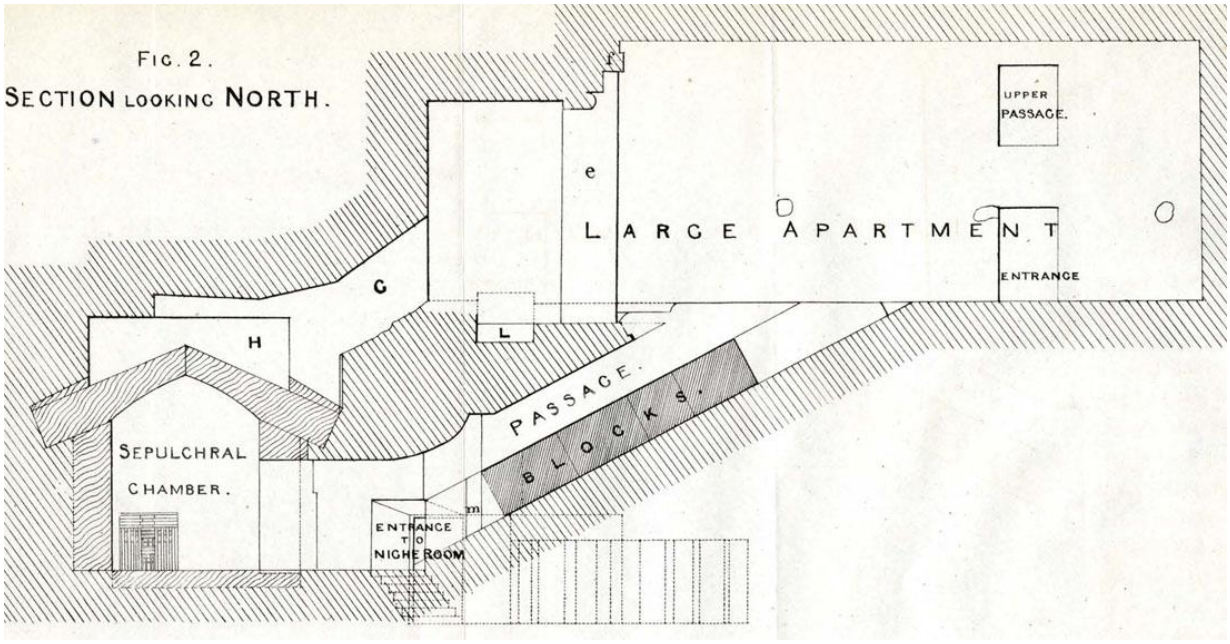
"To Col. HOWARD VYSE." "H. RAVEN.

It would seem strange to only remove the lid of the decorated sarcophagus; why not remove the blocking of the passage and some of the wall lining as Vyse did to retrieve the sarcophagus? (Robbers had bypassed the blocking by removing the ceiling stones of the passage). Though the coffin fragments and human remains appear grouped together, carbon dating of the human remains suggest that the two are from different time periods; unless an intrusive burial was later placed in the

[74] Ibid, pages 85-86
[75] Ibid, page 86

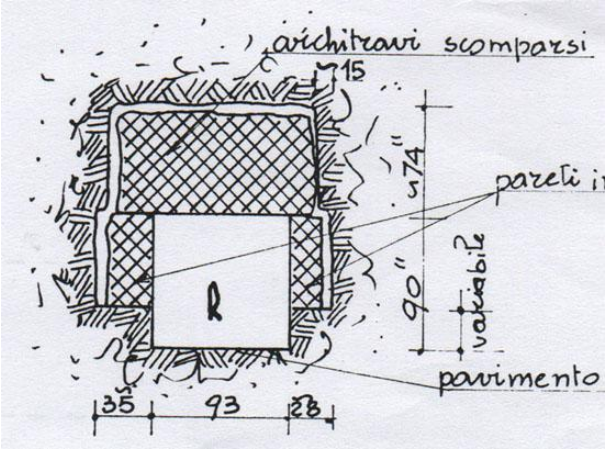
coffin. In Ravens letter he notes that three feet of debris was on top of the finds, though it's unclear if this was the debris level of the chamber when Vyse first entered it. There is hardly any excavation into the chambers by searchers to cause such significant debris, and so the likely source would be from the searcher tunnels into the core of the pyramid at the top of the construction passage.

Passage leading to the Lower Chamber



In Vyse's fig 2 above, we can see plugging blocks that Vyse encountered still in situ; the reports are not clear, but I assume that they were of granite. To circumvent these, the ceiling stones of the passage were removed, and this is how the sarcophagus lid would have been extracted and any other looted goods. The passage is more complicated than a rock cut passage, as it was lined with masonry before the plug stones were inserted. According to M&R; *"It is dug out of the rock and its walls and ceiling were originally faced with blocks of granite."*[76] What happened to the ceiling blocks is uncertain, as Perring mentions only small pieces of red granite being found among the debris in the upper chamber,[77] and it is not clear what these fragments could be assigned too.

[76] *L'Architettura Delle Piramidi Menfite, Parte VI, page 42*
[77] Operations Carried on at the Pyramids of Gizeh in 1837, Vol 2, page 81



From M&R's TAV5, we have a reconstructed section of the passage; a channel has been cut in the rock floor, which as we will soon see, creates a variable height for some of the elements which make up the passage walls; this leaves ramps either side to support the granite wall lining, which supported the ceiling stones.

In this view looking up the passage we can see the wider ramp on the south side; the wall lining on the north side was removed by Mr Raven, along with I assume, shaving some of the rock portion away, in order to provide clearance to remove the sarcophagus. (Vyse could not be present, as he gave the instruction to Mr Raven to remove the sarcophagus from Alexandria, prior to departing for Malta)[78] Vyse's

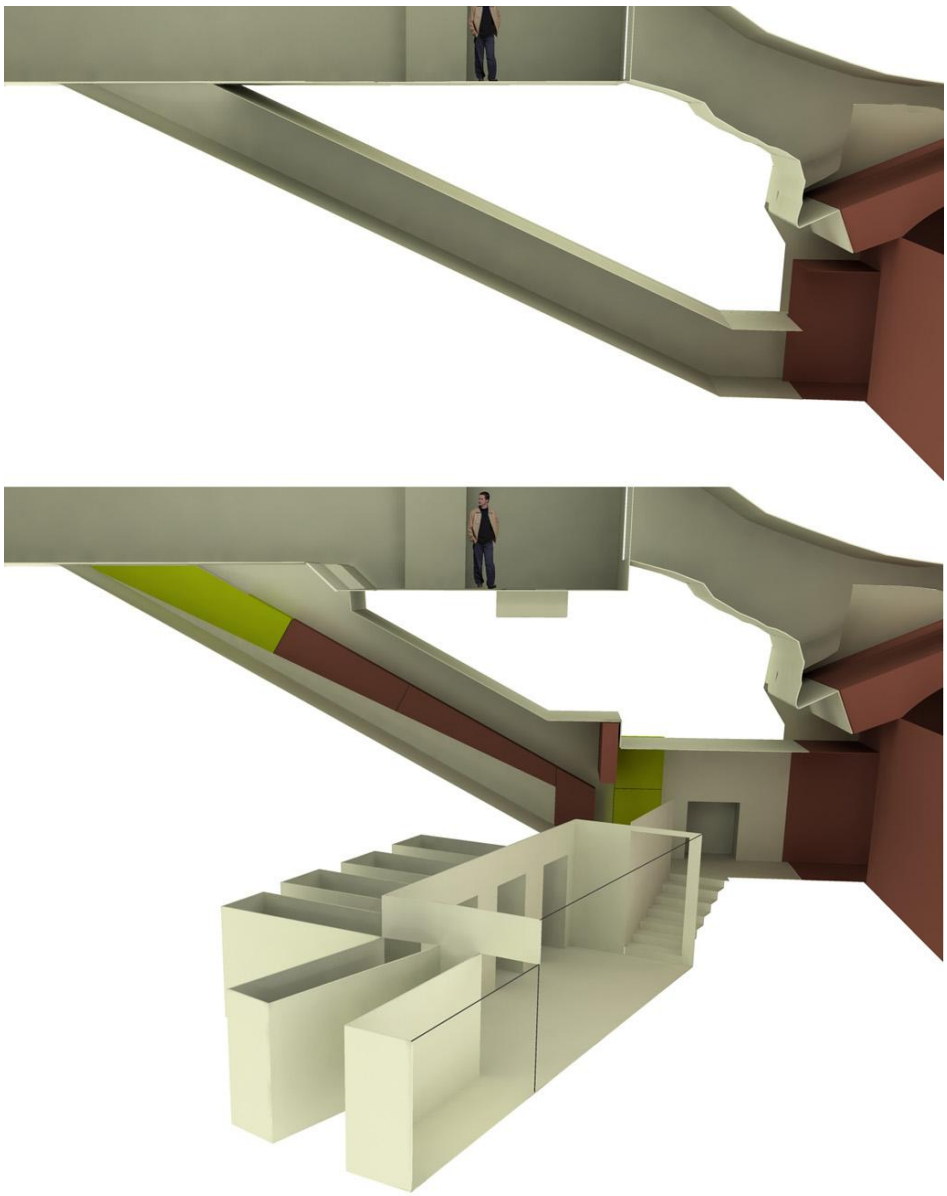
[78] Ibid, page 97

dimensions for the sarcophagus and indeed for the structure are only to the nearest half inch; he would give the width of the sarcophagus as 37inches or 94cm. This is 1cm more than the 93cm that M&R give on their drawing; though how they arrived at this accurate figure given the missing masonry and damage to the south wall is questionable; however, Vyse provides a width for the passage, when the linings were still intact of 35.5 inches or 90cm.[79] This value corresponds more to Petrie's measure, were he gives the passage width as 35.4 to 35.6 inches wide, and 35.6 high;[80] this gives the passage a square bore of 1 cubit 5 palms. This hopefully being settled, it means the sarcophagus was protected much like Khafre's and Khufu's from being removed by robbers due to the narrower passage. Though the sarcophagus lid was found in the upper chamber, the robbers probably baulked at the effort and destruction required in removing the plug stones and widening the passage, once they discovered that the sarcophagus was wider than the passage.

The length of the small descending passage is given as 9.90m, with an angle of 28 degrees (M&R), though it would appear that an earlier phase of the passage existed that had a gentler incline, M&R state; *"It is extremely interesting to note that the corridor was originally excavated and faced with a lesser slope than the present one and that it was later made steeper simply by cutting into the rock, which thus forms the part of the walls below the granite facing. The blocks forming this facing are not regular parallelepipeds but appear slightly wedge-shaped."*[81]

This initial less steep passage may have been excavated along with the upper window to help in excavating the void for the granite lined chamber, and then enlarged as they worked back from the newly created void. It is interesting to note that the window opening in the Upper chamber has its lower edge approximately in line with the chamber floor, which would appear logical as heavy masonry would travel along this route; this suggests that the floor lowering and pit created at the west end occurred after construction of the granite chamber, as it would seem unlikely for the builders to create an obstacle for access to the window.

[79] Ibid, Table of dimensions for 3rd pyramid are on pages 120 to 124
[80] Pyramids and Temples of Giza, page 118
[81] *L'Architettura Delle Piramidi Menfite, Parte VI, page 44*



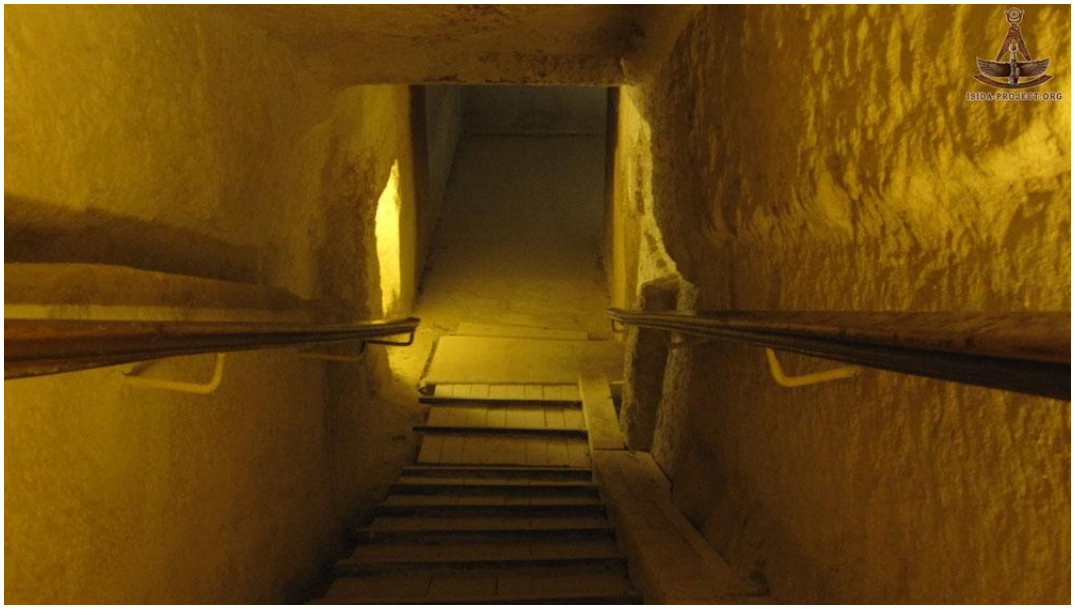
The above is a rough schematic view of how the original less steep passage may have looked in top image. Its initial function would be to assist in excavating the void for the granite chamber; the Upper chamber floor was at this stage possibly all one level to aid masonry access to the upper window. The smaller passage could have been approximately 1.4m wide and 1.1m high; this leaves a smaller opening in the Upper chamber floor to interfere with masonry transport (a space 1.38m wide is available south of the opening). On completion of the granite chamber, masonry could be brought in to block the upper window, and then work on the sarcophagus pit could commence. In the lower passage after excavating the granite chamber, and working backwards, work could commence on the niche chamber.

As they excavated back they would be cutting into the slope of the original floor. After the niche chamber a vertical portcullis had to be installed, which the plug stones likely abutted against. To install this portcullis, the ceiling had to be raised for its storage position, and the walls west of it cut into; this cutting would then be filled with masonry to create the portcullis sliders on this side (I have coloured these blocks green in the above image: the other green block is missing lining). On the east side of the portcullis, its slider would likely have been formed from the passage lining masonry and ceiling stone (Vyse gives the portcullis as 10 inches thick or 25.4cm).

The next task was to create the enlarged passage which would be lined with granite; before this stage commenced, the sarcophagus would likely be introduced into the granite chamber, and the old passage would give ample clearance, as the sarcophagus is 94cm wide by 89cm high. To protect the sarcophagus from robbers the passage had to be narrowed and so the floor of the old passage was cut down to a width of 90cm, though its start point would remain the same from the Upper chamber. This would leave a triangular shaped ramp of rock on either side of the new passage, whose upper surface was the original floor level. On top of these side ramps, the wedge shaped granite wall linings were fitted, whose upper surface was parallel to the cut floor of the new passage: The ceiling would also be cut into to reflect the new passage angle, and to provide room for the passage ceiling stones.

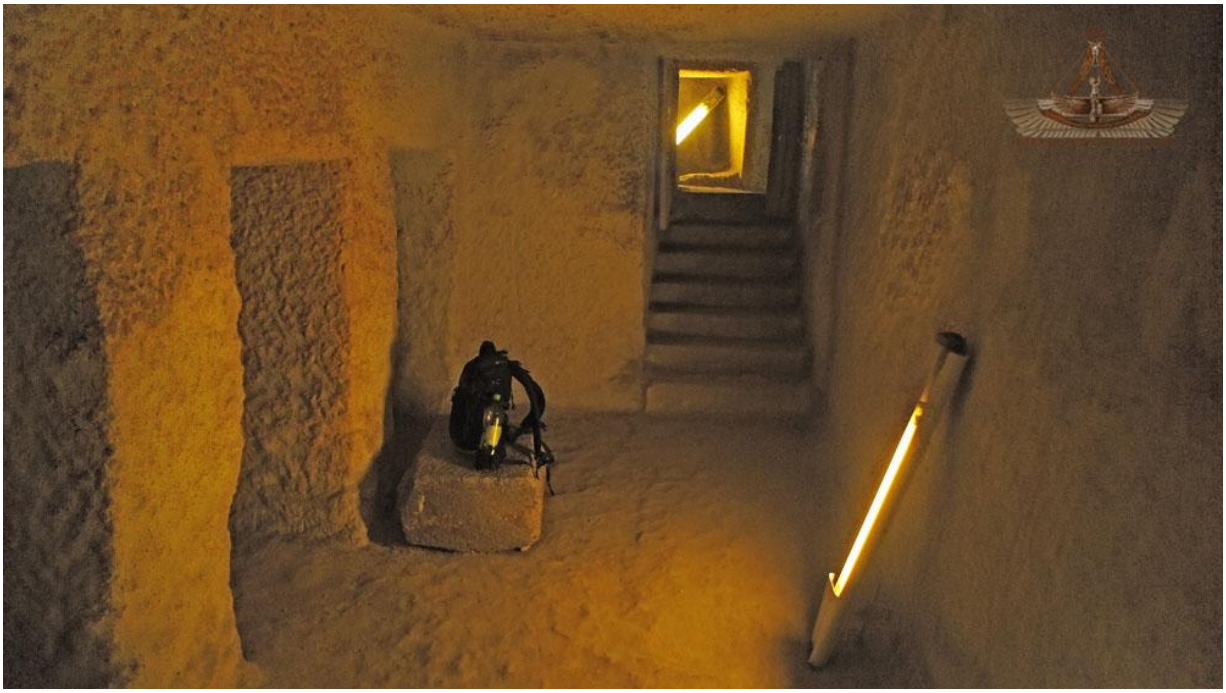
M&R would make the suggestion that the passage was modified in order to extend the horizontal landing at the end of the passage, in order to make space to create the niche chamber, which would imply a design change.[82] Other scenarios could spring to mind, but it is also possible that there was no design change and the whole construction was a pre-planned sequence, which offered protection for the sarcophagus.

[82] Ibid, page 108



Looking down the passage, we see some of the surviving masonry lining on the left which creates a ledge for the ceiling stones, long removed in antiquity. On the right the masonry has been removed in order to extract the sarcophagus; the wall is slightly undercut here, normal practice when installing granite lining; easier to cut into the softer limestone, than extract excess thickness from the granite. Also on the right, near the bottom is a nub of rock projecting out; according to M&R's drawings, this is the west slider for the portcullis on this side. Also visible is the niche, which is illuminated; this space may have helped to turn long items on route to the niche chamber. Whilst some elements of the original passage survive in the passage, the greater angle of the new ceiling mean that none of it survive.

Above is the view from inside the granite chamber, whilst below, we can see the front of the illuminated niche from inside the niche chamber.



The Niche Chamber

At the bottom of the descending passage, the floor does not exactly level out; instead it slopes gently for a further 1.17m, in which it falls only 5cm (M&R).

The floor then falls vertically for 15cm, and from here it is level to the granite chamber. At this point were the floor drops is the eastern edge of the doorway, which gives access to the niche chamber; this doorway is 1.20m high, and on the passage side it has a 4cm high and 12cm deep rebate that frames the door on its top and west sides; was a closure stone intended to seal this chamber? The height of the short level passage which leads to the granite chamber, and from which the niche chamber door branches off is from 2.02m to 2.06m at granite chamber door, a possible 4 cubits? Its width seems to match the width of the granite chamber entrance of some 1.38m; whilst its length is some 3.06m (M&R)

The niche chamber is angled away from the granite chamber by 25 degrees (Vyse), so as not to interfere with the structural integrity of that construction; a series of steps leads down into a rectangular chamber, which contains six niches; four on the long wall and two on the short wall.

Image courtesy of Jon Bodsworth

The niche chamber has quite a utilitarian finish and its function is not certain; it has been compared to similar features inside Shepseskaf's mastaba and inside the nearby tomb of Queen Khentkawes; in all these structures the niches appear purposely set lower than the chamber that they are attached to; I had previously suggested that such niches may have contained food offerings, wine etc, and so a precautionary lower setting might prevent leakages spoiling finer funerary equipment in the adjacent chamber.

The length of the chamber varies, from 5.21 to 5.28m (10 cubits?), its breadth from 1.87 to 1.96m, and height around 2,0m. Five of the niches exhibit a depth from 2.57 to 2.60m, with one at 2.46m; four have a height of 1.40m and two from 1.49 to 1.51m (M&R). The niches appear to be of similar size to those in Shepseskaf's mastaba, but slightly deeper at around 5 cubits, whilst Shepseskaf's is closer to 4 cubits deep.

Vyse found the room half filled with debris, and with several Arabic characters scrawled on the ceiling.[83]

The Granite Chamber

The granite chamber is a fine example of the ancient Egyptian's masonry skill, in assembling and manoeuvring heavy granite blocks, in such a confined space. The use of granite is evident in the principal chambers of the three Giza pyramids, though in Khafre's it is restricted to paving surrounding the sarcophagus. It could be argued that this was a security feature to defend against robber tunnels; but it may also have had some symbolic nature that determined its use: the vast amount of granite casing applied to the pyramid would seem an unlikely security feature, but a more symbolic feature.

The entrance in the south east corner of the chamber opens into a space some 6.62m long by 2.64m wide (M&R).

[83] Operations Carried on at the Pyramids of Gizeh in 1837, Vol 2, page 85

This granite chamber is not at all as regular in form as it is in appearance. The walls measure thus :—

E. 260·75. W. 258·83.

N. 104·06, near N. 103·85, mid. 103·80, by door 103·7, over door, 103·50, S. 103·25.

Height { N.W. 105·8, N.E. 105·7, S.E. 105·4, S.W. 105·9;
N. mid. 134·6, mid. 134·6, S. mid. 135·5.

The doorway is 54·52 wide, and one side of it in the plane of the S. wall. The courses at the door (S.E. corner) are :

27·6 on floor, 26·5 next, 26·7 top of door, 24·2 over door ; total 105·2.

Above we have Petrie's dimensions for the chamber;[84] the chamber width, mean of six measures is 103.69, or 5 cubits, and the wall height may have been intended to be likewise. The chamber length is not to whole cubits; however, from the north wall to the door it is 5.24m (M&R) or using Petrie's figures above, 206.23 inches, which is evidently 10 cubits. This leaves the door width of 54.52 inches (1.38m) or a possible 2 cubits and 4&1/2 palms. Previously, the pyramid axis location was discussed and its uncertainty due to the unknown dimensions of the pyramid; but it may have been the intended design of the architect that the east-west axis of the pyramid would align with the north side of the passage leading to the chamber and the north side of its door: this would leave an area of 10 by 5 cubits in the north; possibly for some symbolic reason.

The walls of the chamber are constructed of four courses of granite which appear to maintain the same level around the chamber; a fifth course is present at the ends to fill the gap between the walls and the curved ceiling. According to M&R's TAV 6, the walls have no foundation, but rest on the natural rock; the rock floor has been cut further down and a granite pavement has been fitted between the walls, such that the upper surface of the pavement aligns with the bottom of the first course.

The construction of the walls is somewhat uncertain, Vyse would give their thickness at 30 inches; however, M&R noted that at some points the walls appeared to have been constructed of more than the visible block in the chamber. At the doorway a second block can be seen behind the facing block, and in two

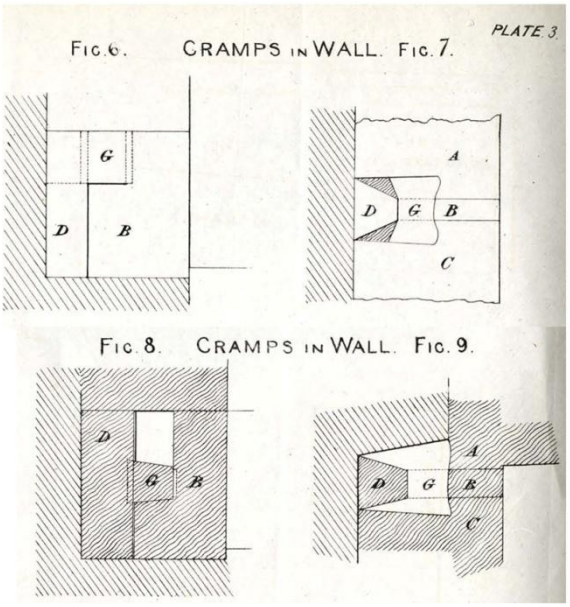
[84] Pyramids and Temples of Giza, page 119

wide joints in the west wall of the chamber, the facing blocks were one cubit thick (52.4cm) and behind it was another block.[85]

This view taken from the doorway, shows the two wide joints in the first course, which sits on the natural rock; some of the granite paving still survives. Below is a front view of one of the joints, and a second granite block is visible behind.

[85] *L'Architettura Delle Piramidi Menfite, Parte VI, page 44*

In connection with these two joints is the following account by Vyse. *"Two cramps were found in the western wall (see Plate III., Fig 6,7,8,9). The stones ABC were kept in their places by the dovetail cramp G, and the wedge-formed piece D, resting against the side of the excavated rock behind, served to keep the whole together."*[86]



Left are the drawings relating to Vyse's description above. Figs 6&7 relate to the middle joint, and 8&9 to the corner. It is difficult to interpret what Vyse saw or thought he saw, but I include it here for others to ponder.

Damage exists along the edges of these wide joints, But M&R's TAV 6 show that they maintain an even gap for the whole depth of the stone. Likely they were originally patched with a thin slip of stone which attracted the attention of robbers who removed them. It's not possible to establish if every facing stone has a hidden layer behind it; some might extend the whole thickness to the rock wall. M&R's drawing suggest up to two layers of masonry on the long walls, and single on the end walls. The drawings show the long walls to be up to 1m thick, with the end walls about 75cm; this would be logical as the long side walls have the job of helping to support the ceiling beams. These side walls share a similar thickness to those found in Shepseskaf's mastaba, which shares a similar ceiling; though here the blocks are of a much larger size, with no requirement for a hidden layer.

[86] Operations Carried on at the Pyramids of Gizeh in 1837, Vol 2, page 82

Menkaure's successor Shepseskaf built a similar chamber (shown above), here the blocks are particularly large; this was possible due to the construction being built in a shallow pit, and thus allowing much more manpower and accessibility. In contrast, Menkaure's chamber had to be assembled inside a small void cut from the rock, and therefore masonry sizes reflect the limitations of manpower and accessibility in such a confined space. It is possible that a lot of this masonry may have been pre-processed above ground and then transported to the void and assembled; some excess rock may have been left on their faces to protect from damage along with handling bosses, which would be dressed away after chamber assembly was completed. Unfortunately M&R provide no drawings of block arrangement in the chamber, or of the surviving pavement.

In Menkaure's granite chamber looking south, we have the doorway in the SE corner. The south wall of the chamber continues into the passage for about 1m, were it blends into the natural rock facing of the horizontal passage. The roofing beams consist of 9 pairs, each of a different width; for example, the pair by the north wall, east beam is about 95cm wide, whilst the west beam is about 75cm wide (M&R TAV6): this overlapping of joints continues along the ceiling. M&R noted that the beams at the north wall abut against this wall, and that the sequence was to complete the north, east and west walls and then introduce the beams starting at the north end.[87]

The beams have a length of around 3.2m; however, three of the beams at the SE corner are around 2.4m long, these beams would rest on the architrave above the door: the remaining beams extend into a groove cut into the rock. The undersides of these beams have been dressed to provide the ceiling with its curved profile. Once all the ceiling beams had been put in place, M&R would state that the south wall was built last; though I suspect the south wall, minus its tympanum, was in fact in place when the beams were brought in via the upper window: this is because the architrave above the door, which supports some of the beams would need to be supported by the south wall; only the blocks which make up the tympanum would be left out. Unlike the north end were the beams abut against a plain wall, the

[87] *L'Architettura Delle Piramidi Menfite, Parte VI, page 46*

blocks which make up the tympanum on the south wall were shaped to fit under the ceiling (it would be helpful to have block layout drawings of these walls, as it's hard to make out the wall joints in the images I hold.) Petrie's description;[88]

The granite lining and floor of it is built in; and in order to introduce the roof-blocks a hole is cut from the end of the second chamber, into the top of the lower chamber. The roofing is not by beams, as in the King's Chamber, nor by cantilevers, as in the Queen's Chamber of the Great Pyramid; but by sloping blocks resting one against the other with a thrust, the essential principle of an arch. The under-sides of these blocks are cut into a barrel or hemi-cylindrical roof, like passages in tombs of the early period. This cavity above the roof, entered from the second chamber, was originally closed; but the masonry has been forced out, and now the tops of the roofing slabs can be easily seen. These have been quarried by means of a groove, and holes drilled at intervals to determine the cleavage plane; as was the roofing of the spaces over the King's Chamber. The introduction of these massive blocks through such a small space, and the placing them in such a confined position, is a good piece of work.

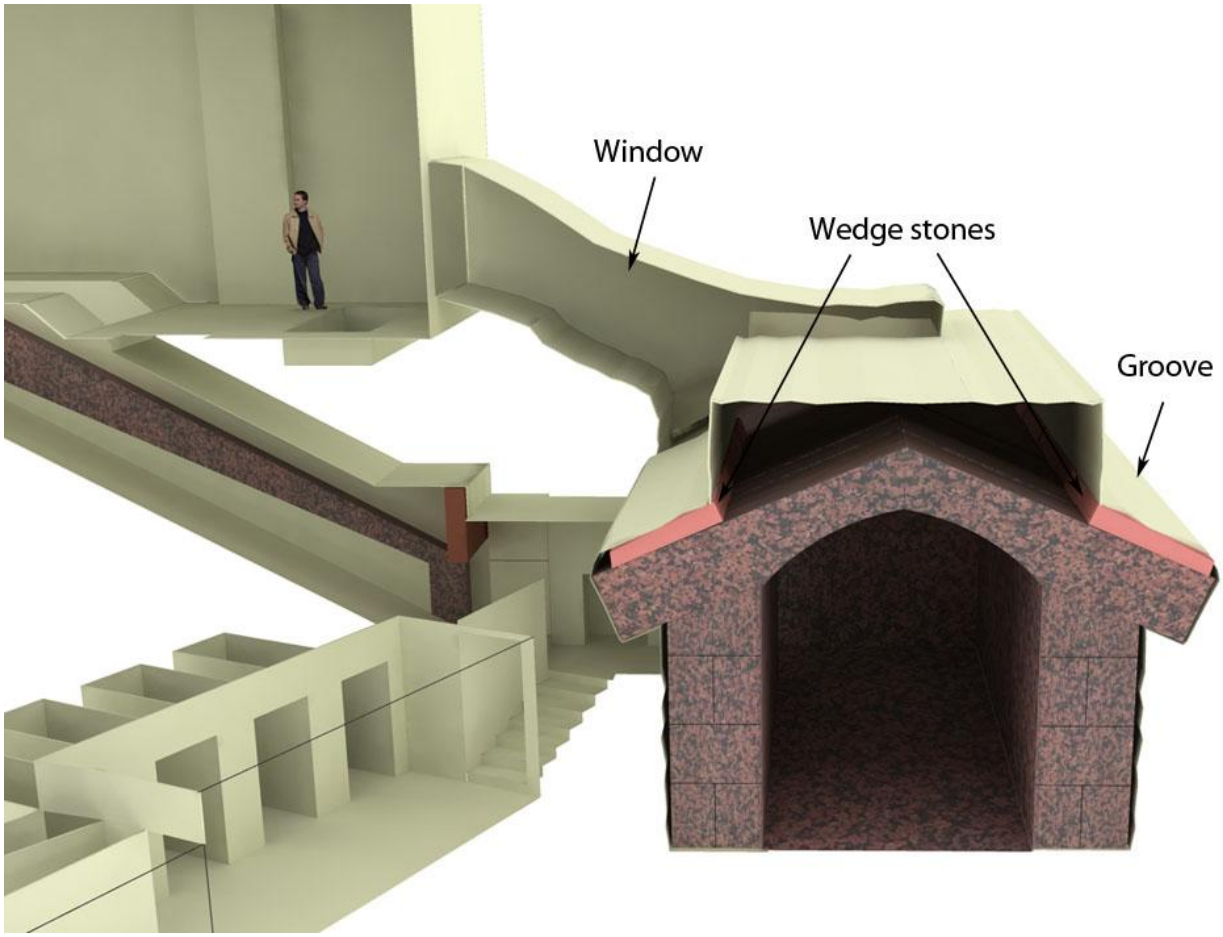
Image courtesy of Jon Bodsworth

[88] Pyramids and Temples of Giza, page 119

The previous image taken from inside the window shows the upper surface of the beams by the SE corner; the three beams in the foreground are the short 2.4m beams, which are supported by the architrave over the door. Also visible in top left is a cutting for the groove that the western beams engage in, which runs the length of the chamber.

Image courtesy of Jon Bodsworth

This image looking along the ceiling, shows more of the beams, and highlights the skill of the ancient Egyptian masons; chisels marks abound on the excavated rock.

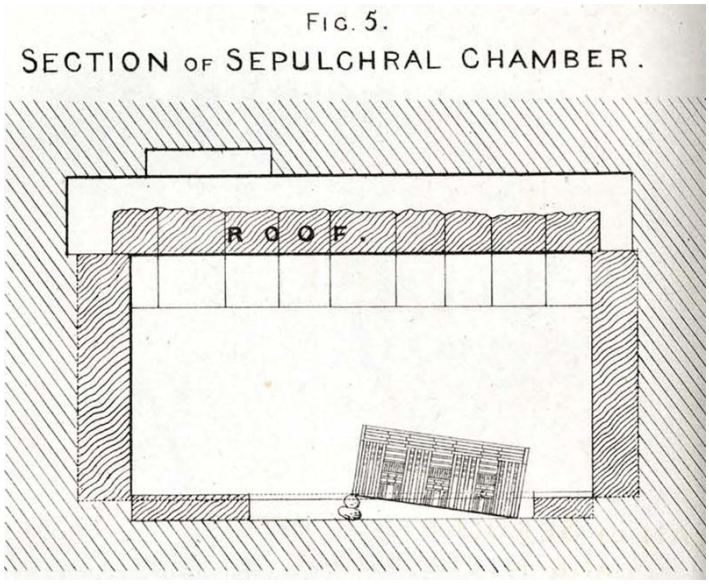


The schematic view above shows the assembled chamber inside the rock void. Grooves were cut into the rock on both east and west sides and the beams were inserted into these grooves; to help secure them, wedge shaped granite stones appear to have been inserted on top to fill the space between the beam and rock ceiling.[89]

The Sarcohagus

Inside the chamber Vyse found a fine decorated sarcophagus, minus its lid, which was found in the Upper chamber. It was found up against the west wall, but as much pavement had been torn up, its original location is unknown. Though we normally find sarcophagi placed transverse to the chamber, it would seem unlikely to be so in the granite chamber as the convention seems to be that the sarcophagi have a north-south alignment.

[89] *L'Architettura Delle Piramidi Menfite, Parte VI, Tav 6*

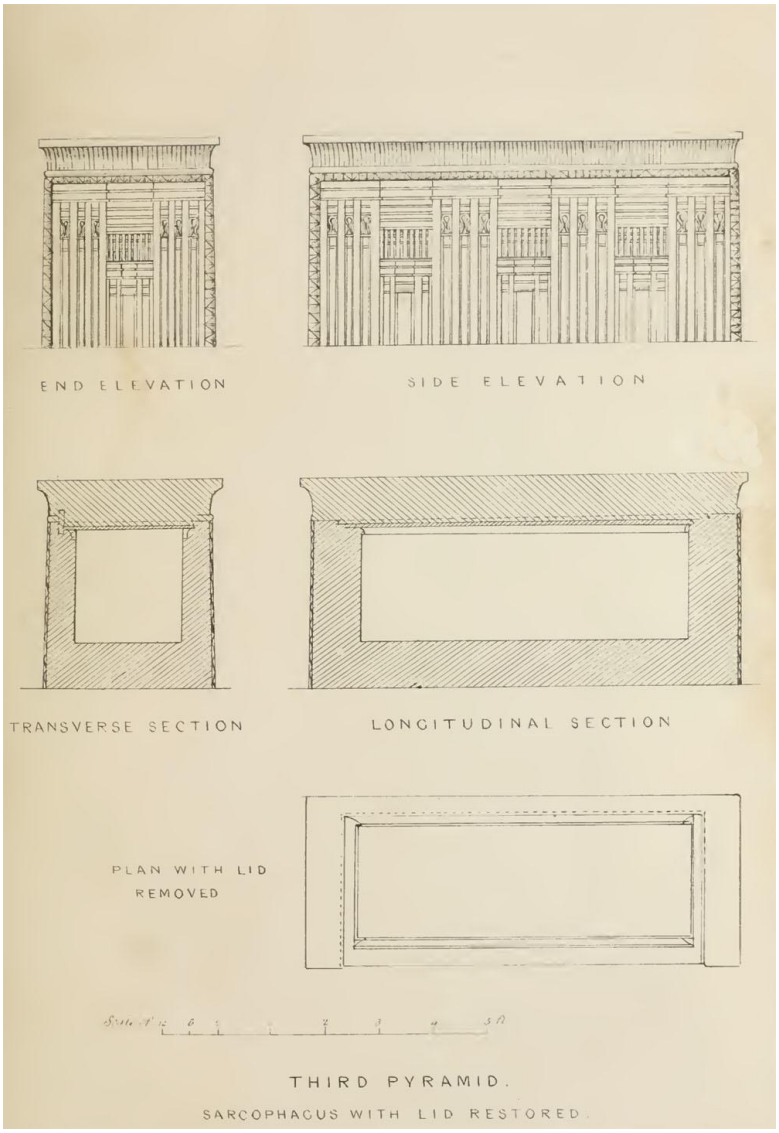


Vyse's section of how he found the sarcophagus. Unfortunately, despite Mr Raven's hard work in extracting the sarcophagus from the pyramid, it was lost at sea, somewhere between Malta and Cartagena. Only a small fragment now exists in the British museum EA6646; Vyse would describe it as basalt, though it would be useful to examine the fragment to confirm it.

Vyse's drawing of the chamber showing the sarcophagus against the west wall. Vyse would state; *"No sculpture, or inscription of any kind, was discovered, excepting some rude and unconnected Arabic words and characters scrawled with something like chalk on various parts of the walls, and on the inside of the sarcophagus. The only words that could be made out were Mahomet Rasoul over the entrance."*[90]

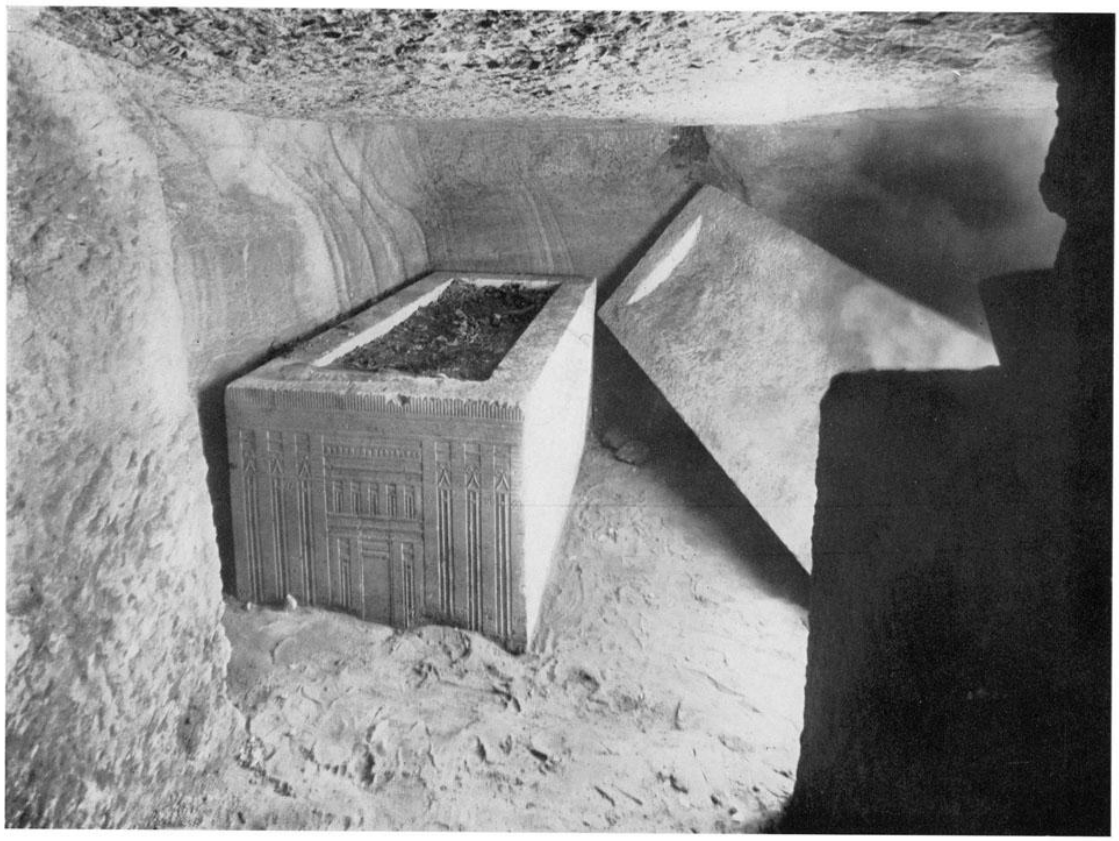
Vyse would note that there were no hieroglyphs on the sarcophagus, and states that the lid was fixed with two pins and with a rounded dovetail.

[90] Operations Carried on at the Pyramids of Gizeh in 1837, Vol 2, page 82-83



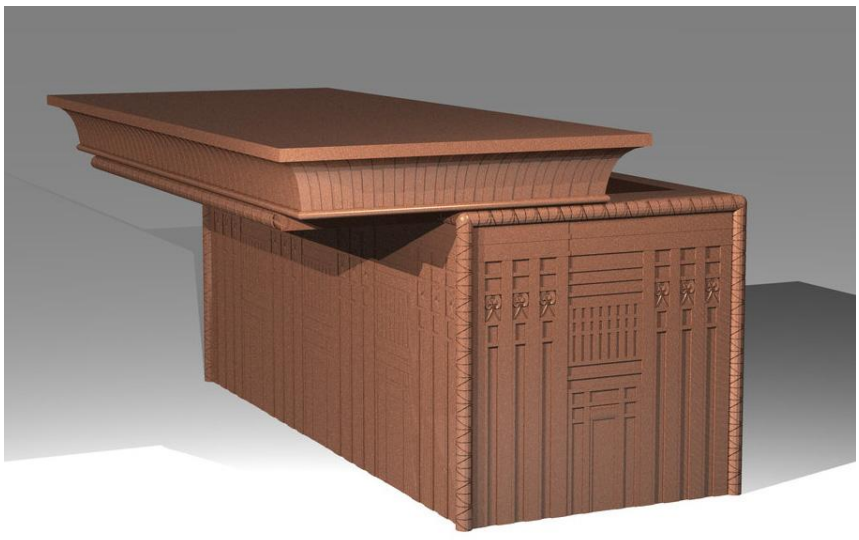
Sarcophagus.		
Outside, length.	8	0
— breadth	3	1
— height	2	11
Inside, length	6	5
— breadth	2	0½
— depth	2	0½

From Vyse's publication we have the above drawing of the sarcophagus, along with his dimensions in feet and inches. Compared to Khufu's and Khafre's plain granite sarcophagi, Menkaure's has impressive palace facade decoration, which must have been labour intensive in such a hard stone. Such a decorated sarcophagus is not unique in the Old kingdom with many examples in various stone types to be found.

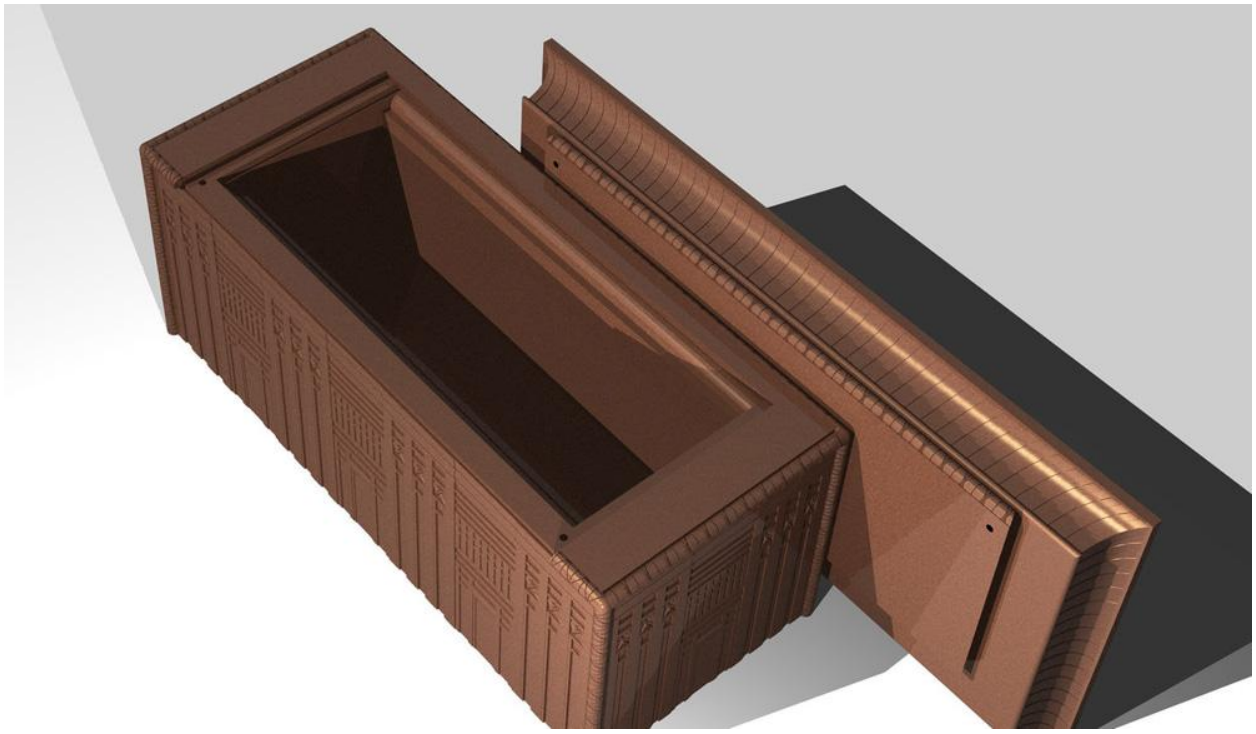


TOMB OF FIFI: THE SARCOPHAGUS CHAMBER WITH SARCOPHAGUS PLATE LXI

Above is an example from the tomb of Fifi. 'Overseer of the Ka-servants' (Central field, G8926): here the sarcophagus is made of limestone.[91]



[91] Excavations at Giza, 1929-1930, Hassan, page 97-101, and plate LXI



The image above and on the previous page is a reconstruction of Menkaure's sarcophagus, created by Jon Bodsworth, and I am most grateful for the kind use of his images. Vyse would describe the sarcophagus as composed of basalt, which bore a fine polish of a shaded brown colour; but where it had been chipped, the stone was blue. As technology improves we can but hope that the ship Beatrice and its valuable cargo will be found in the not too distant future and the sarcophagus returned to its chamber.

Concluding Remarks

Though there is more to Menkaure's complex than the pyramid, such as the temples, causeway, Queens Pyramids etc; in order to keep the guides to a manageable size, these components will hopefully be dealt with in future guides.

The Pyramid itself could do with further investigation, for like so many structures we are reliant on quite dated reports. In an era of high technology, laser scanning etc, we should have more accurate data on the structure. The damage inflicted on the structure, from the great gash on its north face, Vyse's tunnel, and the numerous searcher tunnels allow a rare glimpse into the fabric of the building; these all need to be better explored for clues on how the pyramid was built. The appearance of a stepped core is interesting, and begs the question do such cores also exist in its giant neighbours? The microgravimetry readings carried out by a French team in the 1980's on the Great pyramid provided an unusual image, and

like the more recent muon scans, they can be difficult to interpret. The earlier scan has been used by some to suggest a stepped core in the Great pyramid or an internal ramp.

But what would be the benefit of a stepped core? At the Meidum pyramid, we have a fine cased stepped pyramid that appears to have been converted at a later date into a true smooth pyramid. Petrie would comment on the accuracy of this original step pyramid; *"It is evident therefore that no great accuracy was aimed at in this internal construction, although it was finished off with finely-smoothed faces, well jointed, and of beautiful flatness."*[92] In constructing a step pyramid accuracy is not a great requisite; the vast bulk of the building can easily hide one side being longer than the other; aesthetically it will still look pleasing to the eye at a distance; only by closely measuring the structure do you observe the errors that Petrie measured. However, smooth true pyramids are a different proposition and accuracy is of upmost importance. A true pyramid has in effect five corners, and while the Egyptians showed great skill in creating a level and highly accurate pyramid base on uneven ground, the problem would always be the fifth corner, floating invisible in the sky above.

Building a pyramid layer by layer as it is often portrayed, is a difficult task, the slightest error, could have devastating consequences as you reach the top, when you suddenly find your calculations are in error and the sides do not meet. Building a stepped core first can mitigate against such an outcome, by fixing a reference marker for the fifth corner. The core itself need not be accurately constructed; the only item requiring accuracy is the fixing of the reference marker; with the marker in place, the accurate casing phase of the pyramid can begin, and aided by the marker that highlights the fifth corner.

This two phase approach might appear logical, but it poses a problem in respect of ramps to construct it. Ramp theories are numerous and each has their own problems; though they do tend to be the favoured solution to pyramid construction. Others point to the writings of Herodotus and the use of machines to build the Great pyramid; the pros and cons in respect of the two approaches is beyond the scope of this guide: but overleaf I have placed the account told to Herodotus; from Vyse's publication, along with his footnotes.[93] Of course care has to be taken in such accounts, given that they were told to Herodotus some 2000 odd years after its construction.

[92] Medum, 1892, Petrie, page 7
[93] Operations Carried on at the Pyramids of Gizeh in 1837, Vol 2, page 182

But twenty years were expended on the construction of the Pyramid itself, which is square, each side being of eight hundred feet, and of equal altitude. It is of polished and most accurately jointed stones, no single stone being less than thirty feet. This Pyramid was constructed in the manner of steps, by some called parapets (krossai); by others, little altars;[4] such being its original construction, they raised the remaining stones with machines, made of short pieces of wood, from the ground to the first layer of steps, and when the stone was let down on this, it rested on a second machine standing on the first layer; from this it was drawn to the second layer, where another machine lay to receive it — for there were just so many machines as layers of steps; or perhaps, they transferred the same single portable machine to each layer on removing the stone. We choose to mention both accounts as they were related to us. Thus, the upper part of the Pyramid was first finished off,[5] then the next part, and last of all the lower ground part.

[4] These steps have been already alluded to: they were probably progressive stages, diminishing towards the top like those in the Fourth and Sixth Pyramids, as the several tiers of stones could not have been of sufficient width to support machines of any power. The Third Pyramid appears to have been built in this manner, and the superficies to have been afterwards filled up into one continuous line.

[5] This finishing from the top applies solely to the trimming off and smoothing the surface of the casing-stones, which had been roughly cut to the proper angle.

If stepped cores exist inside the large pyramids, they will be difficult to detect; as taking the example from Menkaure's, we appear to have a single layer of well fitted blocks, with masonry fill in the inside, and on the outside the casing phase laid against it. In my Bent pyramid guides I have suggested that the unusual joints in the two entrance passages could be the boundary between the core and casing phases.[94] However, it is not a simple exercise to go inside pyramid passages looking for unusual joints, as we may not see any: improving construction and masonry techniques could easily disguise such boundarys; as could large construction gaps left in a core, whilst the internal chambers were still under

[94] See 'The curious case of the 60 degree pyramid' and 'Great pits versus shafts and tunnels'

construction. It's possible that technology has moved on from the 1980's when the microgravimetry test was carried out on the Great pyramid, or other experiments could be devised, which might highlight the presence of stepped cores. If so, it would be nice to see all the Old kingdom pyramids tested and not just the Great pyramid; unfortunately, the Great pyramid is a bit like a black hole, sucking in all interest and research to the detriment of so many fine structures that Ancient Egypt offers.

The chronology of the Old kingdom kings is fraught with difficulty, not least their reign lengths; though generally Menkaure is given a range of some 18-22 years.[95] If we were to accept the fantastic build rates from Dahshur, we would be right in questioning how Menkaure failed to complete his small complex; though it could be argued that the Old kingdom was in decline at this stage, and Menkaure simply did not enjoy the favourable circumstances of his giant neighbours. But then how do we explain the small poor complex left by Djedefre at Abu Rawash; a king placed between Khufu and Khafre, who should have enjoyed the favourable conditions given to Khufu and Khafre, and who has been given a reign length of 11 to 22 years, depending on how one interprets the cattle count, be it annual or biennial.

As previously mentioned, the build rates are based on tenuous data and assuming a homogeneous construction; but given that so many Old kingdom pyramids appear to show an inner core, it cannot be discounted that the giant pyramids also contained such cores, and if so, a question mark has to be placed on the dating data: as such data could only relate to the casing phase of the pyramid, meaning that the years to construct the core have still to be accounted for.

Menkaure's pyramid still has many unanswered questions; unfortunately the data on the structure is quite limited and the possible permutations to explain what we see are many; one can only hope that more attention is given to the structure in the future.

[95] Difficulty in interpretating cattle counts, be they annual or biennial, could give a reign length like Djedefre's of between 11-22 years.