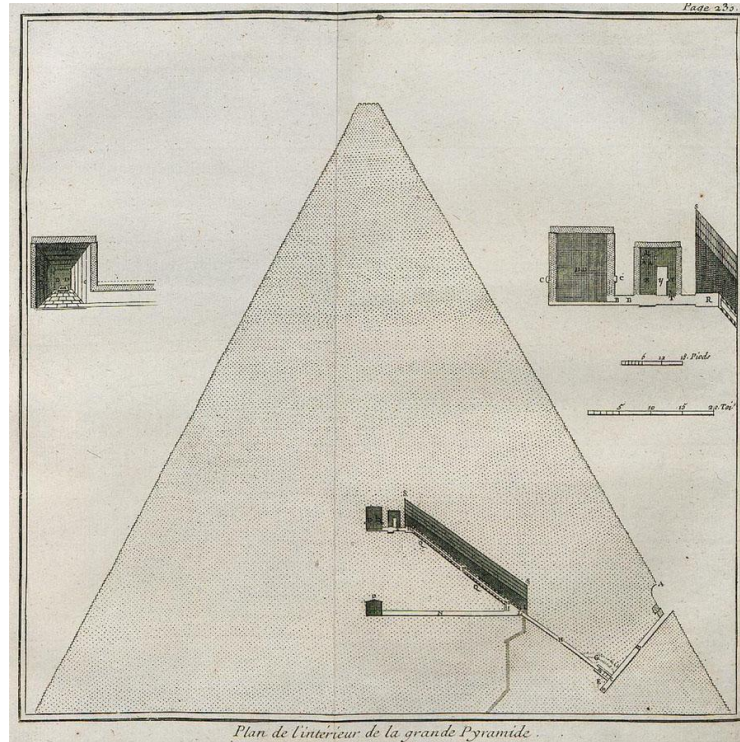


# The Great Pyramid (part 2)

## A Layman's guide

Keith Hamilton

5<sup>th</sup> April, 2022



This part 2 of the guide is a continuation of part 1, and it is advised that the reader should acquaint themselves with part 1, before reading this final part.

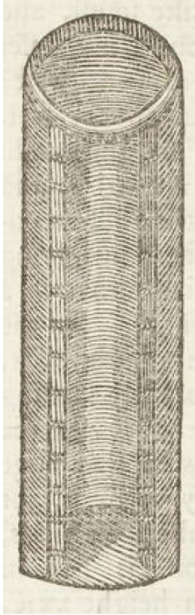
### The Well Shaft

The well shaft is a sea of confusion, and it is somewhat remarkable that the available data on it is so poor and conflicting. Indeed, it is just another example of the inadequate exploration, which is so prevalent throughout the pyramid.

One of the earlier accounts of the well shaft is courtesy of Benoit de Maillet, whose section of the pyramid is shown above; he would publish some observations in 1735,<sup>1</sup> and this appears to be the more detailed account from the early explorers. There are earlier accounts, such as Pliny's who mentions a well some 86 cubits deep (if Roman cubits, about 38m), but such early data has to be treated with caution. Prior to Maillet, Professor Greaves during his travels of 1637-1640 would provide a brief description of the well that was accessible to him.

---

<sup>1</sup> Description de L'Egypte, 1735



Greaves would provide a somewhat curious description of the well, he states;

*“At the end of it, on the right hand, is the well, mentioned by Pliny, the which is circular, and not square, as the Arabian writers describe: the diameter of it exceeds three feet; the sides are lin'd with white marble; and the descent into it is by fastening the hands and feet in little open spaces cut in the sides within, opposite, and answerable to one another in a perpendicular.”*<sup>2</sup>

He provides the drawing shown left of the well, which is most curious, as from his description he appears to be describing the initial vertical section of the well, closest to the grand gallery. He appears to have not climbed down the well, but made a sounding with a line to a depth of 20 feet; he further reports that he lit some combustible material and threw it down the well, to find that the well was choked with rubbish.<sup>3</sup> The strange thing about Greaves report, is that the Arab accounts appear to be correct, in that the upper vertical section is indeed square and not circular; indeed, the Edgars in their exploration describe this first vertical section as nearly 28 inches square in bore and about 25 feet deep:<sup>4</sup> this is clearly less than the 36 inch diameter given by Greaves above. One might be forgiven for thinking that Greaves had used some dodgy candles, and yet we appear to have a similar description from Maillet, who if I have translated correctly, states;

*“This well occupies part of the bench at the bottom of the entrance, and rises to the height of two feet in the wall. It is, as I have said, almost round, or oval.”*<sup>5</sup> The well shaft could be said to consist of four sections; starting from the top we have a vertical section some 25 feet deep (M&R 7.96m), square in bore, and appears quite uniform in core masonry (clear images of the well shaft are rare), after this first vertical section, the shaft inclines to the south, and here it is very irregular in the core masonry; this section is around 7.9m long (M&R), wherein it becomes vertical again for some 5.2m (M&R), in this section is found the so called grotto. This section has its upper section lined with small masonry blocks, whilst its lower section is cut from the natural rock. The shaft then again inclines towards the south through the rock for some 26.5m (M&R), wherein it deviates more steeply for the last 9.5m (M&R), to connect to the descending passage. Its irregular route makes it a difficult shaft to measure, though the Edgar's would give a total length of the shaft as about 200 feet (61m) - M&R's approximate dimensions add up to 57m.

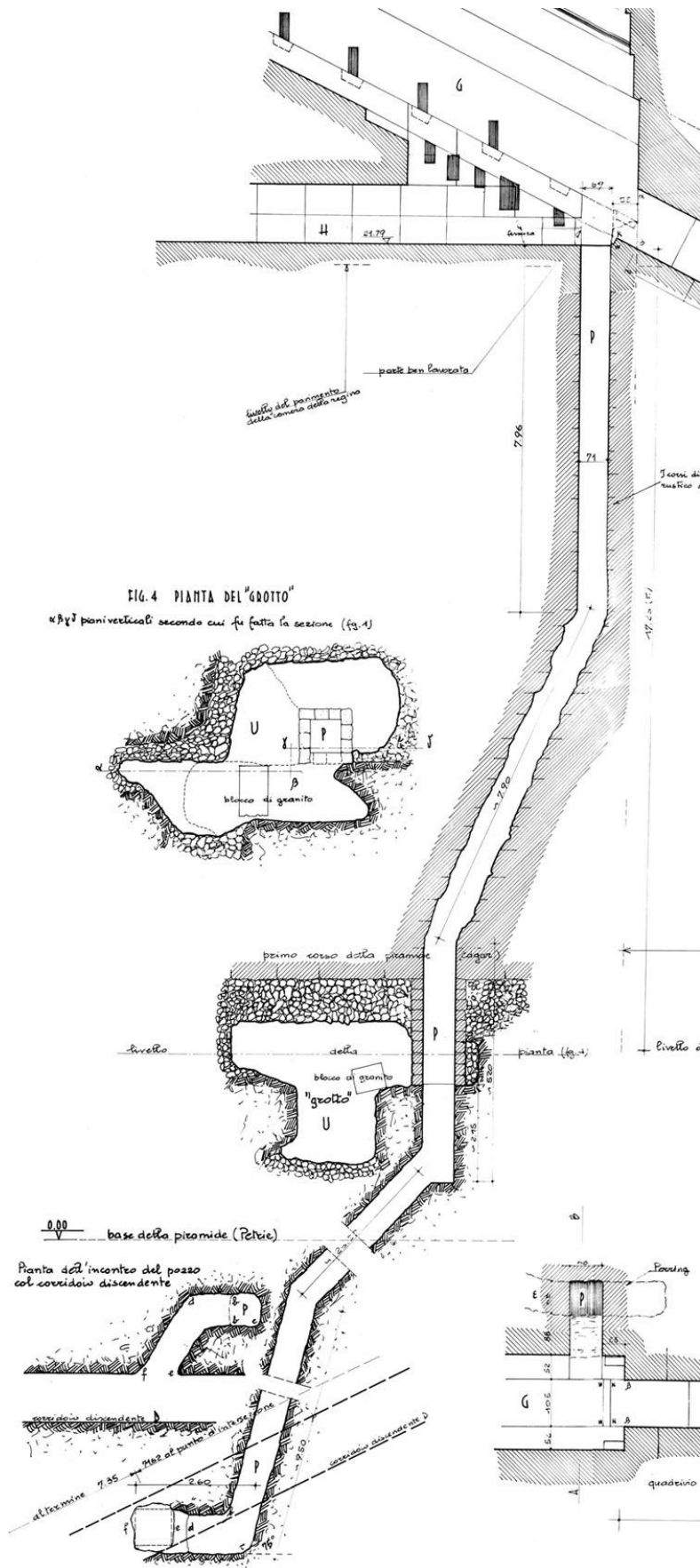
---

<sup>2</sup> Pyramidographia, 1646, page 639

<sup>3</sup> Ibid, page 639-640

<sup>4</sup> Great pyramid passages, Vol 1, page 358

<sup>5</sup> Description de L'Egypte, 1735, page 249



The drawing left, is part of M&R's TAV5, which highlights the somewhat irregular route of the shaft. There is much disagreement on the construction of the shaft and its function, but generally it is thought to be an escape route for the workers who released the granite plugs to slide down into the ascending passage.

Though Greaves reports the well shaft choked with rubbish at some 20 feet, there appears to be no obstruction in Maillet's time, as he reports a square window, which allowed him access into the grotto, where he describes the void as not being of natural rock, but a kind of gravel, strongly bonded to each other. Indeed, he would further report that the shaft would descend 123 feet (37.5m),<sup>6</sup> where he encountered a blockage of sand and stones. It's unclear where this measure is from, but if from the grotto, he must have been in the final steep part of the shaft.

<sup>6</sup> Description de L'Egypte, 1735, page 249.

The important item to note from Maillet's description is that the grotto had already been breached, and the fact that he mentions that the grotto extended some 15 feet east-west, indicates searcher activity inside the grotto. It would seem likely that this excavated material, along with the extracted small masonry blocks was simply thrown down the shaft, and this material might be the obstruction that Maillet came across at the bottom of the shaft.

What obstruction Greaves noticed is anyone's guess; it might have been a block lodged in the shaft, which accumulated debris around it; especially as it appears to be close to the junction where the shaft turns to the south: it doesn't necessarily mean that the entire shaft was blocked below this point; the shaft could have been clear below this point in much the same way that Maillet found it. When the grotto was breached is again anyone's guess, but it could be quite ancient.

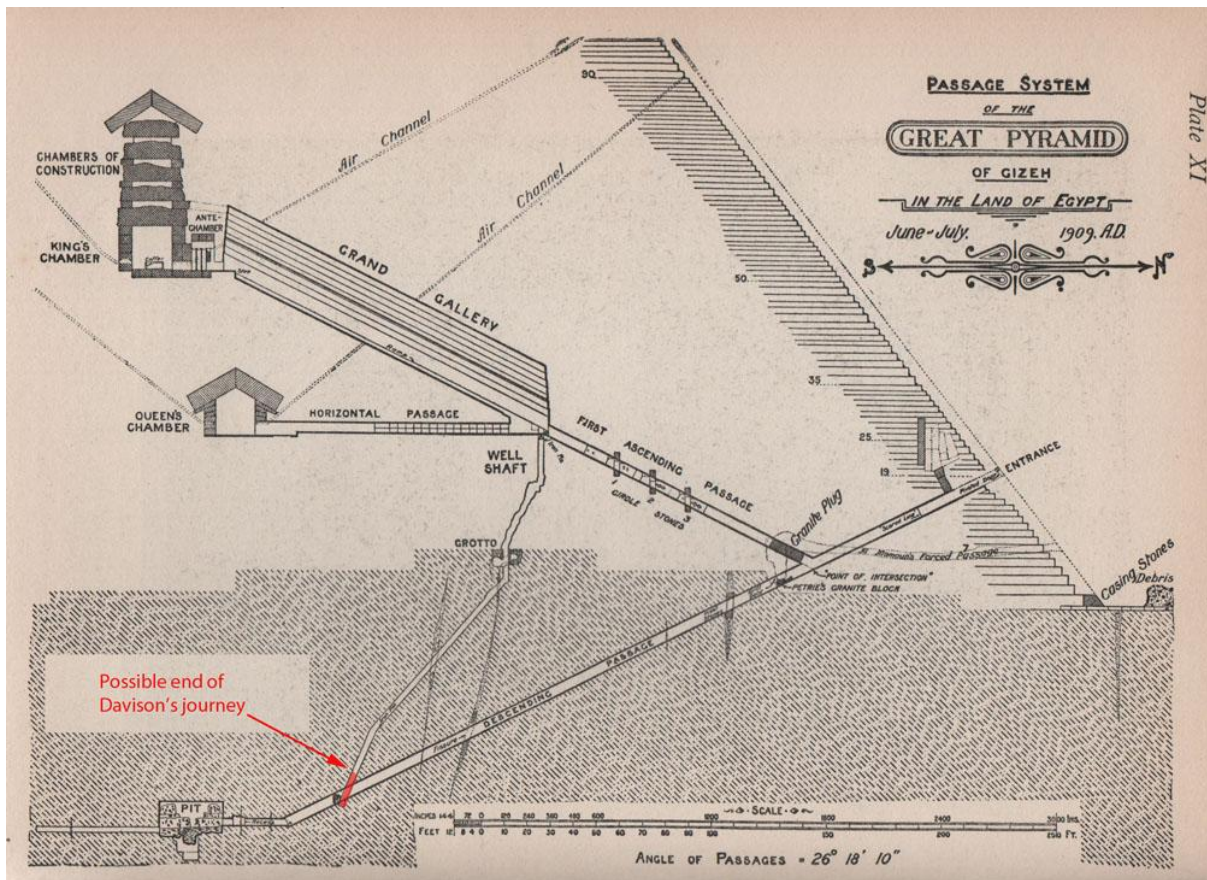
The next person of note to explore the well shaft is Nathaniel Davison, who resided in Cairo for some 18 months. In 1763, suitably attired with a lengthy rope he ventured into the well shaft determined to find its bottom. What we know of these events was published in 1817 by Robert Walpole, who published some extracts from Davison's journals.<sup>7</sup> With a lantern let down before him, and attached to him by a cord, Davison made his way down the first vertical shaft, which he gives as 22 feet (6.7m). From here it is somewhat difficult to interpret his account; *"Here he found, on the south side, at a distance of about 8 feet from the first shaft, a second opening which descended perpendicularly to a depth of five feet only; and at four feet ten inches from the bottom of this, a third shaft, the mouth of which was nearly choked up with a large stone, leaving only a small opening, barely sufficient to allow a man to pass."* He appears to be describing the second section of the shaft which leads to the grotto; in his account he gives three components to the well shaft: *"the depth of the first shaft was 22 feet; of the second 29; and of the third 99; if the five feet between the first and second shaft be added, the whole depth will be found to be 155 feet"*. It is difficult to reconcile this account from the data given in M&R's drawing on the previous page, but it's interesting to note the presence of a large stone in the shaft; this stone might be the granite block which now resides inside the grotto, and thought to be a piece of portcullis: it is thought that Caviglia placed the stone inside the grotto. Davison like Maillet would enter the grotto, and describe it as about 15 feet long, 4 or 5 wide and about the height of a man; Neither Maillet or Davison would report a granite block inside the grotto, though their reports are brief.

Davison continued on his journey along the longest section of the shaft, that which is cut through the rock; footholds left in the corners of the shaft provided some purchase, though some of these had eroded away. As he made

---

<sup>7</sup> See 'Memoirs relating to European and Asiatic Turkey' Robert Walpole, 1817. Davison account of well shaft is in French to M.Varsey, pages 350-354. A similar account in English can be found in the 'Quarterly Review' Vol XIX, 1818, pages 391-393

his way along his third section he, states; “At length the shaft beginning to incline a little more to the perpendicular, brought him speedily to the bottom, where he ascertained it to be completely closed by sand and rubbish.” This might well be the same spot that halted Maillet’s journey. From Davison’s description he appears to have entered the final lowest part of the shaft, which is steeper and leads to the descending passage opening. His third section which he gives as 99 feet (around 30m) would confirm this view; as M&R give the start of the third section as 26.5m long, before becoming steeper for the last 9.5m. This would suggest that Davison was standing on the debris pile, some 6m from the bottom of the well shaft.



From the Edgar’s plate XI above, I have highlighted the possible end of Davison’s journey. Davison would report that a rope ladder was found on the pile of debris, apparently left by a Mr Woods some sixteen years previous, who abandoned his journey at the grotto. Bats also occupied the shaft and Davison was concerned that they might blow out his candle.

Caviglia would eventually succeed in opening the well shaft in 1817; not by removing the debris on which Davison stood, up via the shaft, as this would prove to be too arduous to undertake, but by clearing the debris from the descending passage, which had long been blocked below Mamun’s hole. It was in this operation that he noticed an opening in the west wall of the descending

passage; by removing the debris from this location he would finally remove the blockage that Maillet and Davison had once stood upon.

Unfortunately, the well shaft is the most unexplored part of the pyramid, the data provided by various authors is conflicting and the views to explain the well shaft are just as varied. Clearly an area off limits to tourists, we have little data, images, video etc to help make sense of it. For example, if we compare the Edgars drawing on the previous page, we can see that the second section from the bottom of the initial vertical shaft, to the grotto, is very irregular compared to the drawing given by M&R on page 3; but which author is more accurate. It is clear from the Edgar's accounts that they made the journey down the well shaft and even placed iron pins for their ropes, taking measures as they went; however, the impression from M&R's work is that they did not venture down the well shaft, but relied on the work of others.<sup>8</sup>

Ultimately, we are only left with opinions and hardly any data on which to decide whose opinion is the more valid. For example, let us take the upper portion of the shaft, from the grand gallery to the grotto, which goes through the core masonry of the pyramid; here we have two competing views, one view is that the shaft is cut through pre-existing core masonry, whilst the other view is that the shaft was built as the masonry was laid. Dormion is of the view that originally the well shaft only extended to the grotto, and clues in the cuttings made in the rock suggested that the shaft was cut downwards to join with the descending passage. This passage would help in removal of cuttings from the subterranean chamber, and the reason for the steeper ending of the shaft, is that originally its trajectory would be at the end of the descending passage; however, the cutting of the shaft fell behind that of the descending passage, and so the shaft was shortened. The abandonment of the subterranean chamber meant that the well shaft was superfluous; the shaft would be closed off at the grotto and the pyramid masonry would rise above it; however, a later change of plan in the closing mechanism for the ascending passage, which Dormion suggests was to have held three sliding portcullises, but was changed to plug stones, meant that an escape route was required for the worker's and so the upper part of the well shaft was cut through already laid core masonry, to connect to the lower rock cut part of the shaft.<sup>9</sup>

This view of events might sound plausible, but as shown in part 1 of this guide, Lehner and Hawass suggest that there is evidence that the subterranean chamber was the last part of the pyramid to be built. If this be the correct interpretation, what then would be the function for the well shaft? The suggestion that the closing mechanism for the ascending passage was changed is also questionable as I pointed out in part 1; for it seems clear that the lower end of the ascending passage was specially built and shaped to receive the first

---

<sup>8</sup> For Edgar's account see 'Pyramid passages' vol 1, pages 346 to 368. For M&R see page 140 of their work, where they state; 'from the drawings of the shaft and the narratives of those who penetrated it'.

<sup>9</sup> La chambre de Cheops, 2004, see pages 81 to 86, and pages 106 to 113

granite plug stone. This suggests that at the very outset of the construction of the ascending passage that a decision had been made to seal the passage with plug stones. The area of the girdles where Dormion thinks portcullises were envisioned seems illogical as these are further up the passage. If we accept Dormion's idea that these three girdles are vacated sliding portcullises such as we see in the Bent Pyramid, then it implies that these were constructed first, for he states; *"for some reason that escapes us, this downstream blocking system (i.e. the three sliding portcullises) was abandoned in favour of the upstream system of plug stones."*<sup>10</sup>

It is difficult to understand Dormion's reasoning on these portcullises, for he seems to suggest that the uppermost portcullis was completed last.<sup>11</sup> If so, does this not imply that the ascending passage was built from the bottom up? To me this is the logical construction sequence for the passage; the ascending/descending passage junction is quite near to the natural rock and I can imagine the builders took advantage of this as they set about laying the huge blocks at its lower end, which were purposefully cut through to narrow the passage to restrain the granite plug stones. If Dormion is suggesting that the portcullises was the sealing solution before the change to the plug stones, then the narrow end of the ascending passage should not exist prior to the portcullises. One can always remove material but it is much harder to add material; so if portcullises were the solution then we should expect the lower end of the ascending passage to be the normal 2 cubit width and not be narrowed. Changing the design to plug stones would mean that material had to be added to create a narrowing at this end. But there is no way of adding material to rock already cut, so they would have to totally dismantle all the masonry around this junction area and introduce new masonry, and given the higher elevation of the portcullises, not to mention continued construction of the masonry part of the descending passage, it would seem an impossible job.<sup>12</sup>

But what of the portcullises themselves? Given that each portcullis housing would be higher than the next as the passage rose, should we not expect that some had been completed, i.e. with its portcullis in the retracted position, and housing ceiling finished. If this is the case then we have further dismantling as part of the housing and portcullis was removed and the vacant slots filled with what we call today, girdle stones. Some of the problems could be removed by suggesting that the ascending passage was built from the top down, but this seems illogical to me. The simple solution might be that the locations thought to

---

<sup>10</sup> La chamber de Cheops, 2004, page 104

<sup>11</sup> Ibid, page 104

<sup>12</sup> Of course one could argue that several inches of stock were left on the passage walls, which would be dressed away nearer completion, and they were lucky enough not to have got to that stage when the decision to abandoned the portcullises was taken. Or we could argue that the ascending passage was built from top to bottom.

be for portcullises might have always just been girdle stone locations, whose function is aptly described by M&R;

*“Now, in corridor (A) it is evident that there could have been a strong downward thrust and the girdle-stones served to break the pressure of the blocks, forming the upper part of the corridor, on those in the lower part. In fact the girdle-stones served to prevent the pavement, sides and ceiling from forming uninterrupted sliding planes in the masonry: that is, they served to bond the inclined courses of the corridor with the horizontal ones in the rest of the nucleus masonry. All the blocks in the northern part of corridor (A) are girdle-stones and this is logical as the maximum thrust was here. From this point upwards the girdle-stones become farther apart and finally disappear at the south end where there was the minimum thrust, and in any case opposed by the girdle-stones lower down.”<sup>13</sup>*

As mentioned in part 1, the data on the ascending passage is very poor, but on what is available, I have to conclude that the jury is out as to whether the portcullises suggested by Dormion were ever envisioned by the architect. That said, a portcullis solution would appear to be the ideal solution, as it would allow the funerary procession relatively unimpeded access to the king's chamber, as opposed to navigating around plug stones stored in the grand gallery; (indeed, would there be a requirement for the monstrous grand gallery: with no plug stones to store, the ascending passage could maintain its width up to the king's chamber, and avoid all this construction) moreover, the well shaft would not be required as the workers could safely retreat from the pyramid, as each portcullis could be lowered from inside the ascending passage. The idea seems so simple that one wonders why it was abandoned, to be replaced by a system which compromised security in the form of the well shaft, and the huge construction effort in creating the grand gallery. The answer might be that the portcullis system was never in the mind of the architect and that we are simply projecting an idea onto features, whose only function may have been as described by M&R above.

Even if we accept that the subterranean chamber was created first, would there even be a need to create a well shaft to remove cuttings; it is hardly a user friendly route, especially when the larger descending passage was available. One could argue it was built for ventilation, but how likely is this, given the miles of tunnels dug under the step pyramid and elsewhere, where such luxury is absent.

The most contentious part of the well shaft is the part which goes through the core masonry, and here we have differing views, for example, Dormion would state; *“Similarly, the entire upper part of the shaft which connects the north landing of the grand gallery to the grotto was dug through masonry*

---

<sup>13</sup> L'Architettura Delle Piramidi Menfite, parte IV, page 116



already in place. There is general agreement on this point, which is beyond doubt.”<sup>14</sup> But is this the case? M&R would comment;

*“The space for the upper part of this shaft was left in the pyramid masonry under construction. It descends vertically for a good distance through the nucleus masonry. At a certain point it becomes irregular, bends to the south (the resulting inclined part being cut out of the nucleus masonry) then, penetrating the rocky core of the pyramid above the level of the foundation pavement, opens into the so called « grotto »”<sup>15</sup>*

In M&R’s view, it seems that they view the initial vertical section as being built as the masonry was laid, whilst the irregular inclined part had the appearance of being cut through pre-existing masonry. I have only ever seen two images of this initial vertical section, not great quality, but the shaft does appear to be quite uniform and neat. Petrie would offer his opinion;

*“The plan of the passages was certainly altered once, and perhaps oftener, during the course of the building. The shaft, or “well,” leading from the N.end of the gallery down to the subterranean parts, was either not contemplated at first, or else was forgotten in the course of building; the proof of this is that it has been cut through the masonry after the courses were completed. On examining the shaft, it is found to be irregularly tortuous through the masonry, and without any arrangement of the blocks to suit it; while in more than one place a corner of a block may be seen left in the irregular curved side of the shaft, all the rest of the block having disappeared in cutting the shaft. This is a conclusive point, since it would never have been so built at first.”<sup>16</sup>* This point by Petrie was commented on by the Edgar’s;

*“Our comment upon this reasoning is that: because a section of the tortuous part of the shaft may have been cut through while some of the masonry blocks were in situ, this is not at all a conclusive proof that the Well was not in the original design; for the same thing is evident in the bore of the First Ascending Passage, especially at the lower end of that passage, as we have already noticed; and Professor Petrie does not suggest that the First Ascending Passage was a mere afterthought. And then it is in the tortuous part only that such cutting seems to have been made; for Professor Petrie says nothing of the long section of the shaft which is not tortuous, that is, the top, vertical part, which is square in bore, and presents every appearance of having been built while the building-operations were in progress.”<sup>17</sup>*

So who is correct? Like so much of the pyramid our data is woeful; there are no detailed plans of masonry layout, images etc to even offer an opinion, and this is so systematic of pyramid exploration, were often the layman only receives an

---

<sup>14</sup> La chamber de Cheops, 2004, page 106

<sup>15</sup> L’Architettura Delle Piramidi Menfite, parte IV, page 54

<sup>16</sup> The Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 214

<sup>17</sup> Great Pyramid Passages, Vol 1, 1923, page 346 & 349

opinion, but no data to verify the validity of the opinion. As to the question of whether the shaft was cut through pre-existing masonry, should this question even need to be answered in 2022? Surely a detailed forensic examination of the shaft should be able to finally settle this question once and for all; sadly I suspect that this question will still be asked next century.

Also to be considered is any possible damage inflicted on the tortuous part of the shaft made by the clearance of masonry; for example, the Edgar's would mention an item from Caviglia's list of measurements: "*Depth of the Well to a block of granite that had fallen into it – 38 feet*".<sup>18</sup> This would place the block inside the tortuous part, and this might be the granite block which now resides inside the grotto. How tortuous this part of the shaft is, I know not, as I could find no data. The Edgar's report;

*"The walls of the first vertical part are comparative smooth; but from the bottom of the first down to the top of the second vertical part, the shaft is very uneven indeed, being neither square nor round in section –Plate XI (See page 5). It looks as if the great irregularity in this part of the shaft is the result of stones having been dislodged from its walls; for the whole of this portion of the Well, from the Grand Gallery down to the top of the second vertical part, descends through the comparatively rough core masonry of the pyramid. Here and there, one can see the open joints between the core stones; and we found them sometimes large enough to stow away our measuring rods when not required. Situated on the east, at the foot of the first vertical part, there is a crevice large enough at its outer end to allow one to sit in it; and at its further end, the square corner of one of the core blocks is clearly distinguishable.*

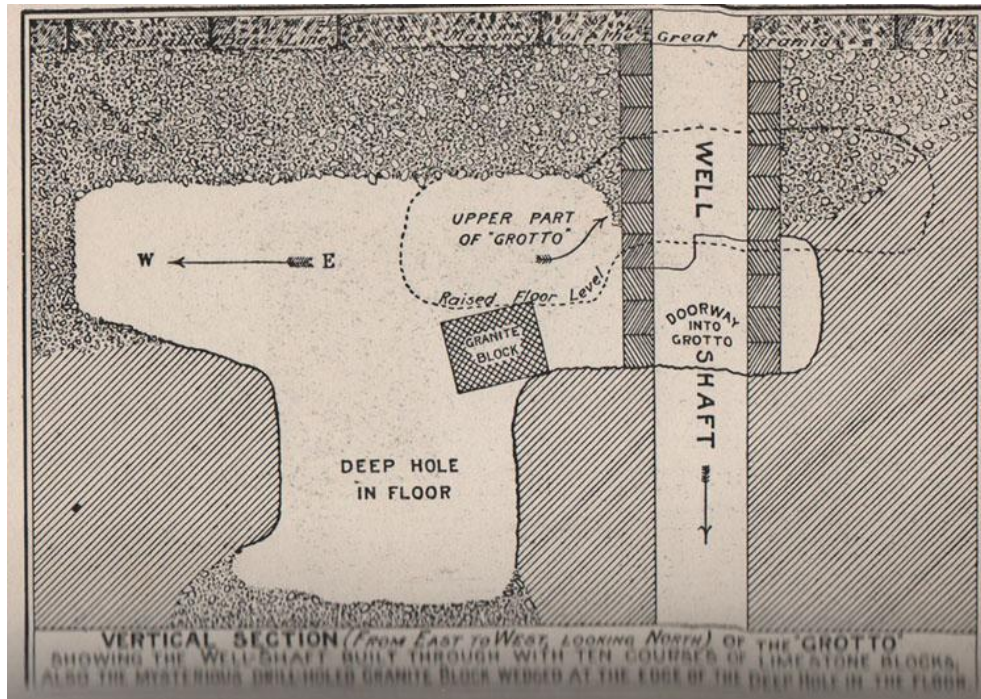
*This thought seems to be supported by some of the older writers on the Great Pyramid, who record that the irregular part of the shaft was in their time much encumbered with large stones. If so, it is evident that to remove these stones without first cutting into the sides of the shaft in order to gain room, would be very difficult, if not impossible in so confined a place. Col. Howard Vyse quotes Mr. Salts account of M. Caviglia's descent of the Well in 1817 – "he descended by means of a rope to the bottom of the first shaft, 20 feet deep [our own measurement, taken from the roof of the small horizontal passage above, down to the lowest part of the vertical shaft is 25 feet], when the passage, which inclined towards the south, was nearly filled up by some large stones, which he had great difficulty in removing."<sup>19</sup>*

The shaft would eventually lead to the second vertical section which goes through the grotto.

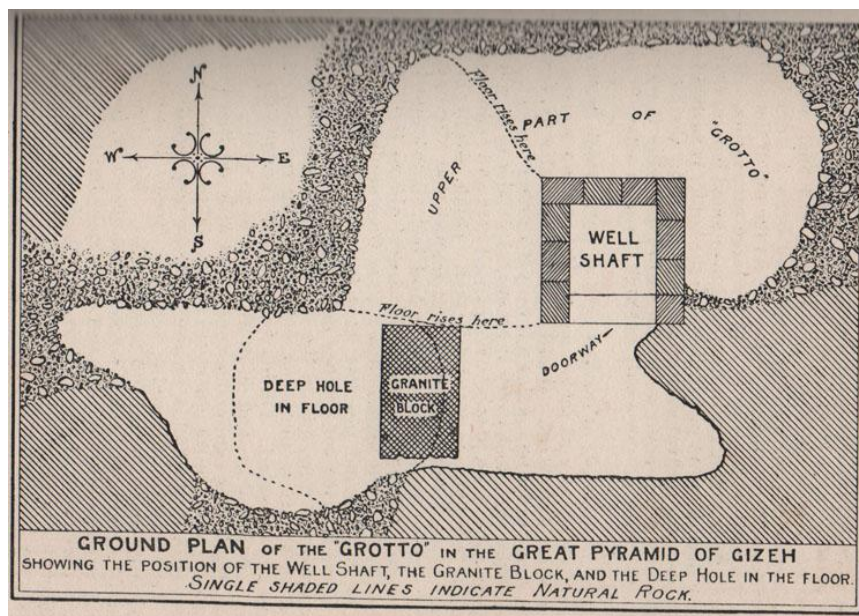
---

<sup>18</sup> Ibid, page 363

<sup>19</sup> Great Pyramid Passages, Vol 1, 1923, page 359



The above drawing by the Edgar's is a section through the grotto and part of the second vertical section. They report that ten courses of small masonry would line the shaft as it went through the grotto. The grotto itself appears to be a natural void, filled with naturally compacted material.



The above drawing also from the Edgar's, shows the plan view of the grotto. The granite block is a sizeable item, and it's hard to see anything of this size accidentally falling down into the well shaft; it may have been placed in the shaft by local guides to dissuade tourists from exploring further, in a similar manner to their blocking of the descending passage (see part 1).



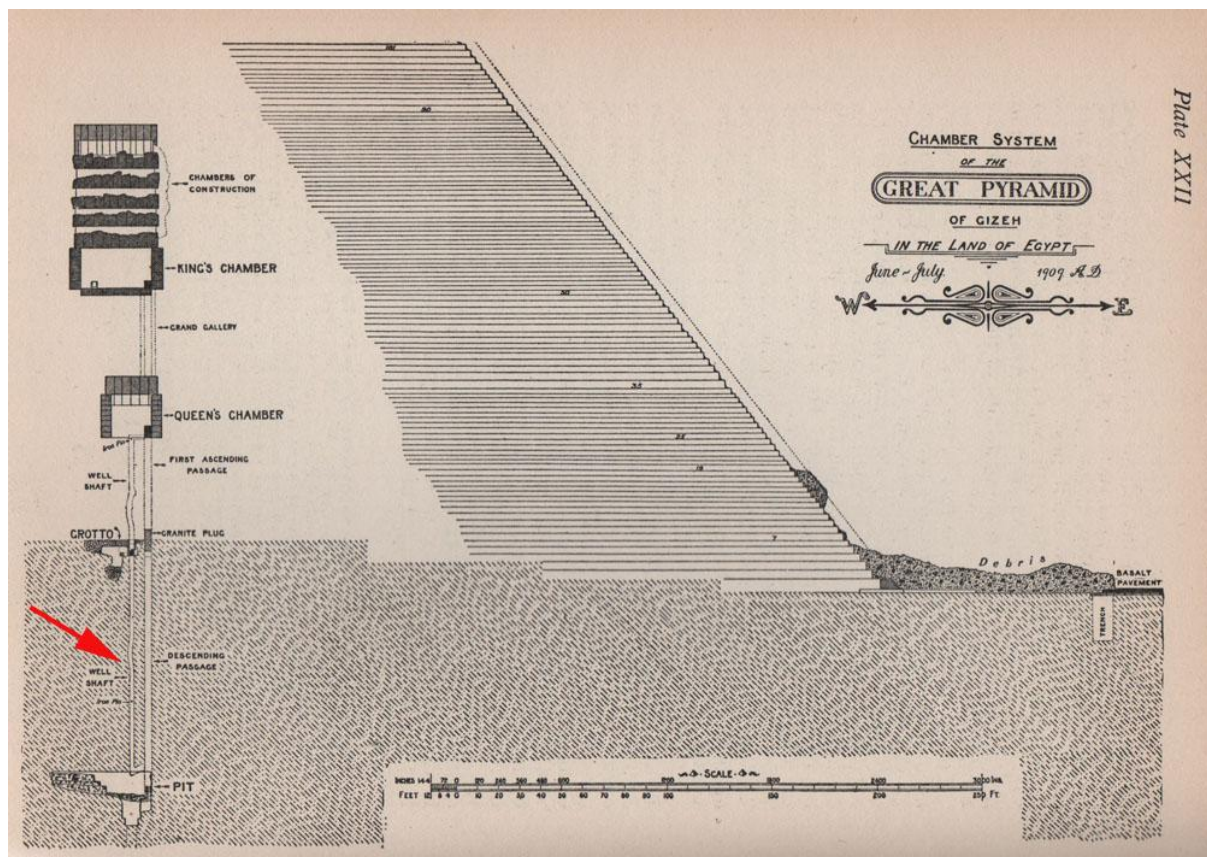
Above we have the Edgar's image of the grotto; at the bottom left corner we can catch a glimpse of the granite block. We are looking at the bottom courses of the small masonry, sitting on the natural rock; the masonry block sticking out on its own, top of image, is outlined on Edgar's drawing on the previous page: note also the rope on right of image. The Edgar's would report; *"It is longer from east to west, than from north to south. The roof is so low; and except in one spot to the west, where there is a deep hollow in the floor, it is too low to allow one to stand. The floor, walls and roof are composed for the most part of gravel embedded in caked sand, which crumbles when touched. Here and there the natural rock appears."*

Dormion would report that these small blocks of masonry were fitted against the compacted fill of the grotto, as excessive gypsum was found on the back of the blocks, with particles of the fill adhering to the gypsum. It has been suggested that the small masonry shaft was constructed first and back filled with this material, but the consensus appears that the fill is a natural conglomerate of material. The Edgar's drawing shows core masonry above this fill, though this is an unknown area. When the breach was made into the grotto is an unknown, but it could not fail to attract the attention of the earliest of searchers.

Below the grotto we have the start of the longest portion of the well shaft, which is solely excavated from the natural rock. Certainly a job for those who picked the short straw, as I doubt there would be many volunteers to cut it. The Edgar's provide the following description; *"The average height of the roof from the floor in this inclined part of the shaft, is about 30 inches. The width between the walls at the roof is greater than the width at the floor, the former being*

about 25 inches, and the latter 22 inches. The roof, walls and floor of this shaft are not, however, so regularly cut in the rock as are the Descending Passage and Small Horizontal Passage leading to the pit. In the angles between the two walls and the floor, rough portions of the rock have been allowed to remain, for the purpose of serving as footholds. These footholds, which are regularly spaced all the way, are not very large, and do not seem secure to those unaccustomed to such places.”<sup>20</sup>

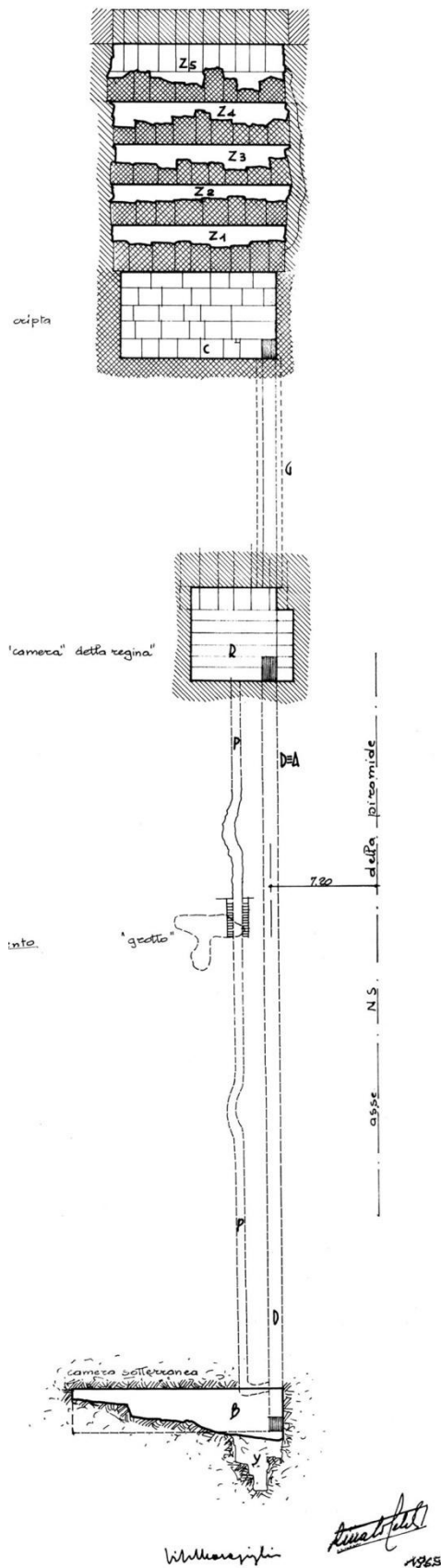
The Edgar’s would also notice an unusual feature of this section; “We noted, however, that at about the middle of its length there is a slight bend westward, and then back eastward to the same general line – plate XXII.”<sup>21</sup>



Above we have Edgar’s plate XXII, and I have arrowed the bend that they report in the shaft; though judging from their drawing, one wonders if another bend existed in the masonry section of the shaft. Given its length the shaft is remarkably accurate and aligned to the main passage system.

<sup>20</sup> Ibid, page 365

<sup>21</sup> Ibid, page 365



Left, we have a similar drawing from M&R's TAV 3; though it's hard to determine how accurate these drawings are. The bend or bends may have been deliberately placed to arrest or slow down any falling objects, be it workers or masonry etc; a worker losing their foothold might be thankful for such a feature, as it could arrest their slide. We seem to have a similar bend in the tunnel which connects the two apartments in the Bent pyramid.

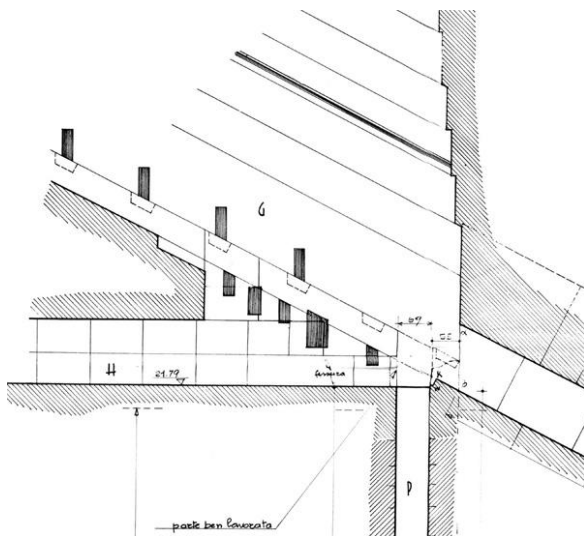
When one looks at a side elevation of the pyramid (see page 5) it has been noted that if the first inclined part of this section was produced onward, it would appear to connect with the end of the descending passage; however, for some reason the final part of the shaft seems to change course and become near vertical, as it connects to the descending passage. We do not know if this was a change of plan to create a shortcut to the descending passage.

Today the well shaft is closed off and resides in darkness, and unfortunately our data on the well shaft does not illuminate much. Ideally the whole shaft could benefit from 3d scanning, along with a detailed forensic look at all the masonry along its route: pending modern exploration, we are still very much in the dark as to its construction and function.

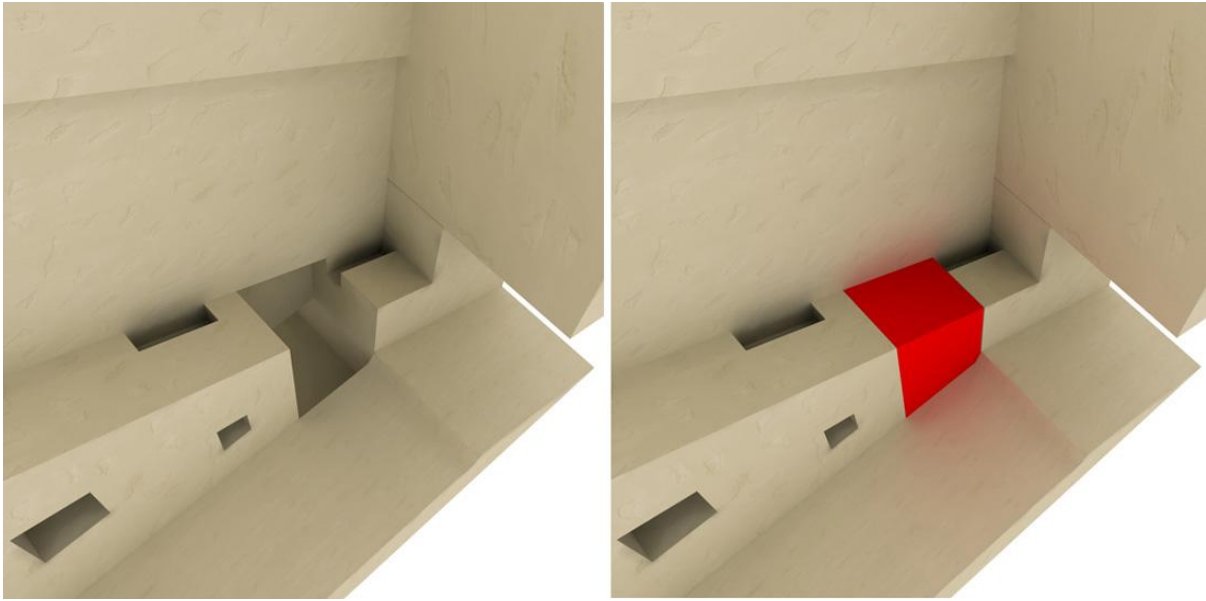


*Image courtesy of Jon Bodsworth*

Today the entrance to the well shaft from the grand gallery is covered over, though the Edgar's managed to take some images of it. The ramp in this location is much damaged, and it is often quoted that the destruction of a cover stone which concealed the entrance to the well shaft, was largely responsible for the damage to the ramp which abuts against the north wall of the grand gallery. However, when one looks at the area in question it would seem unlikely that any such covering stone ever existed, and like the prismatic stone which is thought to have concealed the ascending passage, it may be more a product of our imagination.

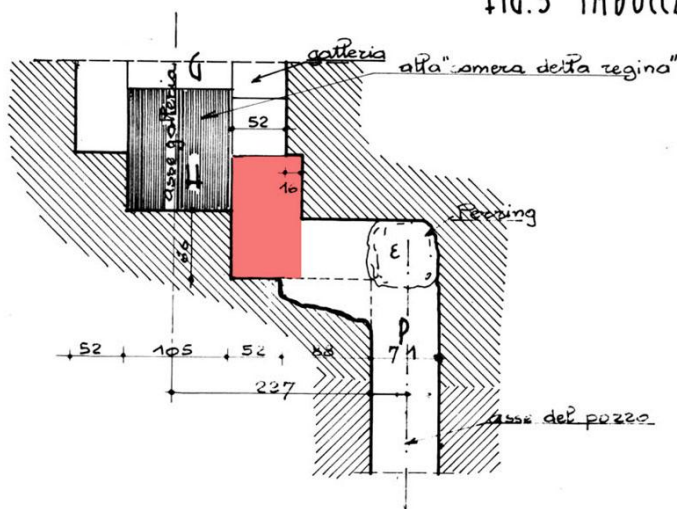


From M&R's TAV5 we can see the entrance to the well opening, and it will be noticed that they have left a small amount of masonry between the first ramp hole and the opening for the well shaft; However, from the dimensions provided by Piazz-Smyth and Petrie, this reconstruction would seem to be unlikely.



The horizontal distance for the well opening from the gallery's north wall is given as 21.3 inches by Piazza-Smyth (Petrie gives 21.8), and if we assume the angle of the ramp was intended to be 1:2, then the inclined length to the well opening would be 23.8 inches. We can see that the starting hole on the east ramp is a long hole (see part 1), and given by Smyth as 23 inches; therefore such a long hole if replicated on the west ramp would basically take up the whole distance to the well shaft opening, as shown in the reconstruction above. The red covering stone which some believe to have existed, would when fitted, create the south wall of the ramp hole: but did such a covering stone exist?

FIG.3 IMBOCCA'



In M&R's fig 3 left, from their TAV5, we can see an east-west cross section through the well shaft opening, and I have highlighted the position of a possible covering stone. Dimensions for this area differ markedly amongst many sources. Piazza-Smyth would give the length of the short horizontal passage from the east side of the hole in the

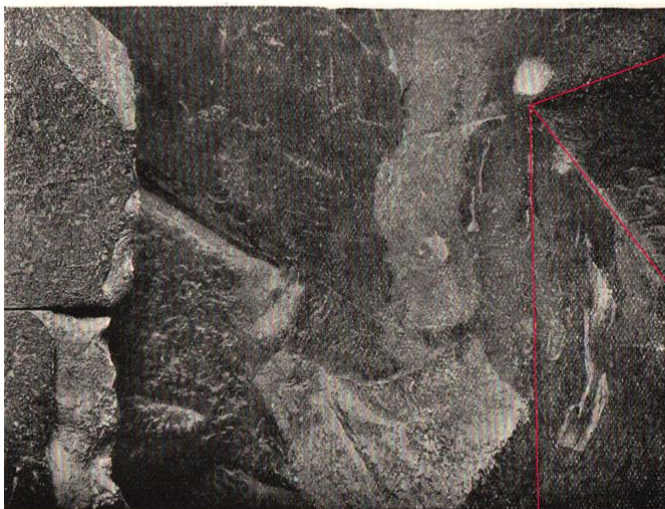
floor to west side of well shaft as 84.5 inches (2.15m, M&R from their fig 3 give 2.11m). Smyth would give the depth of the hole from the horizontal passage as 27 inches, with the width of the passage being some 28 inches.<sup>22</sup>

<sup>22</sup> Life and Work, Vol 2, page 71-72



The Edgar's report that the horizontal passage floor was badly damaged, but that a bit of a step appears to have survived at its beginning, and this is the dotted line in M&R's fig 3, which is thought to be the original floor line.

From the available dimensions, it seems clear that only one worker could comfortably occupy this space, and this will have implications for any covering stone: M&R would calculate that any covering stone must have been about 1350 kg.<sup>23</sup> Given the confines of this narrow passage, it's not clear to me how this stone could be fitted, given its weight, shape, and the 16cm undercut, as shown in fig 3; indeed, was there even a need for such a covering stone? The consensus is generally that the well shaft was a service shaft for the workers to escape after releasing the plugging stones, and as they left the grand gallery for the last time, they would lower a covering stone over the opening. This seems somewhat illogical, as it would hardly amount to much of a barrier for robbers, who after discovering the well shaft at the bottom of the descending passage, would simply climb up the shaft, and break the covering stone from the inside; and it is often thought that it is this process which destroyed much of the ramp north of the well entrance as shown in the Edgar images below.

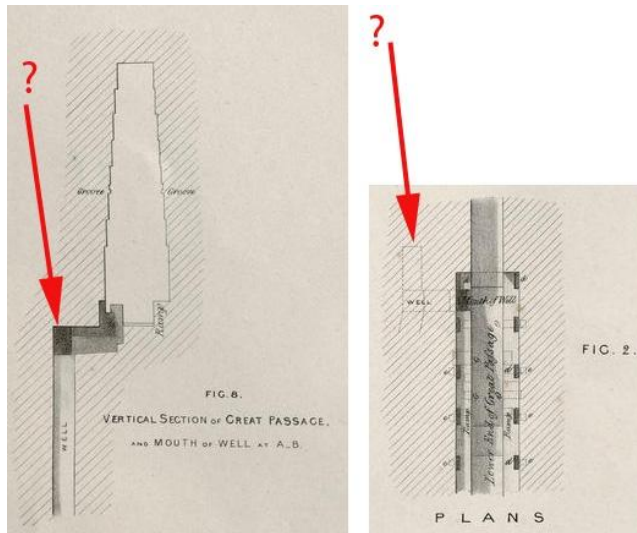


The red lines outline the ascending passage as it enters the grand gallery in the left image; whilst the right image taken from a different angle, has a red line denoting the top of the east ramp. An alternative explanation for this damage is that the ramp hole here, being a long hole, had no south end, and that a glancing blow from a piece of granite portcullis, thrown down the gallery simply broke this ramp portion away. I doubt there would be a requirement for a covering stone; they may have disguised the descending passage entrance as best they

<sup>23</sup> L'Architettura Delle Piramidi Menfite, parte IV, page 138.

could, but the major security would be plugging the upper part of the descending passage.

If a covering stone existed, where would it be stored? If its depth included the undercut, it could hardly rest on the west ramp, as it would then intrude into the area between the ramps, and obstruct the route of the plugging stones. It could be stored on the horizontal passage under the bridging platform, but then said platform would have to be removed in order to fit it. The problems are many, but I fail to see how a large heavy cover stone could be fitted in this location. The only logical solution if this opening was to be sealed is that the opening was closed with a series of small blocks which were manageable given the confines of the passage, such as we see in the lining of the shaft through the grotto. Such stones could have been hoisted up the well shaft, and indeed the short horizontal passage, could have been filled with such small stones.



Another curious feature of the well shaft, which is often omitted from accounts, is the arrowed area, which is shown on Perring's drawings left.<sup>24</sup> The Edgar's would comment on it; *"At the top of the vertical shaft, on the north side, there is a fairly large excavation. It is in the rough floor of this excavation, as I mentioned before, that our men have fixed the iron pin, from which the ladder is suspended. What purpose the*

*excavators had in view in forcing their way into the masonry at this point we do not know; probably it was they who cut the floor of the small passage, to gain more headroom for working.*"<sup>25</sup>

Like so much of the well shaft and the pyramid generally, detailed data on this feature and masonry layout along this short passage are nonexistent or unpublished. But if Perring's drawings are accurate it is a sizeable space, and if contemporary to the build of the pyramid, it could have been used to store small masonry blocks to seal the short passage.

Though the consensus on the shaft is generally a service shaft for the workers to escape, an alternative view is held by M&R, who see the shaft being filled and sealed with a large covering stone after the abandonment of the subterranean chamber. They would suggest that the plug stones stored in the grand gallery were operated in a similar manner to those found in the satellite pyramid next to the Bent Pyramid, and therefore the well shaft would be

<sup>24</sup> The Pyramids Of Gizeh, part 1, plate VIII

<sup>25</sup> Great Pyramid Passages, Vol 1, 1923, page 358

superfluous.<sup>26</sup> The example of the satellite pyramid is bit of a mixed bag, as here we have a steeper gallery of about 34 degrees, but here everything did not go to plan.



In the above section of the satellite pyramid, the plug stones occupied a gallery whose width matched that of the ascending passage, with the ceiling being raised to allow access to the chamber. Here we have no service shaft, but instead, a trigger mechanism appears to have been used to release the lead plug stone and the chain of other plug stones down into the ascending passage.<sup>27</sup> Today two of the upper plug stones still remain in the gallery, having failed to slide down into the ascending passage. Indeed, we do not know if the builders were even aware of this failure; they may have been, as there is no guarantee that the trigger for the lead plug even set that plug in motion. A situation may have arisen were it too remained stationary, and so some brave soul would have to climb up the passage and try to start the lead plug in motion; while hurriedly sliding away as the plug started to bare down on him.

M&R would suspect a somewhat similar mechanism in the Great Pyramid, and therefore doing without the need of the well shaft; however, it's difficult to see how such a solution could work in the Great Pyramid, given the much greater length of the grand gallery and ascending passage, and the sheer number of plug stones required, if it was the intention to largely fill the ascending passage with them. These plug stones may have rested on the floors of their respective galleries for years, during which time, dust and small debris could settle amongst them, and maybe a build up of such material led to the failure at the satellite pyramid. So for an operation of this size, I should imagine

<sup>26</sup> L'Architettura Delle Piramidi Menfite, parte IV, pages 136-144, observation 39.

<sup>27</sup> See Bent Pyramid guide, part 2

that workers would be a requirement inside the grand gallery, to ensure a positive outcome; especially given the shallower angle of about 26 degrees, were I should imagine that each block was released individually, and possibly with the aid of some lubricant.

The well shaft is such a frustrating element of the pyramid, where even in the 21<sup>st</sup> century; we know so little about it. Our data on it is mostly the conflicting opinions of various authors; whilst actual detailed physical data of the shaft is slight. As it stands, there is insufficient data to determine its construction and function, and one can only speculate on its role.

My best guess is that the well shaft had a dual role; the first was in helping orientate and align the pyramid's passage system, and its secondary role was as a service shaft to help seal the ascending passage, with the plug stones in the grand gallery. I concur with Lehner and Hawass that the subterranean chamber was the last construction inside the pyramid, and that this can be removed from the equation for the role of the well shaft: one would hardly create a well shaft for a chamber which was never planned. If we accept that the descending passage was originally planned as a dead end (as discussed in part 1), then why was the well shaft constructed? As Petrie and others have remarked, the accuracy of the descending passage is quite impressive, with its azimuth mirroring that of the pyramid itself. Much ink has been spilt on the various methods employed on how they orientated these pyramid giants, but I do not think it unreasonable that the descending passage was accurately aligned to something in the night sky, in order to maintain its accuracy. The accuracy of the ascending passage and grand gallery is more problematic to measure due to difficulty encountered by Piazzzi-Smyth and Petrie, because of the granite plugs; but even with the probable error in this area, Petrie thought that they were very close to that of the pyramid side.<sup>28</sup> Given that these elements point to the south, how would these be aligned to the correct azimuth?

Many astronomers and others have put forward ideas on how the passages could have been aligned, and more recently, David Lightbody has brought attention to the so called trial passages and how they could have assisted in pyramid alignment.<sup>29</sup> It is certainly a complex area, but it has been noted by some in the past, that the well shaft, especially via its two vertical sections, could have been used by zenith observers, and the route of the well shaft which exits near the end of the descending passage, could have communicated their observations to those tasked with the polar observations. Certainly verbal communication from say the grotto to the descending passage appears easy as the Edgars report; "*we distinctly heard a voice coming up from the Well-shaft from 125 feet below, asking us if we were coming down for tea!*"

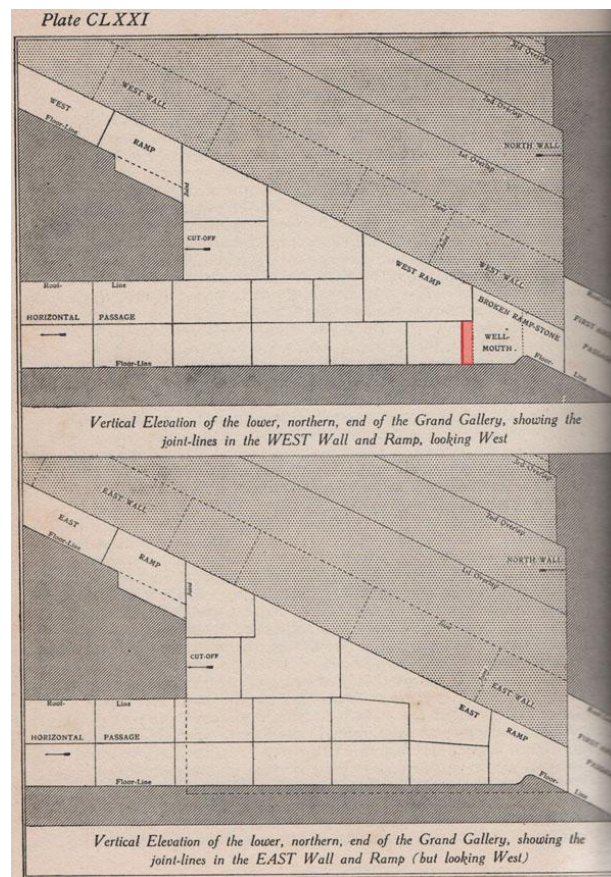
---

<sup>28</sup> The Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 65

<sup>29</sup> Moving Heaven and earth for Khufu: Were the Trial Passages at Giza components of a rudimentary observatory? JAEA 4, 2020, pages 29-53.

The initial vertical shaft through the grotto may have been used for zenith observations; (it's interesting to note the vertical shaft in the so called trial passages closely matches that of the well shaft in being about 28 inches square) though the initial start point for the shaft on the desert surface may have been a best approximation to the architect's unified plan for the pyramid, and where he expected the shaft to enter the grand gallery. One can imagine that it was a difficult calculation for its location and how it would connect to the optimal spot chosen for it in the grand gallery. This spot in the grand gallery could only be nailed down as the ascending passage was getting closer to the grand gallery location, and confident of their location, the upper vertical part of the shaft may have been left in the core masonry; whilst the core masonry below was cut through to connect to the initial shaft through the grotto (or the core masonry was gradually staggered across to its new vertical location, and later damage caused by extracting masonry); hence creating the irregular section.

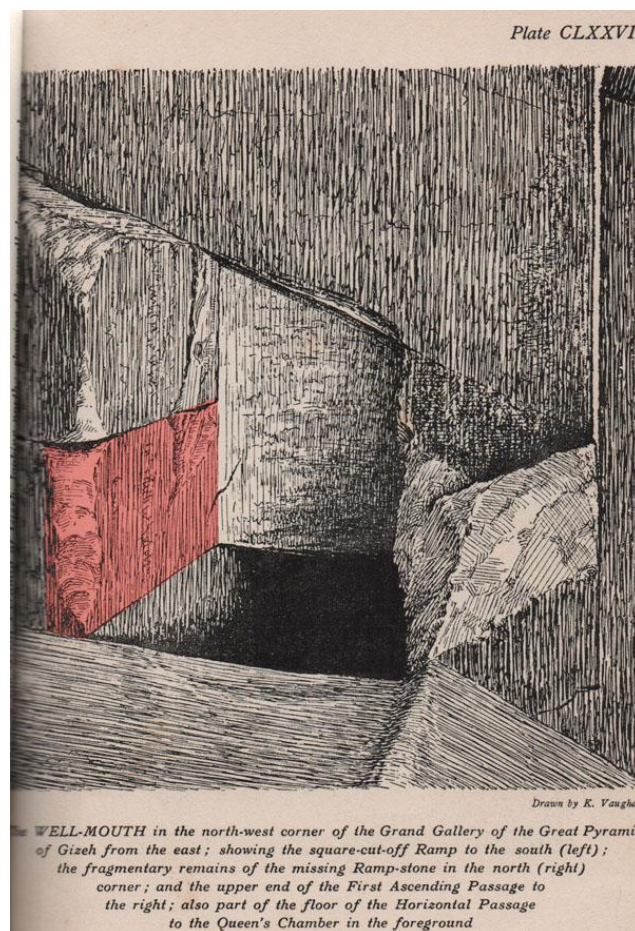
### The Horizontal Passage to the Queen's Chamber



Even a simple horizontal passage such as that which leads to the queen's chamber, throws up some surprises, as we can see in the Edgar's arrangement of the masonry above, which make up the walls of the passage. The beam holes have been omitted from this drawing, whilst the highlighted slip of stone next to the well shaft, is the slip of stone which concerned Petrie. Continuing from his

statement on page 9, he states; “A similar feature is at the mouth of the passage, in the gallery. Here the sides of the mouth are very well cut, quite as good work as the dressing of the gallery walls; but on the S. Side there is a vertical joint in the gallery side, only 5.3 inches from the mouth. Now, great care is always taken in the pyramid to put large stones at a corner, and it is quite inconceivable that a Pyramid builder would put a mere slip 5.3 thick beside the opening to a passage. It evidently shows that the passage mouth was cut out after the building was finished in that part. It is clear, then, that the whole of shaft is an additional feature to the first plan.”<sup>30</sup>

Morton Edgar would return to the Great Pyramid in 1912, and measure the masonry either side of the passage to create the plate above, and report that this mere slip of stone, was uninjured in the main.<sup>31</sup>



In the above plate by Edgar, we have a clearer view of the well shaft opening, and I have highlighted the slip of stone. It's not altogether clear to me due to the lack of data, as to whether this is a standalone slip of stone, or part of the stone to the north of it. M&R would state;

<sup>30</sup> The Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 214-215

<sup>31</sup> Great Pyramid Passages, Vol 1, 1923, page 349

*“In (G) the opening of the shaft was cut in an already laid block not because it had not been planned or had been forgotten (as Petrie says in *Pyr. and Temples etc. cit.*, p 214), but because the masonry of the lower part (Q) of the gallery itself had to be particularly strong and therefore built with very large and solid blocks bound to the nucleus. The unique block forming the north-west lower part of the great gallery was laid whole and then cut to form the entrance to (P).”<sup>32</sup>*

There are numerous breaches made inside the pyramid which could afford us a view on how the masonry was laid, but we never have any data available on them. The well shaft being but one example; does the slip of stone form one part of the large block north of it, and how far does this large block extend back, all the way back to the shaft perhaps? What of the masonry which makes up the side walls of the short passage which connects to the shaft? The list could go on. Laying a block first and then cutting a feature through it, is not an unusual practice for the Egyptian mason’s and does not necessarily mean as Petrie suggested that the feature was a change of plan.

From Edgar’s plate on page 21, we can see that the unusual masonry of the walls, which largely show this form throughout a significant part of the horizontal passage, begin in the open space at the north end of the gallery. Neither Petrie or Piazzzi-Smyth appear to have been aware of this feature, and this is likely down to the significant incrustations which effected this passage; Piazzzi-Smyth states: *“Further, it is particularly noteworthy, that in going from north to south in the horizontal passage, saline encrustations are observable on walls and floor, beginning at about 150 to 200 of distance from north end, and increasing in amount farther southward; until at last both roof, walls, and floor are covered with a coating of them near an inch thick, brown outside, white inside, and of almost stony hardness, and they are termed by some authors, ‘sparry excrescences’.”<sup>33</sup>*

This unusual masonry was observed by the Edgar’s who state; *“For a length of 64 feet from the beginning of the roof at the grand Gallery end, each wall is built in two equal courses. In each of these courses there are 15 stones of uniform size, namely, 41.25 inches in length, and half the height of the passage in breadth. The vertical joints in the upper course are in line with those in the lower; and those on the east are in direct opposition to those on the west wall. These 15 stones are within the passage, south of the Grand Gallery floor “cut-off”. But wall-stones of the same size extend further northward, almost to the north wall of the Grand Gallery as Plate CLXXI shows.”<sup>34</sup>*

This unusual masonry seems to run against convention, were we should expect the rising joints to be staggered to increase the strength of the masonry bonds.

---

<sup>32</sup> L’Architettura Delle Piramidi Menfite, parte IV, page 142

<sup>33</sup> Life and Work, Vol 2, page 55-56

<sup>34</sup> Great Pyramid Passages, Vol 1, 1923, page 376

Beyond this grouping of unusual masonry, the Edgar's report; *"Following these uniform sets of stones, are two long stones in each course, averaging about six feet in length, after which each wall is built in one course only, apparently as far at least as the drop in the floor of the passage; but beyond this, on to the Queen's chamber, the very thick and hard incrustation of salt which entirely covers the walls of this passage, made it impossible for us to locate the joints with any certainty."*<sup>35</sup>



*Image courtesy of J.D.Degreef*

In the image above we can see some of the unusual wall masonry and the alignment of the joints; at some 41.25 inches long, this would equate to two cubits. M&R had the same problem as the Edgar's in not being able to determine the masonry layout beyond the step in the corridor due to salt incrustation, and they state that the Edgar's had made an error in their plate IX (page 5) in that they draw only one pair of long blocks in the wall, when there are two, each 1.83m long.<sup>36</sup> And if that is not confusing enough, we have Dormion's fig 20 in his work which shows a different layout again.<sup>37</sup> Here, they show only the one pair of long blocks as per Edgar's plate IX; however on the west wall a further pair of small blocks some 89.3cm (35.16 inches) follow these, and then the rest of the passage up to the step are singular blocks. On the east wall he shows the singular blocks starting after the long pair.

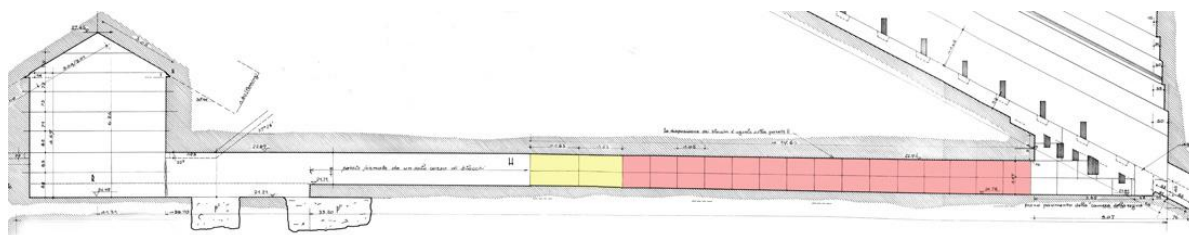
---

<sup>35</sup> Ibid, pages 376 & 379

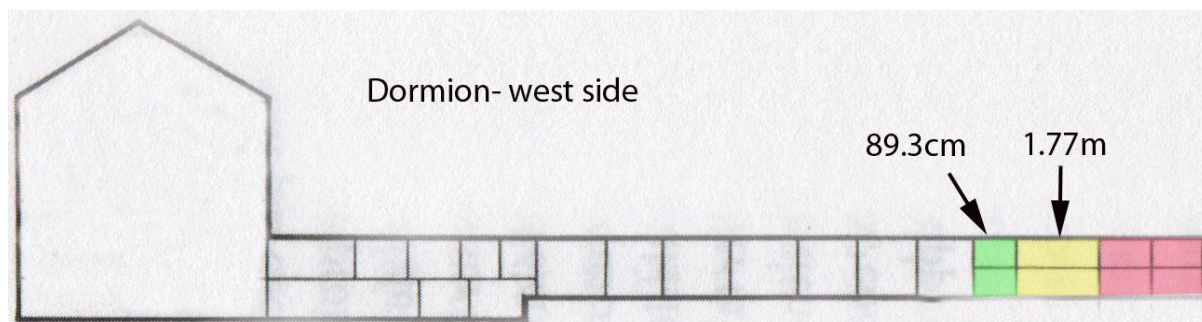
<sup>36</sup> L'Architettura Delle Piramidi Menfite, parte IV, page 40

<sup>37</sup> La Chambre de Cheops, 2004, fig 20, page 115

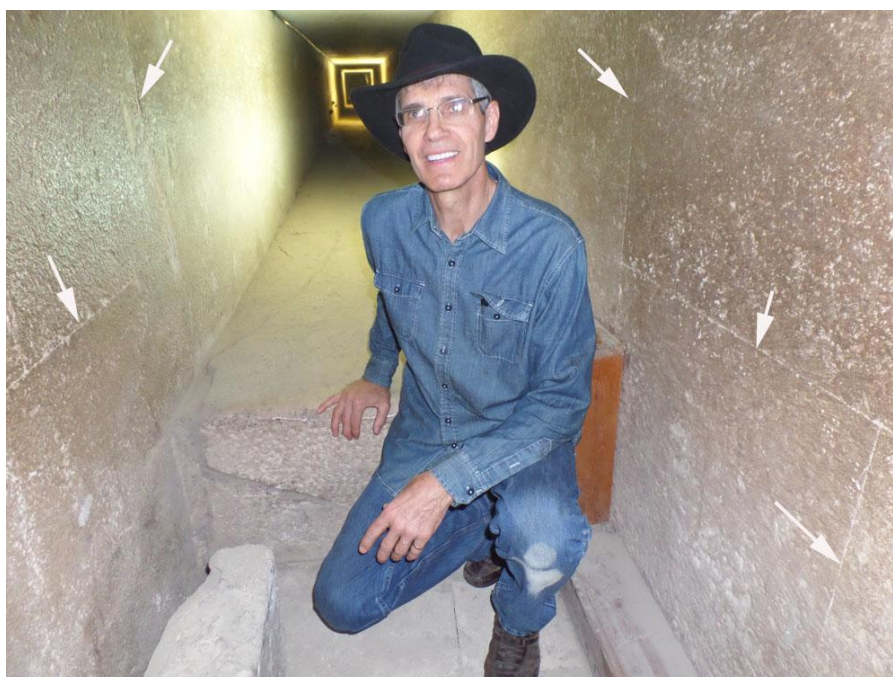




In the above drawing, a part of M&R's TAV 6, I have highlighted in red the 15 pairs of short blocks and the two pairs of long blocks in yellow. M&R give these as around 1.83m long (3.5 cubits?)



In the image above we can see the masonry layout for the west side according to Dormion's fig 20. Here, we only have the one pair of long blocks given as 1.77m long (M&R give 1.83m and two pairs of this length): Dormion would give the long pair on the east side as 1.865m. Only on the west side do we see a short pair of blocks follow the long pair, only 89.3cm long; after this the singular large blocks continue to the step, and beyond this the walls of the passage resort to two courses.



*Image courtesy of and starring Larry Pahl*

In the above image I have highlighted the joints which show the two courses of masonry after the step in the floor of the passage; modern cleaning and restoration of the passages allow these to be seen.



*Image courtesy of Larry Pahl*

In the above image we are looking north along the horizontal passage from the step. The width of the passage reflects that of the other main passages being 2 cubits wide. The floor of the passage itself is a mystery, being a fairly rough construct and not the “*more precious Mokattam stone, which forms the floor of all the other passages.*”<sup>38</sup> Indeed, Piazzzi-Smyth would record many holes left in this rough floor. It certainly gives the impression of a poorer quality foundation stone, similar to what we see in the floor of the queen’s chamber, and it appears that the walls of the passage rest on this stone. The form of the queen’s chamber floor was a concern for Petrie, who states;

*“But all round the chamber, and the lower part of the passage leading to it, is a footing of fine stone, at the rough floor level; this projects 1 to 4 inches from the base of the walls, apparently as if intended as a support for flooring blocks, which have never been introduced. It is to this footing or ledge that we must refer as the starting point; though what floor was ever intended to have been inserted (like the floor of the King’s chamber, which is inserted between the walls) we cannot now say. Certainly, a floor at the level of the higher part of the passage, would not reconcile everything; as that higher part of the passage, would not reconcile everything; as that higher floor is also not a finished surface, but has sundry round holes in it, like those in the chamber floor and elsewhere; intended, apparently, for use in process of building.”*<sup>39</sup>

Though in Petrie’s statement above, he thought flooring was not introduced, we cannot know this for sure. Inserted thick flooring such as we find in the king’s chamber, may have been fitted, though of fine limestone and not granite. The limestone pavement in comparison to granite is more easily broken up by searchers, compared to the large granite blocks found in the king’s chamber; but even there some small granite blocks have been ripped up. The problem as Petrie points out, is that any fine pavement which abutted against the step in the image above, would seem at odds with the unfinished nature of the horizontal passage floor.

Petrie does not give us much data on the horizontal passage, other than its length at certain points and level, and from this data the floor seems to drop slightly along its length; for example the level of the flat floor at the north end is given as 858.4 inches and some 1255 inches later by the step, the floor level is recorded as 854.6, or a fall of some 3.8 inches: he did not record the azimuth of the passage; neither does he provide any detailed data on the height and width of the passage.<sup>40</sup>

Likely the salt incrustation dissuaded him, and in any case Piazzzi-Smyth had already recorded some of these dimensions, which are shown on his table, overleaf.<sup>41</sup>

---

<sup>38</sup> Life and Work, Vol 2, page 60

<sup>39</sup> The Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 68

<sup>40</sup> Ibid, page 66

<sup>41</sup> Life and Work, Vol 2, page 59

Place in passage, by distance from North wall of Grand Gallery.	Breadth, near the			Height, vertical, and also in this case perpendicular to axis of passage.			Notes, February 20.
	Bottom.	Middle.	Top.	East side.	Middle.	West side.	
220·	40·61	40·84	41·16	46·58	...	46·64	
760·	...	40·96	...	46·16	...	46·16	
1270·	41·06	...	41·16	46·36	...	46·26	
1310·	...	41·36	...	69·0	...	68·5	Lower level of floor here; stones much broken and badly placed over an excavated hole. Roof stone is cracked over the entrance into Queen's chamber.
1516·	...	41·46	...	67·3	67·2	66·5	

The table shown left by Smyth are the limited data we have, and in difficult circumstances due to the salt incrustation and the rough nature of the floor. Smyth would suggest that the intended height of the passage may be related to the vertical height of the ascending passage or around 53 inches (the flat floor of the passage according to Smyth was some 6 inches above the doorway of the

ascending passage, and this added to the height of the horizontal passage of 47 inches would give us 53 inches).<sup>42</sup> Of course other options could exist, and likely the roof of the passage was intended to be on the same level as the roof of the ascending passage doorway. Given the variable range one could also suggest a height of 2&1/4 cubits or 2 cubits 2 palms (to reflect the perpendicular height of the ascending & descending passages; i.e. 63 digits versus 64 digits: now that the passage is cleaned, a closer inspection of the masonry dimensions might provide a better clue.

It would seem clear that a thick good quality pavement on the horizontal passage can be ruled out as it would severely restrict access through the passage. In the Bent pyramid the inclined passages had a square bore of 2 cubits and this could have been reflected also in the horizontal passage. If this was the case, and we take 64 digits as the unpaved height of the passage, then we are left with paving of 8 digits thick (2 palms or just under 6 inches). This thin paving of the horizontal passage would align with the thicker paving of the chamber; and as the step in the floor appears to be 1 cubit high, then any paving in the chamber would have to be 1 cubit 2 palms thick. Such a solution could satisfy Petrie's concerns on the nature of these floors; moreover, it might provide a solution to the extension of the ascending passage floor into the north end of the gallery (see part 1), as any thin paving could have blended into this also. Though this area is badly damaged, it need not necessarily mean that this extension received the butt ends of any bridging platform, as it could also have received paving. As shown in part 1, the northernmost pair of holes could hardly have any function in a bridging platform, and other solutions could have been devised to secure the platform at its north end.

Petrie would use tape as opposed to Smyth's rods to measure the length of the passage, and differences are apparent between the two author's; for example, Smyth would give 1303.3 to the step, whilst Petrie would find 1307, a

<sup>42</sup> Ibid, page 61

noticeable difference of 3.7 inches. Likewise, total length of passage to queen's chamber door, Smyth 1519.4, to Petrie's 1523.9, a difference of 4.5 inches. Indeed, one can see the accumulating difference in the tables of the two authors'.<sup>43</sup>



*Image courtesy of Larry Pahl*

In the above image we can see three capped pipes jutting out of the passages west wall. These holes were drilled by a French team in 1986 to help answer some anomalies picked up by a microgravimeter survey. Unfortunately I could not find any detailed data on the above drilling; some online articles suggest that two of the holes just drilled through masonry, whilst the third drilled into a sand cavity after a depth of some 2.6m. In the following year a Japanese team undertook a non destructive survey of the passage, which seemed to indicate cavities; they also analyzed the sand found in the cavity.<sup>44</sup> This sand appears unusual, in that it appears to be not locally sourced, but instead may have come as far away as the Sinai Peninsula. The sand is described as almost 100% quartz sand of large grain size.<sup>45</sup>

---

<sup>43</sup> For Smyth see page 57, in his Vol1, and Petrie see page 66 in his 1<sup>st</sup> edition

<sup>44</sup> Studies in Egyptian Culture No.8, Non-destructive Pyramid Investigation (2)

<sup>45</sup> Ibid, page 86-87

The sand might offer a clue on the cavities, for it seems an unusual find. The Egyptian's would be well versed in the properties of sand, be it for cutting, polishing abrasives etc, but also for masonry movement. Not all sand is equal and suitable for a particular task; for example, if we take the sand lowering devices often found in Middle Kingdom pyramids, some sands would be unsuitable in this task and would merely clog up and have to be dug out in order to lower the heavy lid. Other sands would be free flowing and more suitable for the task; however, we have no data on these sand lowering devices to analyze the sand used. In the Great pyramid, especially in monumental chambers such as the grand gallery, there may well have been particularly large blocks of masonry which had to be laid, and some may have been set in place by a controlled method such as sand. In using sand to control masonry, cavities or spaces may have been left at certain points for the sand to empty into and maybe this is what the scans are picking up on.

Lehner and Hawass would comment on these drilling operations and scans: *"However, the Great Pyramid is full of cavities. In this case the geophysical surveys probably detected empty spaces and sand fill between the fine, Turah-quality limestone casing of the Horizontal Passage and the rough masonry filling the pyramid core*

*The French team then approached the Supreme Council of Antiquities (SCA) with a new proposal to drill in the middle of the Queen's Chamber, where they thought lay a hidden chamber, but one of us (Hawass), together with Rainer Stadlmann, recommended that the pyramid should not be drilled simply to test theories."*<sup>46</sup>

Clearly no more holes will be drilled, but I have heard no more investigation on the sand found and its properties. Maybe it's worth at least reopening the existing pipes and re-examining this sand at least, for if it turns out to come from a more distant locale, we need to find an answer why.

One suggestion on the unusual masonry of the passage is one put forward by Dormion, who has put forward the idea that the pairs of blocks, 2 cubits long, would originally have been alternating magazines, similar to what we see in the 3<sup>rd</sup> dynasty pyramid of Sekhemkhet at Saqqara. These magazines, a bit like the teeth of a comb, would flank either side of the passage, and be protected by a horizontal grand gallery; but a change of plan, at an early stage, resulted in these magazines being filled with solid masonry, with their openings closed with pairs of 2 cubit long blocks (the magazines would be spaced 2 cubits apart, hence the unusual pattern).<sup>47</sup> There are some issues I have with this suggestion along with Dormion's idea that a hidden chamber might be found under the queen's chamber, but I don't want to divert too much from the guide, and the

---

<sup>46</sup> Giza and the Pyramids, 2017, page 150

<sup>47</sup> La Chambre de Cheops, 2004, Chapter VIII. This suggestion or variants of it was mentioned in the earlier work, Kheops: Nouvelle Enquete, 1986, see drawing on page 77.

reader can easily find more detail on Dormion's work from his publications. The three drill holes in the west wall of the passage, according to Dormion's Plan No 8,<sup>48</sup> are drilled through three pairs of blocks; the northernmost through a 2 cubit pair, the middle hole through a long pair, with the last hole going through the shortest pair, only 89.3 cm long. It would be interesting to have data on what they actually drilled through in these locations; for example, how thick are the fine Tura wall blocks; and what did they drill into beyond these, etc?

The horizontal passage certainly has unusual features; however, the conflicting data, and lack of detailed data, hamper investigations somewhat. As we can see from M&R's drawing on page 25, we also have significant searcher activity in the floor of the passage; such breaches can be very useful, as they give us an insight into the hidden areas of masonry construction; unfortunately, I could find no detailed data on these exposed areas.

### **The Queen's Chamber**



*Image courtesy of Jon Bodsworth*

---

<sup>48</sup> La Chambre de Cheops, 2004, page 288-289

In the above image we can see the horizontal passage enter into the north-east corner of the queen's chamber. One can notice the two courses of masonry which form the walls of the south end of the horizontal passage, continue into the chamber itself. Also visible is a roughly broken hole in the chamber's north wall; this was made by Waynman Dixon in 1872, during his discovery of the queen's chamber shafts. Above the doorway we have no massive lintel stone, such as we see in the king's chamber, which takes up two courses; instead the stone above the door is the same height as the others of the third course, and one can just make out a fracture which runs through this stone and the course above.

Also by the west side of the door an excess of stone has been left at this corner to protect it. Petrie would state; "*The projection on the western side of the doorway, mentioned by Professor Smyth, is really a surplus left on both sides of the corner; in order to protect the stone in transit and in course of building. This undressed part in the chamber, is cut away down to the true surface at the top and at the middle joint, in order to show the workman exactly to where it needed to be dressed in finishing it off. The excess in the chamber begins 1.3 below joint at top of doorway, and thence projects 1.4, with a width of 5.5; it is dressed away for 1.05 at the middle joint, and then continues sloping away rather thinner down to the floor. The projection into the passage is 1.5 maximum at base, usually .8; and it is 5.5 maximum width, or usually 4.5.*"<sup>49</sup> This would appear to be the only area of the chamber that is unfinished, apart from the questionable flooring.

The name 'queen's chamber' is a bit of a misnomer that has largely stuck over time; today Egyptology think that the chamber is more likely to be a Serdab: Lehner and Hawass would state; "*Many nobles' tombs had a roughly finished blind chamber, housing a statue of the deceased. And like Serdabs in other tombs, the floor and walls of this version in Khufu's pyramid were left slightly rough and unfinished.*"<sup>50</sup> I would question the unfinished nature of this chamber, as the jointing and laying of the masonry are quite superb, with the only unfinished area of the walls and ceiling is the aforementioned area by the door; moreover, as Petrie points out, the floor consists of rough core masonry:<sup>51</sup> we cannot discount fine paving having once been laid on top of this. Piazzis-Smyth would give his account;

*"The material of walls, roof, and niche, is a fine white limestone; the floor is ragged and uneven, and apparently merely the general masonry of the Pyramid, so that the room is in fact without a floor proper, and we are left to speculate where, in height, the upper surface of that would have reached. This peculiar condition of the chamber becomes all the more manifest on examining the structure of the walls; for they are not only not of the general masonry of the*

---

<sup>49</sup> The Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 69

<sup>50</sup> Giza and the Pyramids, 2017, page 149-150

<sup>51</sup> The Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 67



*whole building, but are in advance both as to whiteness, beauty of the material, and closeness of the joints to the lining of any of the passages yet inspected. The joints are so close, that the edges of the two surfaces of worked stone, and the filling of cement between, are comprisable often within the thickness of a hair. This fact was noted chiefly on the west wall, where, too, the presence of cement in the vertical as well as horizontal joints was duly noted. Elsewhere there is a difficulty in recognising the joints, on account of the half-glazy coating of saline matter. This substance must be regarded as a modern exudation of the stone, for some letters scratched on the north wall, with date 1824, have now a raised outline in the salty matter around and upon them. The saline matter was also seen filling a fissure apparently formed by injurious pressure in the west wall. In one or two places small portions of the original surface of the wall stones appeared, and bore traces of having been once exquisitely smoothed and finished.”<sup>52</sup>*

Today, the chamber walls etc have been cleaned and restored; gone are the soot stain walls covered in various graffiti, and the salt issues addressed with humidity controls. This chamber is normally not accessible for tourists, unless your part of some private tour group.

Though a Serdab has been suggested, the function of the chamber is largely unknown; some would suggest that it was originally planned as the king’s chamber, but abandoned when a change of plan took place to locate the chamber higher in the superstructure. Edrisi’s account of the pyramid is interesting, and was mentioned by Petrie, who states;

*“It may be an open question whether the Queen's Chamber\* was not the sepulchre of Khnumu-Khufu, the co-regent of Khufu. Edrisi, in his accurate and observant account of the Pyramid (1236 A.D.), mentions an empty vessel in the Queen's Chamber; and that this was not a confused notion of the coffer now known, is proved by his saying that in the King's Chamber “an empty vessel is seen here similar to the former.” Whether any fragments of a coffer remained there, among the great quantity of. stone excavated from the floor and niche, it is almost hopeless to inquire, since that rubbish is now all shot away into various holes and spaces. Caviglia, however, did not find a coffer when clearing the chamber, but fragments might have been easily overlooked.”<sup>53</sup>*

Edrisi’s account of a second sarcophagus cannot be dismissed lightly, for we only have to look at the inside of Menkaure’s pyramid, where we find the decorated sarcophagus in the lower granite chamber, and yet in the larger upper chamber we have a pit sunk in the floor, which has every appearance of being a sarcophagus pit.<sup>54</sup>

---

<sup>52</sup> Life and Work, Vol 2, pages 62-63

<sup>53</sup> The Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 216-217. \*These names, King's and Queen's, were given by the Arabs, in conformity with their custom of making the tombs or niches for men flat-topped, and those for women with a sloping gable roof.

<sup>54</sup> See my Menkaure guide. I have touched on dual sarcophagus in my Bent pyramid guides.

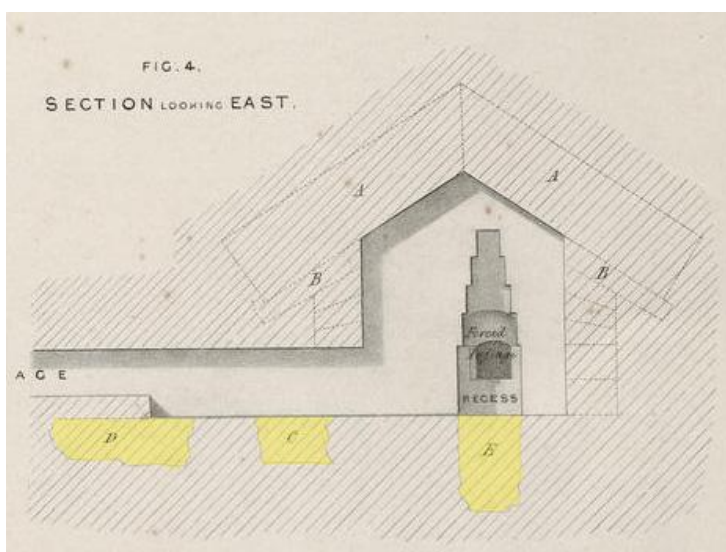
Edrisi's early account is quite brief, and it's a pity that more information was not forthcoming on the condition of the chamber; i.e. was there a pavement and what searcher activity if any, existed? Greaves account of the chamber some centuries later during his travels of 1637-1640, shows more a scene of destruction, he states;

*"This leadeth (running in length upon a level an hundred and ten feet) into an arched vault, or little chamber; which, by reason it was of a grave-like smell, and half-full of rubbish, occasioned my lesser stay. This chamber stands east and west; the length of it is less than twenty feet, the breadth about seventeen, and the height less than fifteen. The walls are entire, and plastered over with lime; the roof is covered with large smooth stones, not lying flat, but shelving, and meeting above in a kind of arch, or rather an angle. On the east side of this room, in the middle of it, there seems to have been a passage leading to some other place."*<sup>55</sup>

It's difficult to obtain a clear picture of the destruction inside the queen's chamber, and who is responsible for any particular searcher activity, as numerous people have been in and out, clearing debris or digging anew. Caviglia, along with Howard-Vyse and Perring have undertaken operations in the chamber, and as Greaves description above shows, they were not the first to dig in this chamber. Piazzzi-Smyth who would arrive at the pyramid long after the above gentleman had left, would give his description of the chamber;

*"So in our way out, we merely stopped a few minutes to look in at the Queen's chamber, and take note of a monstrous quarry-hole in the eastern side of the floor, under the strange niche in the wall, and a huge heap of stones and rubbish in the north-west corner, rising nearly a third the height of the room:"*<sup>56</sup>

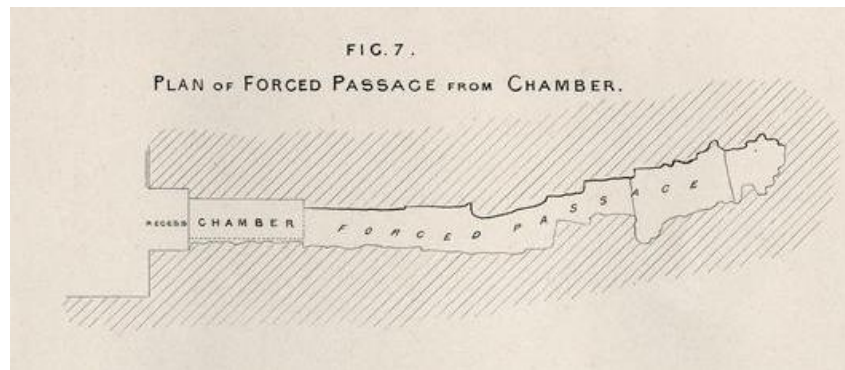
Smyth would eventually clear all the debris from the chamber, and likely some of it went in to fill the monstrous quarry hole.



From Perring's fig 4, I have highlighted the excavations made in the floor of the passage and chamber floor. The monstrous quarry hole mentioned by Smyth is the one under the niche. The largest excavation is that carried out in the rear wall of the niche, and this is probably the passage referred to by Greaves.

<sup>55</sup> Pyramidographia, 1646, page 640

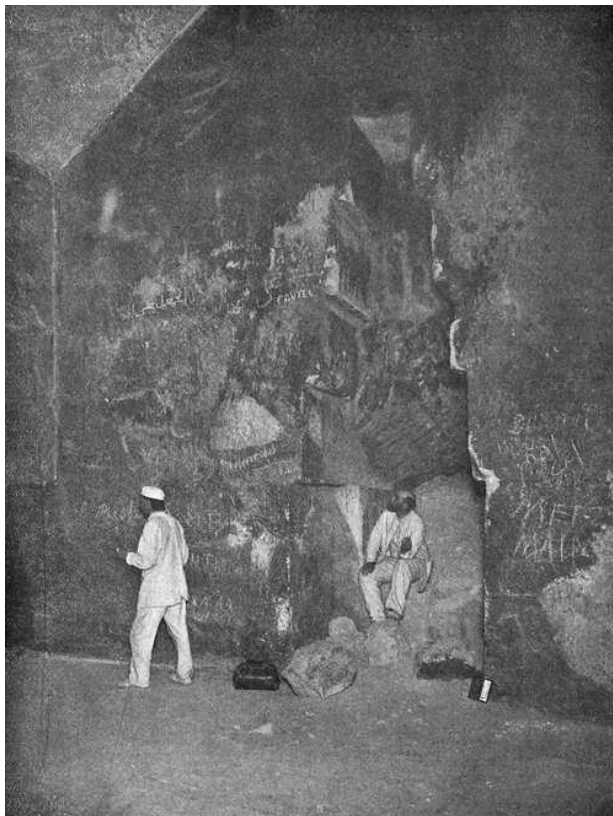
<sup>56</sup> Life and Work, Vol 1, page 92



In Perring's Fig 7 above, we have a plan view of the excavation carried out in the back of the niche; on these excavations, Perring would state;

*“From the recess at the east end of the Chamber is a forced passage (Fig. 7) extending 50 feet eastward into the Pyramid. The excavations C and D in the horizontal passage had been made some years before, and filled in again, it is supposed, by Mr. Caviglia, and were subsequently reopened, and carried to a much greater extent particularly under the stone that forms the step by Colonel Howard Vyse, who also made the excavation E near the recess in the apartment.”<sup>57</sup>*

A sizeable tunnel such as above would generate a lot of debris, especially when we take into account the greater cubic amount required to store it due to bulking.



In this early image by the Edgar's we can see one of the brother's sitting on the debris inside the niche of the chambers east wall; the other figure is facing the chamber doorway. The niche is carefully constructed and has a depth of 2 cubits in the wall. Its widest part at the base is 3 cubits, and it maintains this width up to the top of the doorway, wherein we have a series of corbels, each a quarter cubit wide, which reduces the width of the niche at the top to 1 cubit. The favoured suggestion for this niche is that it would have held a statue.

<sup>57</sup> Pyramids of Gizeh, Part 1, The Great Pyramid, Plate VIII, page 3



*Image courtesy of Jon Bodsworth*

In the above image we have a more modern image from a similar viewpoint; indeed, one can still make out some of the graffiti above in the earlier Edgar image. This blackness of the walls, caused by numerous torches and the like, was reported by early explorers, though today, restoration efforts have cleaned all this dirt away. The debris on which Edgar sits has been cleaned away and a grill fitted over the forced tunnel in the back of the niche, which extends back some 15.30m.



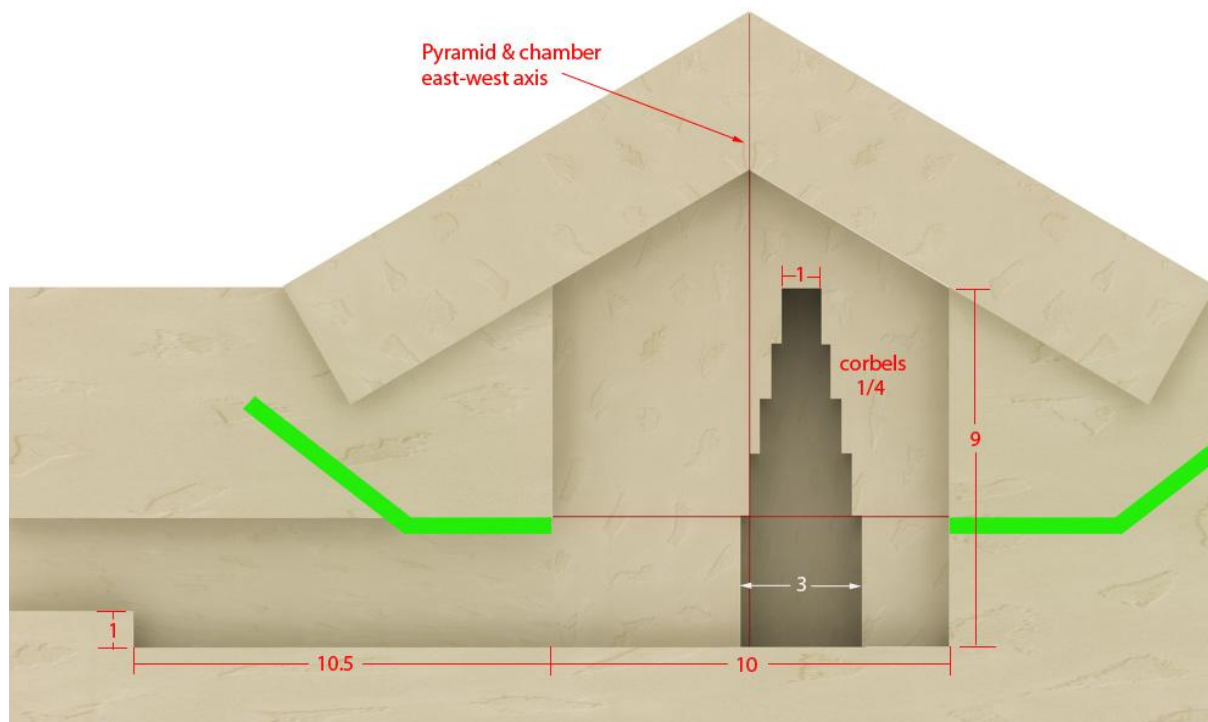
*Image courtesy of Larry Pahl*

In the above more recent image, we can see that cleaning of the walls had been finished. One can just make out a fracture that runs practically the full height of the niche, in the masonry between the doorway and the niche: note also the rough nature of the floor.



*Image courtesy of J.D.Degreef*

In this view we can see that the niche is not centered in the east wall, but from the measures collected by Piazzzi-Smyth and Petrie, the niche appears to have been purposely placed mostly to the south of the chambers E-W axis: this axis also being determined by Petrie to agree with the pyramids E-W axis. This means that that the upper four corbels reside in the south half of the pyramid; whilst the bottom space being 3 cubits wide has 2.75 cubits placed to the south, and .25 cubits placed to the north. Also visible in the above image, is a dark area on the south wall, which is the opening for the southern shaft.



From the data provided by Petrie and Piazz-Smyth the above schematic of the chamber is based on cubits. The green areas highlight the position of the shafts, and show how the uppermost part of the horizontal section aligns with the passage roof line. The passage roof line along with the east-west axis of the chamber appear to neatly separate the upper 4 corbels, from the portion of the niche below the passage roof line. The width of the chamber is 10 cubits, whilst the E-W length of the chamber is a cubit more at 11 cubits. The height at the wall seems to be 9 cubits, whilst the ceiling apex would appear to be 3 cubits higher, at 12 cubits. This suggests that whole numbers of cubits were used for the layout of the chamber, being 9, 10, 11 & 12 cubits. Petrie would describe several theories on the intended dimensions for the chamber; but would describe the above cubit scheme as the '*simplest theory of all*'.<sup>58</sup>

Petrie would also note that the vertical axis of the niche was some 80 cubits from the north wall of the gallery, or 2/5ths of the length of the descending passage.<sup>59</sup> A possible connection to Petrie's 80 cubit distance is the observation made by Dormion, who would suggest in his drawings that the end of the 2 cubit long pairings of masonry in the horizontal passage, from the gallery's north wall would be half of 80 at 40 cubits; though I have no accurate data to check this.<sup>60</sup>

<sup>58</sup> The Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 192

<sup>59</sup> Ibid, page 188-189

<sup>60</sup> The Edgar's report that the symmetrical masonry runs for some 64 feet, from the beginning of the roof at the grand gallery end (see vol 1, page 376) to this we add 200 inches for the gap to the gallery north wall, for a total of 968 inches (about 47 cubits). This distance would incorporate the longer stones which follow the long section of 2 cubit pairings, and which are uncertain. However, they state that there are 15 of these 2 cubit pairing's in the passage; so if we use 20.64 for the cubit this gives us 619.2, to this we add 200 for the gap, and

This niche axis would attract the attention of pyramidologists who sought for evidence of a sacred 25 inch cubit, and this they managed to do by calculating the distance from the chambers E-W axis and the vertical axis of the niche. Though this distance can also be simply described as 1&1/4 cubits, which would work out as about 25.8 inches for a cubit of 20.64 inches. Indeed, Petrie who was well versed in pyramid theories, and was aware of the importance placed on the niche, would thoroughly measure the niche and state; *“This cubit is the regular cubit of 20.6 inches, and there is no evidence of a cubit of 25 inches here.”*<sup>61</sup>

The uppermost four corbels are not of the same height and vary somewhat, the lowest corbel having a mean height of 31.79, whilst the uppermost had the lowest value of 27.70 inches.<sup>62</sup> The widest part of the niche had a mean height of 67.14, whilst a joint level which signaled the top of the doorway is given a mean of 67.44 inches. M&R would report;

*“The walls of chamber are formed of very large limestone blocks: the heights of the courses differ sensibly and also from one side wall to the other so that the joints do not always meet in the chamber corners. These differences, however, are always less than 2 cms. and the mean difference is about 6 millimetres. The walls were well dressed and flat with very thin joints filled with mortar. Today the walls show many fissures and the blocks are, at times, quite extensively flaked.”*<sup>63</sup>

When it comes to the floor of the chamber, M&R would state;

*“As mentioned above, the actual pavement is very rough as it is composed of the nucleus masonry. On it can be noted the levelling cuts characterizing the preparation of rock or masonry for the superimposing of a course made of slabs or blocks having unequal thicknesses. This seems to indicate that here a pavement made of at least one course of white limestone slabs was laid. At the general level of the rough pavement, along its sides and those of the southern part of (H-Horizontal passage), we noticed a kind of footing or ledge made out of fine stone and well dressed. It juts out from 2.5 cms. to 10 cms. from the walls and it has always been used as the starting point for measuring all the heights in the chamber. It appears evident to us that a real pavement was inserted in chamber (R-Queen’s chamber) and, contrary to Petrie’s opinion, we think it must have had the same level as the northern and higher part of the (H) pavement.”*<sup>64</sup>

---

judging from their drawing on page 21, we could add a further 6 inches, for the start of the first pair in the passage, for a total of 825.2 inches, which divided by 40 gives 20.63; which is a good approximation.

<sup>61</sup> The Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 70; see also page 193

<sup>62</sup> Ibid, page 70 (Smyth Vol II, page 67) gives slightly different measures; the most notable being the upper corbel, which he gives as 29.4, compared to Petrie’s 27.70

<sup>63</sup> L’Architettura Delle Piramidi Menfite, parte IV, page 42

<sup>64</sup> Ibid, page 42





*Image courtesy of J.D.Degreef*

In the above image we can make out some of the levelling cuts mentioned by M&R. That these cuts exist, rather suggests that some flooring was fitted to the rough core masonry, as each floor stone was likely unique in shape and requiring some adjustment to the rough core masonry. We have no surviving fine flooring today, but that in itself does not mean that flooring was never fitted. In Khafre's burial chamber for example, fine limestone paving once covered a significant portion of the chamber floor, which was largely intact when Belzoni discovered it; however, Perring would rip up this floor in his search for a hidden chamber, and it is sadly now lost; an event which is fairly modern. So the fact that no flooring exists in the queen's chamber, can be explained in a similar way, and was likely ripped up by searchers.

Other than the cuts above, are there any other clues which could help restore the original floor level? M&R would suggest a level commensurate with the step in the passage floor; or paving about 1 cubit thick: an idea that Petrie had difficulty with, due to the similar rough nature of the horizontal passage floor. M&R would oppose the use of thin flooring slabs for this passage, as no such thin slabs exist elsewhere in the pyramid.<sup>65</sup> This I feel is a weak argument, as most of the passages in the pyramid are inclined, and subject to heavy traffic such as plug stones for instance; the horizontal passage, would be more subject to light traffic and could have utilised thin slabs to cover the rough floor, and create a square bore of some 2 cubits.

---

<sup>65</sup> Ibid, page 124, obs 22.

For more clues we could look at the king's chamber which still largely retains its flooring; no doubt due to its granite material. However, we have a major problem in the king's chamber in trying to determine the architect's intent for this floor. The king's chamber pavement consists of sizeable granite blocks inserted between the walls; however, their upper surface is not level with the base of the granite walls, but is placed at a certain level above the base. This feature gives two heights for the chamber, the first being the five equal courses of granite, and the second, the shorter height from the paved floor. This second height is more difficult to determine due to the irregular level of the pavement, which could vary 2.29, from 42.94 to 40.65 inches below the first course joint; but from the mean of his measures Petrie suggested that the simplest theory for the height was that the pavement level was to be placed a quarter of a cubit above the base of the walls.<sup>66</sup>

Petrie would make the following reasoned attempt on the height of the paving in the queen's chamber. He would suggest that the upper surface of the paving would be at half the height of the base of the king's chamber walls. The base of the walls was intended as 1688.5 above base and so half of this, 844.2 should be the paving height; however the rough floor of the queen's chamber is given as 834.4 above base, and therefore paving some 9.8 inches thick would be required. Moreover, these 9.8 inches subtracted from the apex height of the queen's chamber would equal the height of the five courses in the king's chamber.<sup>67</sup>

Petrie's solution like M&R's leaves the rough horizontal passage floor, with the holes in it, which seems at odds with the fine grandeur of the structure. His solution would still leave a step in the floor, albeit now half the height than before. This step seems out of place when the convention was for passage floors leading to the chamber to be on the same level, such as we see in the king's chamber, here one has to stoop quite low as the passage height is only about 1.11m; though it may have been originally intended to be 2 cubits high to match the width of the passage.<sup>68</sup>

The above example highlights the difficulty in trying to determine the architect's intentions, especially when the range of measures is quite varied, and many theories might fit inside its range of variability. I have come across

---

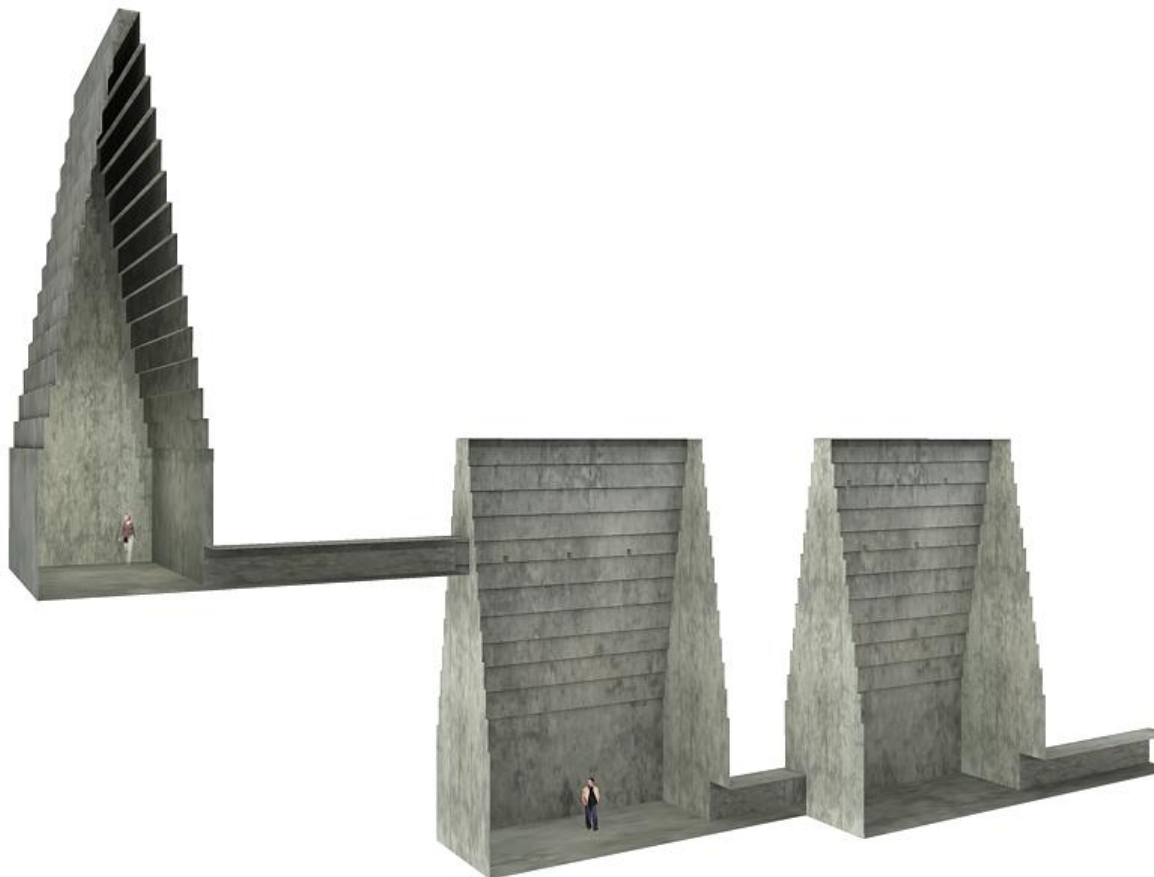
<sup>66</sup> The Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 82; see also page 195

<sup>67</sup> Ibid, page 187

<sup>68</sup> This low passage through the antechamber to the king's chamber is quite irregular like the chamber floor, with no two stones aligned, and like the chamber they are inserted between the walls. If we accept that the first course was intended to be 64 digits high, with the floor  $\frac{1}{4}$  cubit above this, then the passage height would be some 57 digits or some 42 inches or 1.07m (for a cubit of 20.63 inches). This vertical height is close to 2 cubits and may have been intended to be 2 cubits high. The irregular nature of the floor is such that the  $\frac{1}{4}$  cubit suggestion by Petrie for the floor level above the wall base, could just as likely be intended as 2 palms, which would mean that the passage height would be 2 cubits, the same as its width.  $\frac{1}{4}$  cubit or two palms is only a difference of one digit, or .73 of an inch, in a floor that varies up to 2.29 inches.

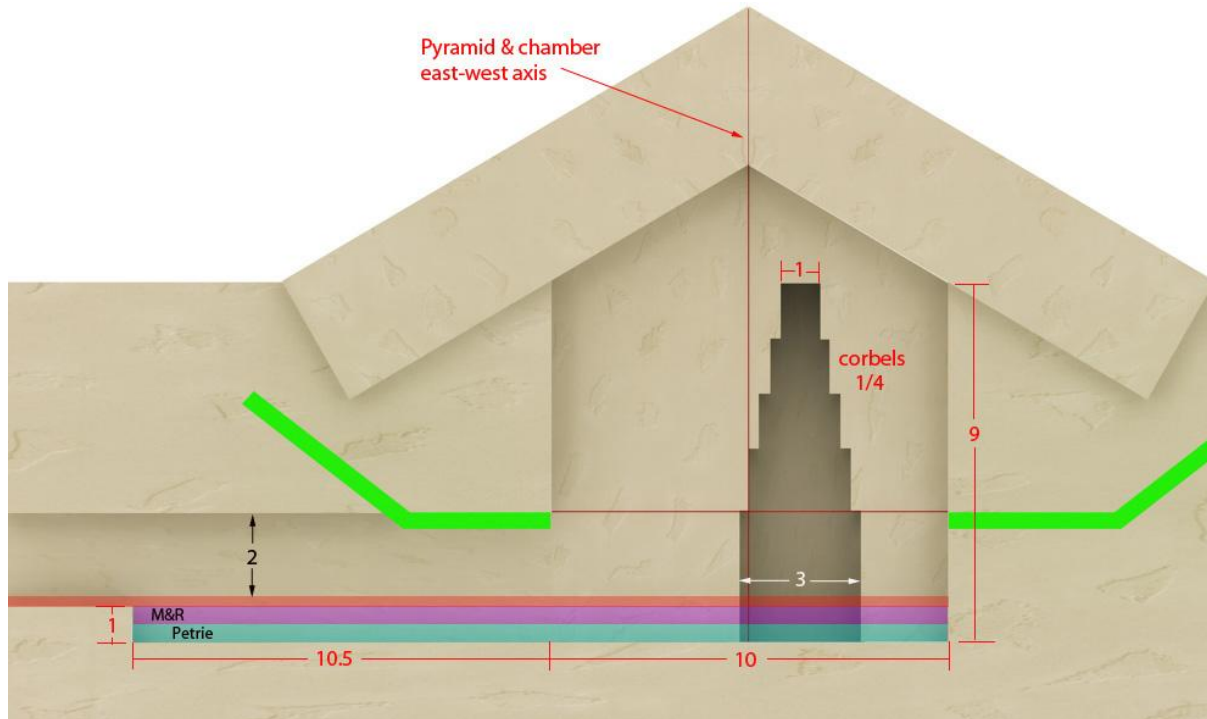
theories that show dimensions to 10 decimal places; with many purporting to be the correct solution, but too often we seem to resemble a dog chasing its tail.

Returning to the horizontal passage, as previously mentioned is its height 2 and one quarter cubits (63 digits) or 2 cubits 2 palms (64 digits)? For a cubit of 20.63 inches this would be either 46.4 or 47.2 inches: compare to Smyth's table on page 28. We also have to factor in the cubit used by any individual tradesman, and the care they choose in enacting the plans of the architect; for example, let us take Petrie's mean chamber width for the east wall of the queen's chamber, which he gives as 205.68: would anyone doubt that this was intended as 10 cubits? Clearly if the work is accurately carried out, it might suggest a cubit rod of 20.57 inches; likewise the chambers mean length of 226.47 would give 11 cubits of 20.59 inches. This does not mean that this was the length of the cubit rod used, as other factors need to be taken into account; but it shows the difficulty in trying to recover intended dimensions, in often damaged structures.



We could take a look at the pyramid built prior to the Great Pyramid. The Red Pyramid built by Sneferu at Dahshur could be classed as a Giza class pyramid, and the above view gives a view of the chamber layout. Here we have two lower chambers orientated N-S, whilst the larger upper chamber is orientated E-W. It is in this pyramid that we first see the descending passage size which would become a common standard at Giza. It is to be noted that the horizontal

passage which leads to the upper chamber is 2 cubits wide by 2 cubits high.<sup>69</sup> So here we have a precedent of a horizontal passage with a square bore of 2 cubits leading to a major chamber, and so it's not unlikely that such a design could be used also at Khufu's pyramid.



In the above schematic I have highlighted Petrie's and M&R's suggested pavement levels along with the pavement level left by a 2 cubit square passage as seen at the Red Pyramid. This solution would cover the rough pavement of the horizontal passage which has concerned many. If we take the thin paving of the horizontal passage as 2 palms thick and add it to the 1 cubit step in the passage, then we would have chamber paving thickness of 1 cubit 2 palms which would be 1/7<sup>th</sup> of the chamber wall height of 9 cubits.

The ceiling beams vary in width and consist of six pairs; the joint lines of each pair do not align but rather overlap. From Dormion's Plan No 9 the widest beams (E-W) is some 1.23m, with the narrowest visible beam being some 0.92m. There is not much data on the beams, even though Vyse made an excavation under the ceiling in the northwest corner; here, he excavated under the ceiling beam to discover its length behind the wall face, which he gives as 9 feet 10 inches. Petrie would give a more precise 121.6 inches or 3.09m, which is only slightly longer than the sloping length visible inside the chamber, where I have seen values range from 3.01 to 3.05m. Petrie would suggest that this; *"throws the centre of gravity of each of the slabs well behind the wall face, so*

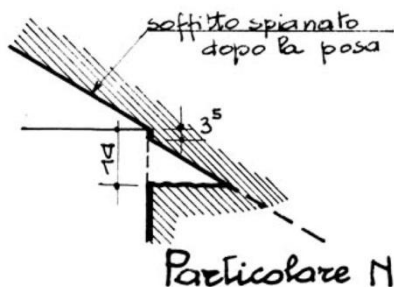
<sup>69</sup> This upper passage has had its floor cut down, but the fine finish of its walls clearly denote the original passage size. See TAV 19, in M&R's Parte III, Tavole, and my Red pyramid guide.

that they could be placed in position without pressing one on another.”<sup>70</sup> It is not known if further layers of beams have been placed above the visible ceiling, such as we see in some of the smaller Old Kingdom pyramids of the 5<sup>th</sup> and 6<sup>th</sup> dynasties.



*Image courtesy of Jon Bodsworth*

In the above image we can see the excavation in the northwest corner of the chamber; how far the ceiling beam extends beyond the end walls is unknown: Perring’s drawings seem to suggest that they extend beyond the end walls, and I suppose the masonry making up the tympana was fitted after the end beams had been placed.

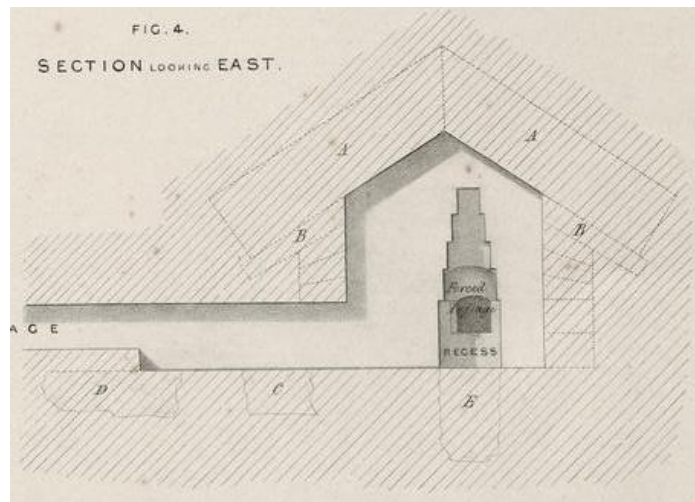


The section left is from M&R’s TAV 6 and indicates how the wall top meets with the ceiling beam. M&R state; “It seems that the beams were dressed together with the chamber walls some time after their laying, following the ancient Egyptian custom. In fact, along the top of the north and south side walls the roofing beams present a sharp offset jutting down for 2 - 3 cms. which can only be

*explained in this way.”<sup>71</sup>*

<sup>70</sup> The Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 69

<sup>71</sup> L’Architettura Delle Piramidi Menfite, parte IV, page 44



Given the considerable depth of the beams into the side walls, how was the wall masonry adapted to the slope of these beams. In Perring's drawing above we can see how he has some of the wall masonry inclining somewhat. Given that the excavation in the northwest corner extended far enough to determine the length of the beam, one would have thought that he may have observed how the wall masonry was fitted. We simply do not know if his drawing is accurate or what he believed. M&R would comment on it;

*“According to Perring, the laying beds of the courses making up the north and south walls are not horizontal but slant downwards starting with that of the fourth course. Instead, Petrie is rather explicit in this regard and in pl. IX of his volume « Pyr. and Temples, etc. », cit., the joints between the courses are all drawn horizontal except, naturally, that between the uppermost course and the butting beams as the upper faces of the blocks here were cut obliquely for fitting them to the slope of the beams. A direct control is impossible but anyway we prefer Petrie's version.”<sup>72</sup>*

I would hardly say that Petrie's plate IX is explicit; this is Petrie's cross section drawing of the pyramid, and as such the queen's chamber is drawn very small and quite schematic. But the above is yet another example of how little we know about the pyramid; surely in this day and age we should have detailed data on this excavation and the masonry which it cuts through.

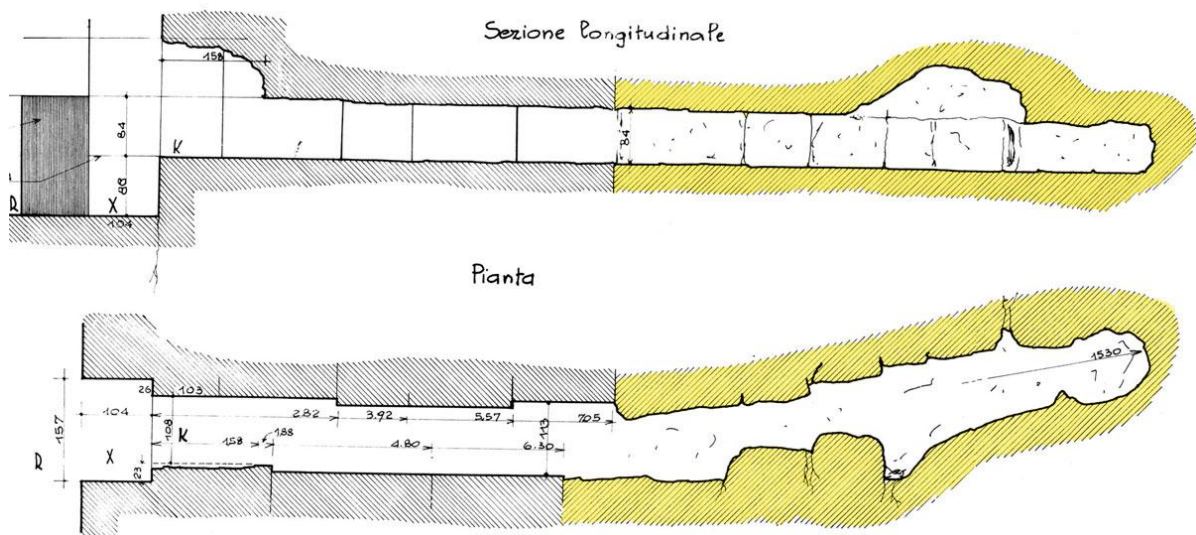
Another excavation in the chamber, namely the tunnel cut in the back of the niche is better recorded, and affords us a glimpse of the masonry which surrounds the chamber, M&R would state;

*“Upon a close examination of this tunnel we found that for about 6 - 7 metres, starting from the niche end wall, the masonry is composed of large well squared and dressed limestone blocks. Beyond these, there is the usual inner nucleus masonry made up of great blocks which are roughly dressed only on the horizontal faces: they have large vertical joints showing no presence of mortar.*

<sup>72</sup> Ibid, page 124, observation 25

The courses of this masonry seem to be regular enough and are about 1.00 m. high. Therefore, it seems that all around the chamber was built a special kind of masonry which was particularly laid and different from the rest. However, one cannot clearly distinguish a division between the two qualities of masonry as they are closely bonded and show no definite dividing face.”<sup>73</sup>

They would comment more on this breach in their observation 24; “It is quite probable that the violators made the tunnel visible today in the end wall of the niche because they found a block which was 1.08 m. wide, 0.84 m. high, 0.95 m. above the actual pavement and symmetrical with the niche sides there. This symmetry must have raised suspicions in the violators' minds and they removed the block by breaking the niche above and to the right of the block itself. As both these parts are damaged for a distance of 1.58 m., it may be that the block was 3 cubits long. After having removed the first block and seeing that the sides of the breach were well dressed and with thin joints, the thieves were even more convinced to have discovered a plugged corridor, and continued the breach for almost 15 metres before giving up the undertaking.”<sup>74</sup>



From M&R’s TAV 6 we have their section and plan of the tunnel from the niche; this is similar to Perring’s plan on page 35.<sup>75</sup> I have highlighted the area which is built of rough core masonry. Clearly a 2 cubit wide stone in the back wall of the niche could not escape the attention of even the most myopic robber. As we can see, the lintel above this opening has been severely cut away by the robbers; possibly to aid in extracting the closing stone. Dormion would state that the section through the good masonry was purposely made; indeed, he states; “Finally, the entire ceiling forms a lintel, an arrangement which has

<sup>73</sup> Ibid, page 44

<sup>74</sup> Ibid, page 124, Observation 24

<sup>75</sup> Dormion has a plan, fig 57 & 59 in his work, which differs slightly from M&R’s; whose is more correct is anyone’s guess.

*practically no chance of occurring in a normal excavation*”<sup>76</sup> This neat ceiling arrangement did not appear to extend into the rough core masonry section. Judging from Dormion’s fig 59, we have two stones which form the ceiling for the fine masonry section of the tunnel, the first being 1.65m long, with the other being 3.37m long.<sup>77</sup> Dormion’s work appears to have the more detailed data and drawings on this area; though one would always want more data on this tunnel. But from the available data, the initial fine masonry section some 5m long certainly has the appearance of a built passage purposely left in the masonry, which would appear illogical.

Dormion would question the idea that the niche contained a statue, but would see it more as a weight relieving structure similar to the corbelled window above the shaft at the Meidum pyramid. This along with the passage left behind the niche would relieve weight for a hidden passage/chamber under the queen’s chamber.<sup>78</sup> I am not convinced that a hidden chamber exists under the queen’s chamber, and it is possible that a statue could have occupied the niche. The niche itself could have been centered in the east wall, but for some reason it was displaced mostly south of the pyramids E-W axis, and maybe there was some symbolic reason for a statue to be placed in the southern half of the pyramid. The fine masonry section behind the niche appears to be left in the masonry as the surrounding masonry of the queen’s chamber was built up, to leave a narrow passage to the chamber. Given the limited data on the chamber it’s difficult to visualise how they went about constructing it, the placing of the beams etc; but I can imagine a situation arising were access to the chamber via the horizontal passage was not possible at some stage of construction, and so it may have been beneficial to have another temporary access passage to the chamber during construction. This temporary passage would be deliberately left in the fine masonry surrounding the chamber as it rose and used by the workers to gain access to the inside of the chamber during construction. Once the chamber’s horizontal passage was opened and available for the workers, this temporary passage behind the niche was superfluous, and likely closed with masonry, only to later attract the keen eyes of robbers who dug in vain for some treasure.

The last items to look at in the chamber are the two shafts discovered by Dixon in 1872. These shafts along with the king’s chamber shafts are sometimes referred to as air shafts or star shafts, but frankly their function is largely unknown. Whereas the shafts in the King’s chamber appear to have been left open in the walls of the chamber, this is not the case for the shafts in the queen’s chamber. Taking clues from the locations of the shafts in the king’s chamber, Dixon found the mouths of the shafts in the queen’s chamber obscured by a

---

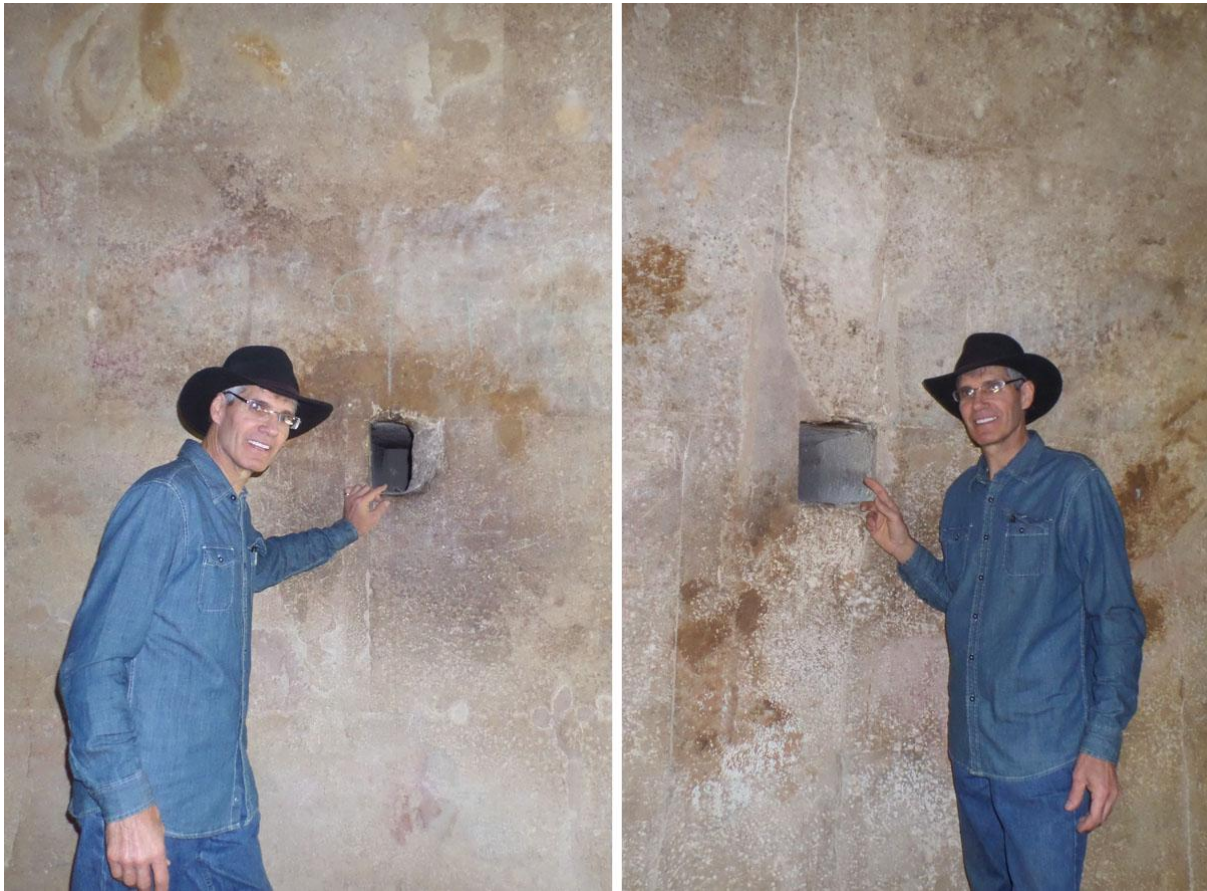
<sup>76</sup> La Chambre de Cheops, 2004, page 240

<sup>77</sup> Ibid, page 241, measures for south wall, north wall joints are given as 1.53 and 3.32m

<sup>78</sup> Ibid, see chapitre XIV

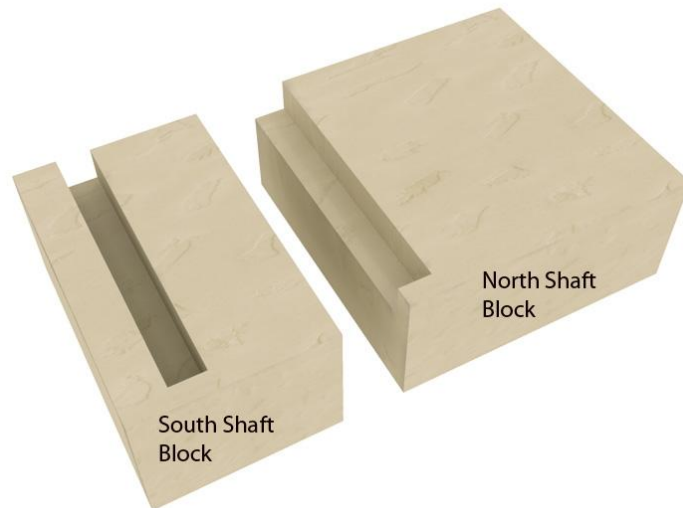


stock of stone deliberately left in the wall masonry. It's important to note that the shaft was hidden behind a stock of stone left in the masonry and not behind a stone patch.



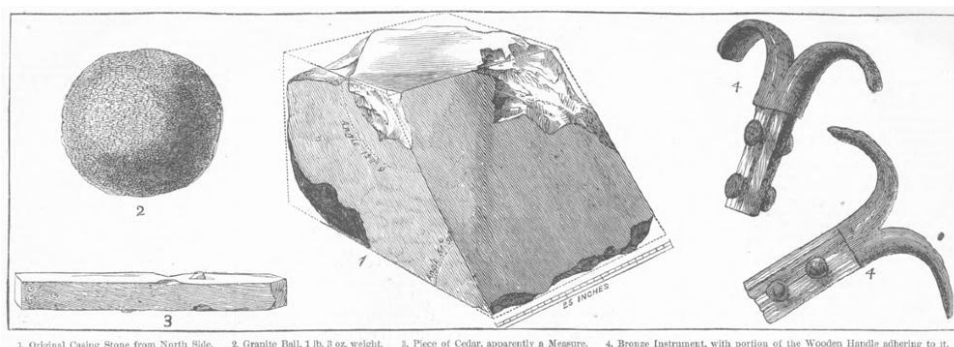
*Image courtesy of and starring Larry Pahl*

The above image shows the partially opened shaft of the north wall, whilst the opening in the south wall is more opened and regular. In the north shaft the creation of the shaft in the wall block was slightly easier for the mason's as two sides of the shaft aligned with joint lines; whereas the southern shaft is a trough cut in the wall stone with only the upper side aligned with a joint. The bore of the shafts is similar to the King's shafts; Petrie gives the north shaft as 8.6 high by about 8 inches wide (21.8 by 20.3 cm), with the south shaft as some 8.8 inches high. According to Petrie the north shaft runs some 76 inches (1.93m) before its turn upwards; whilst the south shaft runs for 80 inches (2.03m) before its turn. The amount of stock left in the masonry block to conceal the shafts was about 5 inches.



If we could pull the masonry blocks out of the wall we would see something like above. Clearly the stock of stone left on the front face of the wall blocks is of interest, and begs the question why was it done? Was it always the intent that these shafts be concealed? If the pyramid was a unified plan was it a backup plan in case the king died early and the upper chamber was not complete; they could then cut through this stock and enable the shafts to perform their function: whatever that was. Indeed, one wonders why the shaft was not left open in the chamber, as the termination of these shafts is well above the ceiling of the king's chamber; why not leave them open to help ventilate the chamber for the workers; moreover, any items which accidentally fell into the shaft be it debris or tools, had a chance of being recovered at the lower end. If the intent was to seal the shaft why not just fit a close fitting stone patch in the wall? The questions could go on.

When Dixon broke into the shafts, he found a few artefacts; how and where is not so clear, but a drawing of them appeared below in Harpers Weekly (January 11, 1873).



1. Original Casing Stone from North Side. 2. Granite Ball, 1 lb. 3 oz. weight. 3. Piece of Cedar, apparently a Measure. 4. Bronze Instrument, with portion of the Wooden Handle adhering to it.

The artefacts consisted of a small dolerite ball, a copper hook, and a fragment of cedar wood. Zahi Hawass would state;

*“We are still uncertain as to what specifically Dixon found inside these air-shafts. We do know, however, that he unearthed a copper implement often described as a hook. It was located at the bottom of the southern shaft's entrance (QCS) among much debris. Dixon also pulled out a wooden shaft and a granite ball, often described as a sculptor's tool, from the bottom of the northern shaft (QCN), where he found it hidden amongst a small amount of debris.”*<sup>79</sup> (The reference for this information is given by Hawass as Romer-The Great Pyramid, 2007, page 383-384; however, this data is not present. But it can be confirmed in an edition of Nature, dated Dec.26, 1872, page 146-147 which describes Dixon's discovery. It is often assumed that all three items came from the north shaft, but the article seems clear that the copper hook is from the south shaft; this places a question mark that the piece of wood may be a handle for the hook.)

These three items are often referred to as the Dixon relics. The most interesting relic for some was the wooden fragment, due to the fact that this could be carbon dated. This wooden fragment was only rediscovered by Abeer Eladany in an Aberdeen university in 2019, and subsequent carbon dating of the wood suggested that it was some five centuries earlier than the supposed dating of Khufu's pyramid. This in itself is not so unusual, as other carbon dating studies in Egypt have produced similar results. This is often explained as wood from the centre of a long lived tree, or recycled wood etc. Carbon dating often has a large plus or minus date range, and to this we can add the uncertainties of Egyptian chronology itself, with the current best estimate that Khufu ascended the throne around 2590BC. Given the uncertainties in carbon dating and Egyptian chronology, should the dates really surprise us in an era some 4500 years ago. The wood being found in a sealed shaft is clearly contemporary to the construction of the pyramid, and this is why so much interest has been shown in the past to finding the relic so it could be dated. Now that it has been dated, it will come as a disappointment to those who see the pyramid as a much older structure from some lost civilisation.

Early explorers had limited means to explore these shafts, other than by inserting rods through the shafts in order to determine their limits. Some of these rods still exist in the northern shaft, stuck fast as explorers tried to push them through the bends of the shaft. The northern shaft has quite a convoluted route in order to avoid the masonry of the grand gallery, whereas the southern shaft forms a relatively straight line.

Between 1992 and 1993 the Upuaut project led by Rudolf Gantenbrink would explore the shafts using a small robotic rover; however, only a lower portion of the convoluted north shaft could be observed by the rover (The remainder of the shaft could not be observed until 2002, when a new team from

---

<sup>79</sup> CASAE 43, 2014, The so-called secret doors inside Khufu's pyramid, page 53

National Geographic, with their pyramid rover finally completed the journey to the shafts end).

Our best view of the shafts and their construction comes from Gantenbrink's work; he would create a website and provide an impressive amount of information on his discoveries, along with providing detailed CAD drawings; unfortunately Gantenbrink's website no longer exists.<sup>80</sup>

The major discovery of Gantenbrink's rover was at the end of the southern shaft; here his rover came across a fine piece of limestone with copper fittings, which closed the end of the shaft (a similar stone with fittings was also discovered at the end of the northern shaft in 2002 by the National Geographic team).

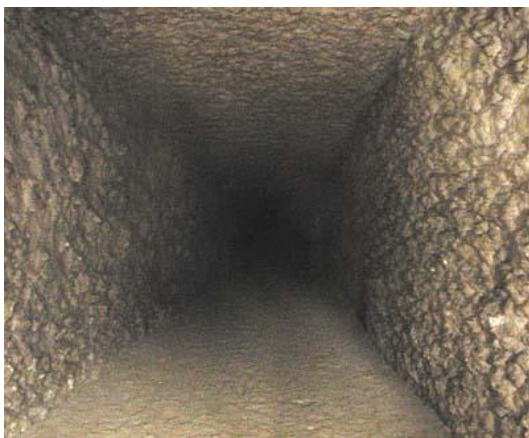
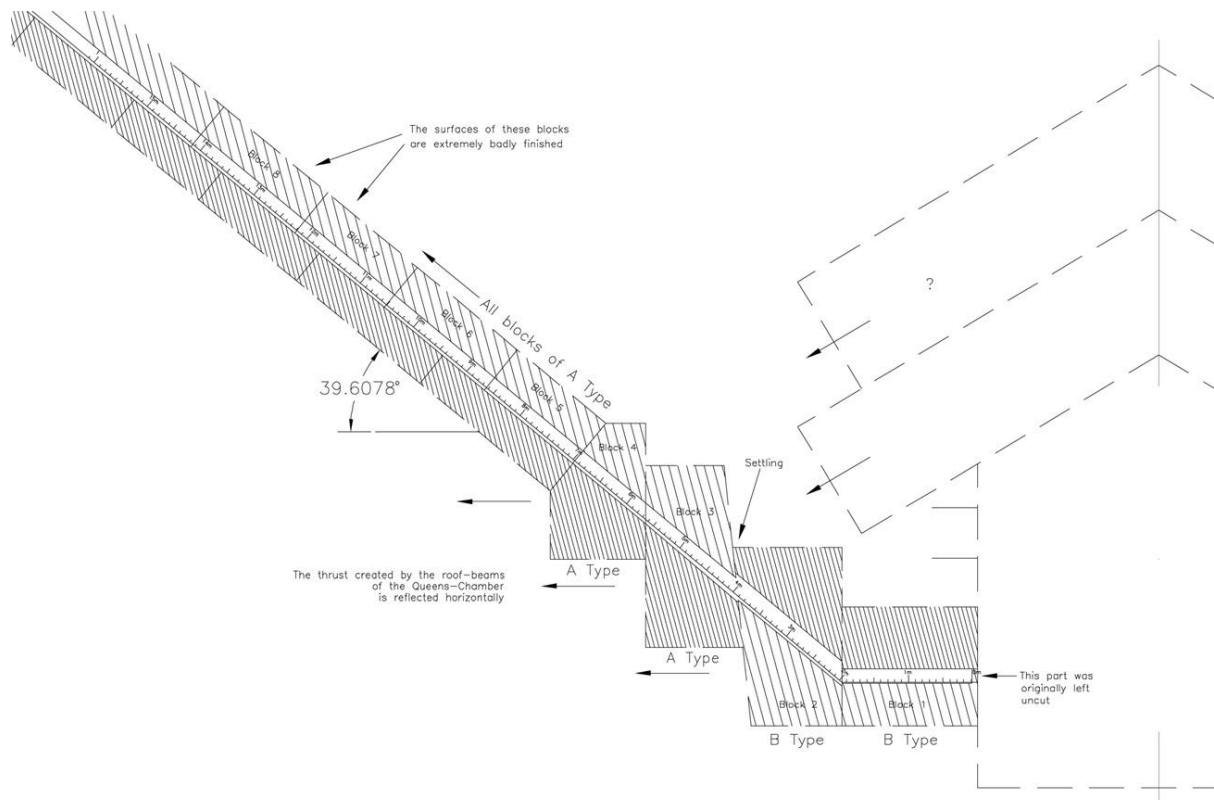


From Gantenbrink's website we can see the end of the southern shaft and the copper fittings, somewhat corroded, a piece had fallen off one and was found on the floor (it is reported to be at the end of block No 27). In 2002 the National Geographic team with their pyramid rover would drill a hole through this stone; but all that was found was a small space beyond and the back of what appears to be a core

limestone block. As we can see from the image, the limestone at the end of the shaft was noted by Gantenbrink to have been subject to a very fine finish. The construction of the inclined shaft is sort of inverse to the horizontal portion through the wall block, in that the ceiling and walls of the small shaft are cut out of a single block of masonry, and lay on top of a limestone block, which formed the pavement. The stone block by the closure stone is Block No 28, and Gantenbrink states; *“Block No. 28 is extremely well-crafted, smoothly polished and consists of a lighter-colored material than that of the other blocks. In some spots, including the ceiling just before the mysterious closure stone, very fine, dark-gray veins are visible in the stone, evidence of the material's high degree of homogeneity.”* He would further state; *“In our video inspection of all four shafts so far, a total of about 180 meters, we have seen only blocks made of local limestone. But the final block before the slab is definitely carved from lighter-colored limestone, probably originating from the Mocatam Mountains about 30 km from the Giza Plateau, on the other side of the Nile. This was the material the builders used for the higher-quality casing stones of the pyramid's exterior, and for the chamber systems. The workmanship of the last block in front of the slab is also much higher than anything we have seen in any of the shafts so far.”*

---

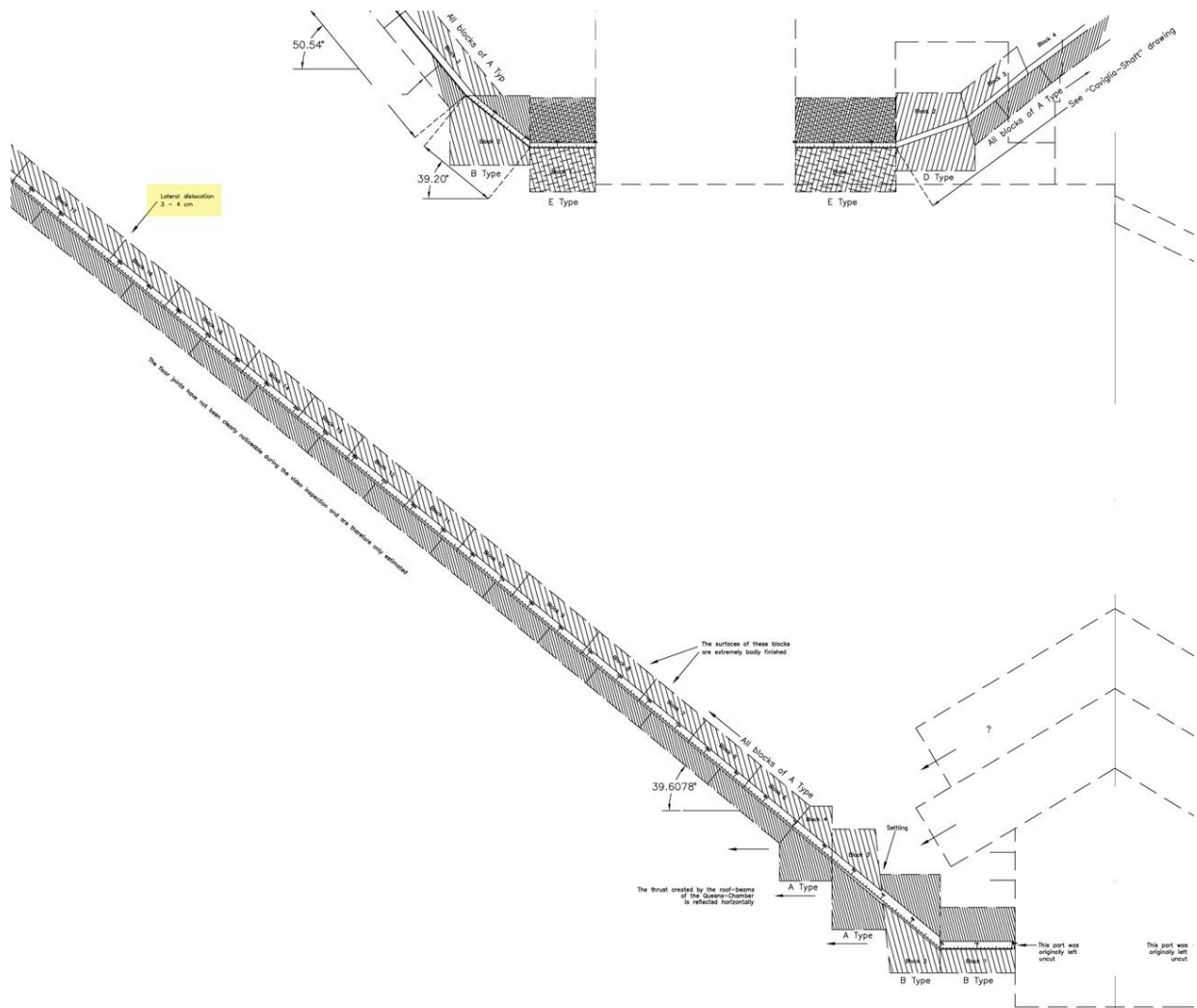
<sup>80</sup> Gantenbrink's website originally had the url [www.cheops.org](http://www.cheops.org) Though no longer available, parts of it can still be found on wayback machine at [www.archive.org](http://www.archive.org)



In the above image I have zoomed in on Gantenbrinks CAD file for the southern shaft beginning (type A blocks are basically the inverse of type B). Here we can see some settling of block 3, which he thought likely due to the pressure of the ceiling beams. Blocks 7 & 8 were left very rough, as his image of block 8, shown left, clearly shows. He comments how the first three joints of the shaft are vertical, “to deflect the pressure of the roof beams into the horizontal plane”.

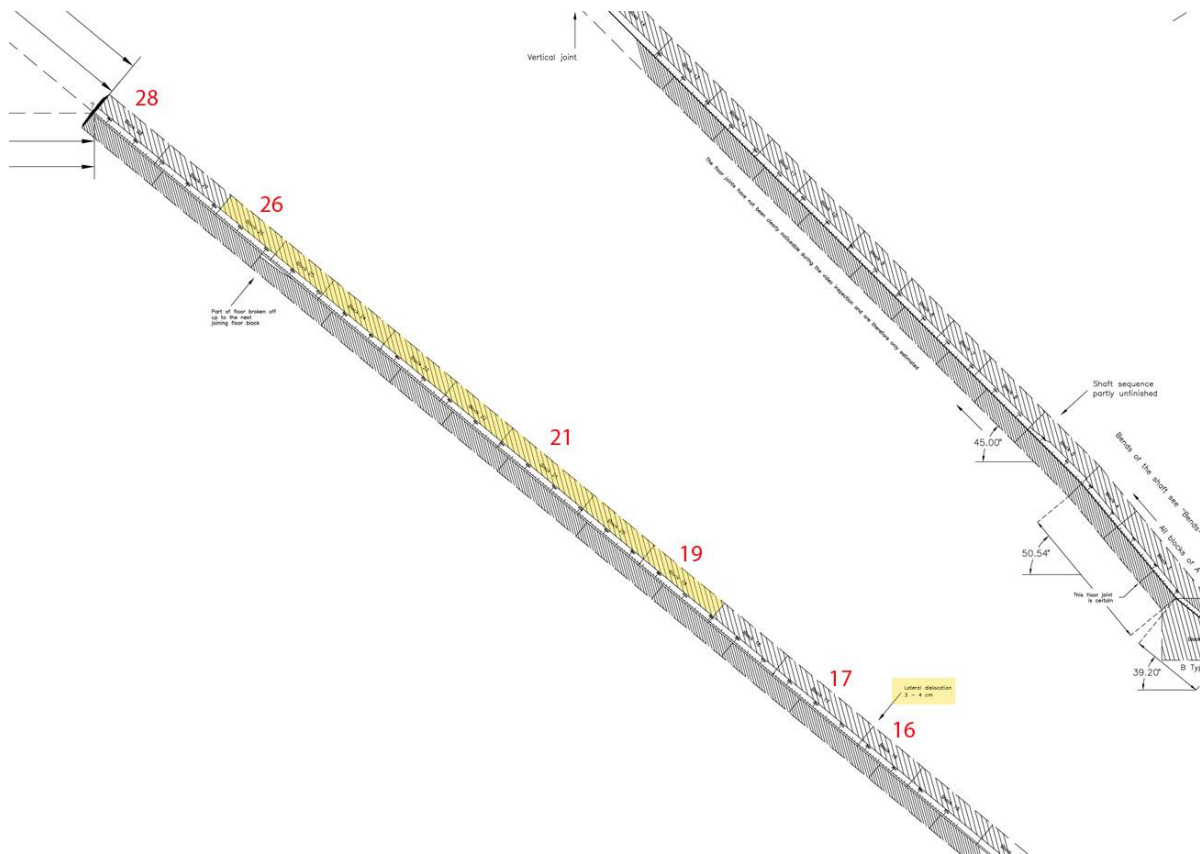
On the rough block 8 he states;

*“Block No. 8 has an unusually irregular surface. This riddle is solved by Block No. 9, one wall and the ceiling of which are rough. But the western wall is relatively smooth and shows signs of having been worked with a chipping chisel. Apparently the ancient Egyptian builders first initially shaped the shaft blocks with a pointed chisel, which explains the uneven surface, and then dressed them with a chipping chisel. Blocks No. 8 and 9 were evidently built into the structure in unfinished form. In 1992 we also found three unfinished blocks in the upper shafts”.*



Further up the southern shaft (highlighted above) we come across what appears to be a lateral displacement in some of the shaft blocks (shown left). Here we can see a red mason's line on the corner of the block. Gantenbrink would state; *“Blocks No. 16 and 17 are offset by about 3 to 4 centimeters. It is impossible to determine with any certainty whether this deviation occurred during original construction*

*or at a later date. This spot lies just under the floor level of the King's Chamber, where Petrie discovered unusual settling. It is possible that this settling, and the observed deviations were caused by an earthquake during the pyramid's construction.”*



In the CAD drawing above, I have numbered some of the blocks, and highlighted blocks 19 to 26. Gantenbrink would comment; *“From Block No. 19 onwards, we detected strange scratches on the walls of the shaft, extending all the way up to Block No. 26. Depending on the surface texture of the walls, these scratches appear with varying clarity, at a consistent height of 2 to 3 centimeters above the shaft*

*floor. The scratches are not very deep and are visible only because they penetrate the stones' patina. Since the scratches extend over the block joints, it is obvious that they were made after this shaft sequence was finished. It would appear that something was dragged up through the shaft subsequent to its completion.”* In Gantenbrink’s image above, we can see some of these faint scratches just above the floor.



In this image by Gantenbrink we can see the scratches on both walls, and something adhering to the west wall. Gantenbrink states; *“Shortly after the joint leading to Block No. 21, a bit of light-colored mortar (most likely gypsum) adhering to the west wall of the shaft gives the impression that here, something was originally attached to the wall.”*



*“We made an identical find farther along the shaft, at Block No. 26. Just as with Block No. 21, the impression here is located on the west wall of the shaft, at the beginning of the block.”* This second location is shown in his image left; note also the damage to the floor in this area.

Gantenbrink would offer a possible suggestion for these mortar traces on the west wall: *“It is quite possible that the mortar was used to temporarily fasten strings to the shaft wall. These strings could have been removed later by giving them a sharp tug, causing the mortar to break away and leaving behind the kind of hollow impression of the strings that we observe today.”* These strings could have been measuring cords to monitor the length of the shaft.





In Gantenbrink's image left we can see a significant amount of floor damage, which created a major tank trap for his robot. He would state; *"At the beginning of Block No. 26, a large section of the floor has broken away. This is the worst damage we observed anywhere in the shaft sequences so far investigated. At this point, however, the pressure on the shaft*

*amounts to only one-third of the maximum value. Near the Queen's Chamber, 115 meters of pyramid material press downward on the shaft. But only 35 meters of material press down on this spot, where we observe the greatest shaft damage. This highly unusual finding can have resulted only from one of two possible causes:*

*1. Extremely inept construction work below Block No. 25 and 26. It must be remembered, however, that it is this final section of the shaft which otherwise displays the highest quality workmanship observed anywhere in the shafts system.*

*2. The existence of an as yet undiscovered structure below or above this shaft section. Such a structure could produce a pressure peak, which could in turn focus considerable additional force on the shaft and possibly cause the observed damage."*



*In his image left, we can see a cut groove in the floor. "At block No. 26, the shaft floor is marked by a long cutting groove. We found more such grooves in the floors of Blocks No. 27 and 28. Such grooves were caused during construction of precise joints. Two blocks, which had been preliminarily worked with a chipping chisel, were shoved together. Then a*

*saw was run down through the gap remaining between the two blocks, removing material from the ends of both. This procedure created a precise joint between*

*two adjoining blocks. This method also leaves behind a cutting groove on the block underneath, a fact which testifies to the use of this method.*

*Based on the grooves found in the shaft, we can assume that, before their insertion as floor slabs, these blocks served as a base for the cutting of precision joints.*

*This gives rise to a crucial question: exactly which precision joints were cut here?*

*The shaft blocks themselves were only dressed with the chisel. We observed ample evidence of this in the Caviglia Tunnel, on the lower sides of the shaft blocks, as well as at several sites of block displacement, which exposed the abutting edges. At the upper southern shaft outlet, both outer sides of the blocks are visible. These, too, were worked only with the chisel. Thus, as 9 of a total of 10 surfaces of a shaft block were definitely chiselled, we can well assume that the shafts were constructed without recourse to sawing.*

*The pyramid's nearest casing stones, which lie 19 meters distant from this spot in the shaft, were cut in their final position. We know this because the stones located directly beneath the casing stones display cutting grooves.*

*The pyramid's corridor and chamber system, which also displays precise, cut joints, had been completed long before this shaft construction level was reached.*

*Taken together, these findings constitute a compelling case for a possible, as yet undiscovered structure - for which precision joints were made - in this upper region of the southern, Queen's Chamber shaft."*

Currently no anomalies have been detected by the ScanPyramids project in this area; though recently efforts are underway to raise funds for more detailed scans of the pyramid.



In Gantenbrink's image left, we can see what appear to be two circular lighter patches. On his website under the 1993 campaign section, a discussion ensues as to whether these patches may have been seals. He states; *"About the seals, Prof. Stadelmann is quite adamant. He says no such round seals were ever used in the Old Kingdom. But much later, together with a German Egyptologist, I was to investigate this issue more*

*thoroughly and discover that this is not necessarily true."* The National Geographic report would suggest; *"Two white areas appear on the stone face centered under both of the metal pins. The white areas may be from natural erosion of the block or may be attributed to a blow from the tool that could have been used to flatten the metal pins to the face of the stone."*<sup>81</sup>

According to Gantenbrink this closure stone is not mortared in place, but appears to be slightly wider and taller than the shaft, with only the bottom edge being visible. The hole drilled through the stone by the Net Geo team shows it to be quite a thin slab, and based on measurements with the borescope camera the stone is about 2 inches thick, with the gap to the next block being around 7 inches.<sup>82</sup> In 2010 the Djedi rover managed to insert a flexible camera through this hole and made further discoveries.



The camera allowed us to see the rear of the closure stone, and here we can see that the copper fittings form a sort of loop.

<sup>81</sup> The National Geographic/Supreme Council of Antiquities Scientific Expedition, Report Final, page 14

<sup>82</sup> Ibid, page 20



The Djedi rover also recorded some further mason's marks and what appear to be some hieratic numerals. The researcher Luca Miatello would suggest that these markings denote the number 121, reading from right to left, the first mark would denote 100, the middle mark 20, and the last mark 1. This might suggest that the shaft was 121 cubits long, which might seem a strange number. The length of the shaft also appears uncertain, with Gantenbrink's CAD files suggesting a length of some 59.4m which is too short. However, the National Geographic team state that the step in the floor was approximately 185 feet or 56.4m, but Gantenbrink gives this step as 53m, a significant difference. In a further twist, Hawass would state; *"The 'step' was re-calculated to be at approximately 57 meters (187 feet) inside the southern shaft, and 5cm (2 inches) high."*<sup>83</sup>

What has caused this disparity is uncertain, but Gantenbrink's CAD drawing shows that from the step to the closure stone we have a distance of some 6.4m; if we add this to the new figure given by Hawass we get 63.4m or 121 cubits of 52.4cm or 20.63 inches. In their latest book, Lehner and Hawass would comment on the work of the National Geographic pyramid rover; *"The investigation ascertained that the two blocking slabs with copper pins seem to be about the same distance from the Queen's Chamber (65m/213 ft) in both northern and southern shafts, although Gantenbrink measured the distance of the southern one as 59.5m (about 195 ft)."*<sup>84</sup> Unfortunately data from the two other rover teams is not as forthcoming as the detail provided by Gantenbrink, and so it's difficult to come to a conclusion on the length of these shafts, other than to say that the 121 cubits suggested by Miatello is still a possibility.

A possible corroboration of the longer length might come from Morton Edgar, who was given permission to clear the debris from the shafts in 1928. In a later edition of his 'Great Pyramid Passages' he provides a 'Pyramid discourse

<sup>83</sup> CASAE 43, 2014, The so-called secret doors inside Khufu's pyramid, page 57

<sup>84</sup> Giza and the Pyramids, 2017, page 161

– 1929’. Here he informs us that at the time, Egyptologists such as Reisner thought that the queen’s chamber shafts were only dummies and only extended a few feet upward into the pyramid. Edgar determined to get to the truth of the matter ordered several long steel rods from a Cairo engineering company. The rods threaded together, with the lead rod topped with a wooden ball to prevent it getting stuck into a joint, Edgar pushed the rods up the southern shaft, where it hit an obstruction at some 208 feet. He would repeat this exercise a week later and again could not get beyond 208 feet.<sup>85</sup> At 208 feet or 63.4m the only obstruction to the rods would be the closure stone, and maybe the broken copper fitting was caused by the wooden ball hitting it, and could the scratches observed by Gantenbrink be caused by Edgar’s rods?

One might ask why such an odd number as 121 cubits was chosen? A possible solution is in connection with pyramid geometry by John Legon. In a paper entitled ‘The Geometry of the Air-Shafts’ he would state;

*“The north and south shafts from the King's Chamber are now reported by Gantenbrink to have both opened in the casing at the same height of 80.63 ms ± 4 cm above the base. They thus coincided with the level of the 105th course as determined by Petrie (3174.7 to 3176.0 inches above the base, mean 80.65 ms). This is exactly 2 x 7 x 11 equals 154 cubits above the base. The level of the outlets was therefore commensurate with both the shaft-profile of 7 rise on 11 base, and the casing-profile of 14 rise on 11 base, placing the outlets at a distance of 154 x 11/14 or 121 cubits horizontally inside the north and south base-lines of the pyramid. Given the side-length of the base of 440 cubits, the horizontal distance across the Great Pyramid at the level of the outlets was (440 - 2 x 121) or 198 cubits, and hence was exactly equal to the height of the pyramid from the floor-level of the King's Chamber to the apex, of (280 - 82) cubits or 198 cubits.”<sup>86</sup>*

The reader must forgive me for not going into the various design theories of the pyramid, as a guide on those would easily take up hundreds of pages. But from the inconsistent data we hold on the pyramid, I am more inclined to agree with the following statement from Legon; *“It should be more obvious than ever, therefore, that the design of these shafts was determined by considerations of geometry, symmetry, and the desire for a coherent dimensional design, and can have had nothing to do with the conjectured astronomical alignments.”<sup>87</sup>*

Neither does the air shaft/ventilation theory work for the queen’s chamber as the shaft is purposely sealed at either end; though even here we find differing opinion on how the shaft was closed at the chamber end. For example, Romer

---

<sup>85</sup> Great Pyramid Passages, 1929 edition, page XXI

<sup>86</sup> The above quote is from an article on his website, though it is also to be found in; The Orion Correlation and Air-Shaft Theories. Discussions in Egyptology 33, 1995, pages 53-54

<sup>87</sup> Ibid, page 55

would state; *“Following their discovery in the 1870s – until that time, the ends of these tiny shafts appear to have been closed with little slabs of stone set flush to the surface of the walls.”*<sup>88</sup> In the footnote to the above statement, he states;

*“Despite claims that the ends of these two hidden shafts were left uncut at their point of entrance into the chamber – which probably owe their origin to Petrie’s ambiguous description of them (1883, p.70) – practicalities of stone cutting make it more likely that the two square holes were closed with two well-made ‘flickstein’ which had been rendered invisible by the copious deposits of soot and salt which, prior to their recent conservation, had long obscured the chamber walls.”*<sup>89</sup> This statement in turn has a reference at its end, which is an update written by Hawass in a reprint of Petrie’s smaller 2<sup>nd</sup> edition, published in 1990.<sup>90</sup> There is nothing in this update to suggest that *‘flickstein’* (patch stones) had sealed the chamber openings; the only item of note is that the soot and salt had been cleaned from the walls.”

As for Petrie’s ambiguous statement, he simply states; *“they are exactly like the air channels in the King’s Chamber in their appearance, but were covered over the mouth by a plate of stone, left not cut through in the chamber wall;”*<sup>91</sup> Other explorers have commented, and here the consensus is that patch stones were not used; for example, the Edgar’s would state; *“They had left the last five inches uncut! That this was their set purpose is demonstrated by the fact that the orifices are not plugged, for there is no jointing,”*<sup>92</sup>

So who is correct? Playing devil’s advocate, I simply do not know; being disabled, I cannot make the journey to the queen’s chamber: but it is yet another example of the confusion and the interpretation of data, which clouds too much of the pyramid. That this question needs to be asked in the modern era just highlights how poor our data is on the structure. The pyramid is certainly not short of opinions, but accurate data is in short supply.

In the image overleaf, we can see a close up of the north shaft opening (this is the shaft shown left on page 49). This has not been fully opened, and in this image along with other’s I have examined, I can see no joint lines; this image was also taken after the removal of salt incrustations and soot.

---

<sup>88</sup> The Great Pyramid, 2007, page 381

<sup>89</sup> Ibid, page 527, note 3

<sup>90</sup> The Pyramids and Temples of Gizeh, New and Revised edition. Histories & Mysteries of Man Ltd, 1990. Romer cites page 103

<sup>91</sup> The Pyramids and Temples of Gizeh, 1<sup>st</sup> edition, page 70

<sup>92</sup> Great Pyramid Passage, 1923, page 385



*Image courtesy of Larry Pahl*

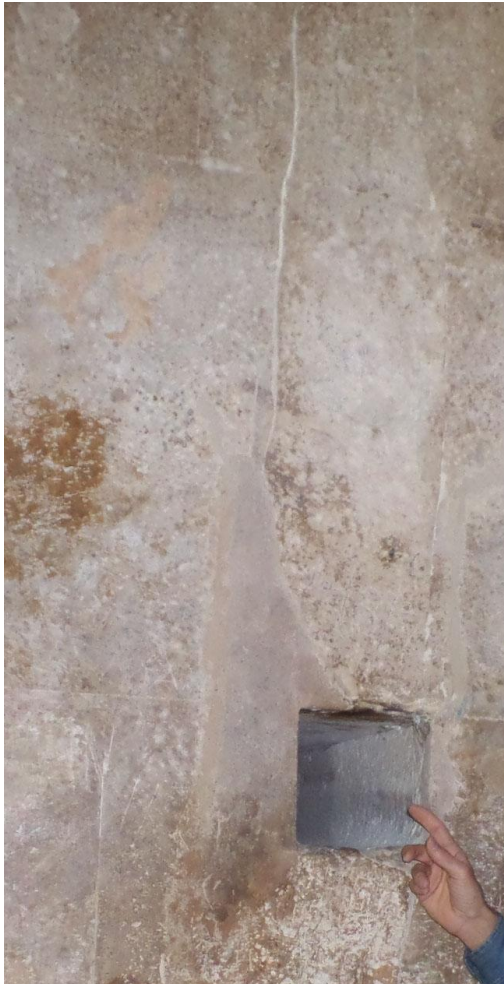
The exact circumstance on how Dixon discovered these shafts is not wholly clear, but Piazzzi-Smyth who had communication with Dixon, would state;

*“Perceiving a crack (first, I am told, pointed out by Dr. Grant) in the south wall of the Queen’s Chamber, which allowed him at one place to push in a wire to a most unconscionable length, Mr.W.Dixon set his carpenter man-of-all-work, by name Bill Grundy, to jump a hole with hammer and steel chisel at that place.”*<sup>93</sup> This account agrees with the Nature article of 1872, in that Dixon could insert a wire through the joints; though the hammer and chisel is replaced

---

<sup>93</sup> Our Inheritance in the Great Pyramid, 4<sup>th</sup> edition, page 428

by drilling a hole. The walls of the queen's chamber display numerous cracks, and quite a few in the south wall, with some leading to the shaft (Piazzzi-Smyth would also assert that the shafts were not closed with patch stones; though he never observed them, as they were discovered long after his visit).



In this image we can see cracks in the south wall leading down to the shaft (this is a close up of the image on page 49). It is possible that this fault attracted attention and allowed the wire to be inserted; indeed, the fracture appears to be significant enough to allow pollution, for in the Nature article, it states that after breaking into the south shaft;

*“The sides of the channel were found to be blackened with smoke, like the walls of the Queen’s Chamber, and it was thought that a slight draught was perceptible.”<sup>94</sup>*

The article continues by describing the opening of the northern shaft, and here they state; *“The surface of the stone in the channel on the north side appeared to be as clean as when originally cut, and the cement of the joints was perfectly white.”* It would

seem then that the fracture leading down to the top of the shaft was significant enough to allow pollution into the shaft.

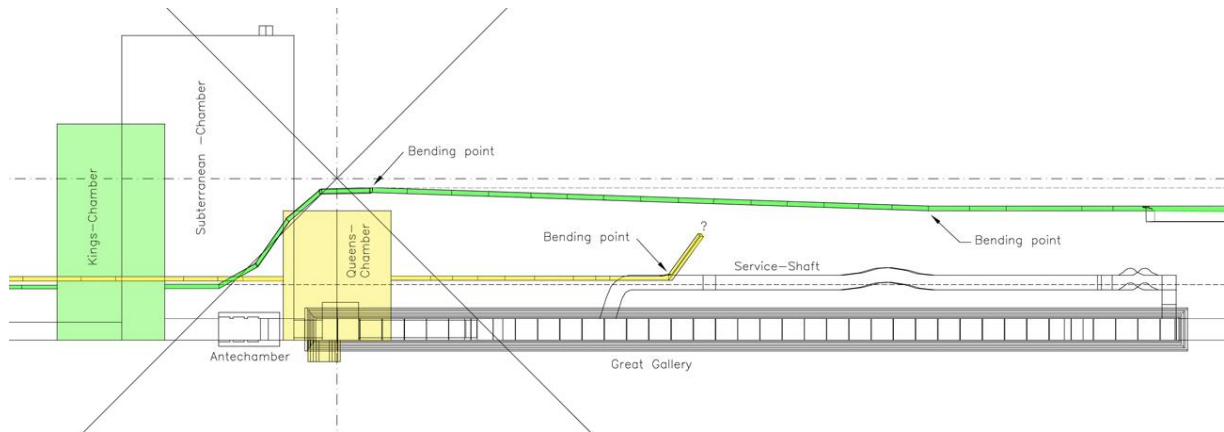
The next shaft to look at is the northern shaft; this shaft is a difficult challenge for the robotic rover's due to the bends in the shaft, as it circumvented the masonry of the grand gallery. This in itself is a mystery, for instance, why were the shafts not placed at the west end of the chamber, which would allow a straighter route for the shaft. One could argue that the chamber and the start of the shaft were already under construction, before the grand gallery was decided upon: with the shaft already started they had to adapt the shaft to avoid the

---

<sup>94</sup> Nature, Dec 26, 1872, page 146

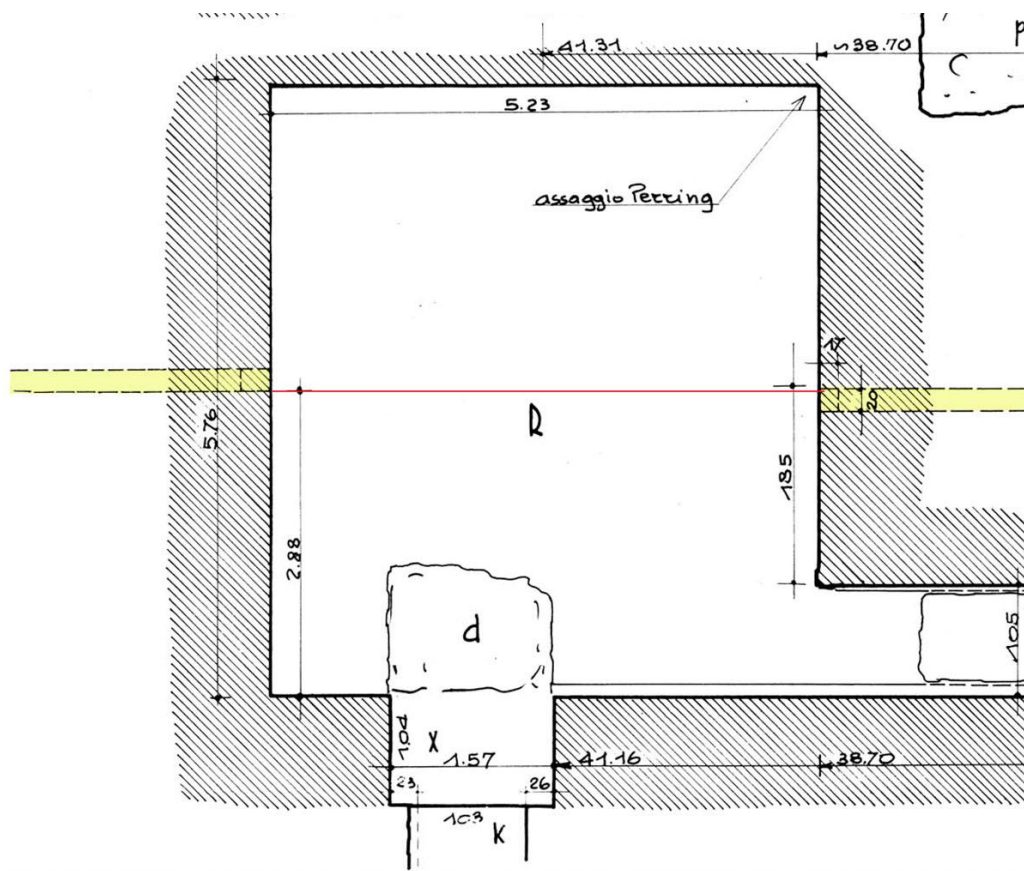


grand gallery. But this seems unsatisfactory as the north shaft in the king's chamber likewise had to bend around the masonry of the grand gallery, and one would like to think that the grand gallery was decided upon before the king's chamber was built, as the grand gallery is required to access the king's chamber.



In the above plan view from Gantenbrink's CAD files, I have coloured in the shaft locations; Gantenbrink's robot could travel no further than the question mark, in the queen's chamber north shaft (the bends in king's chamber north shaft was largely bypassed thanks to an earlier excavation in this area by Caviglia). As can be seen from the plan above, especially in the king's chamber, the northern shaft could have been placed further west and totally avoided all these bends in the shaft. If we discount the change of plan idea, then there must be some important or symbolic reason why the shafts are placed where they are.

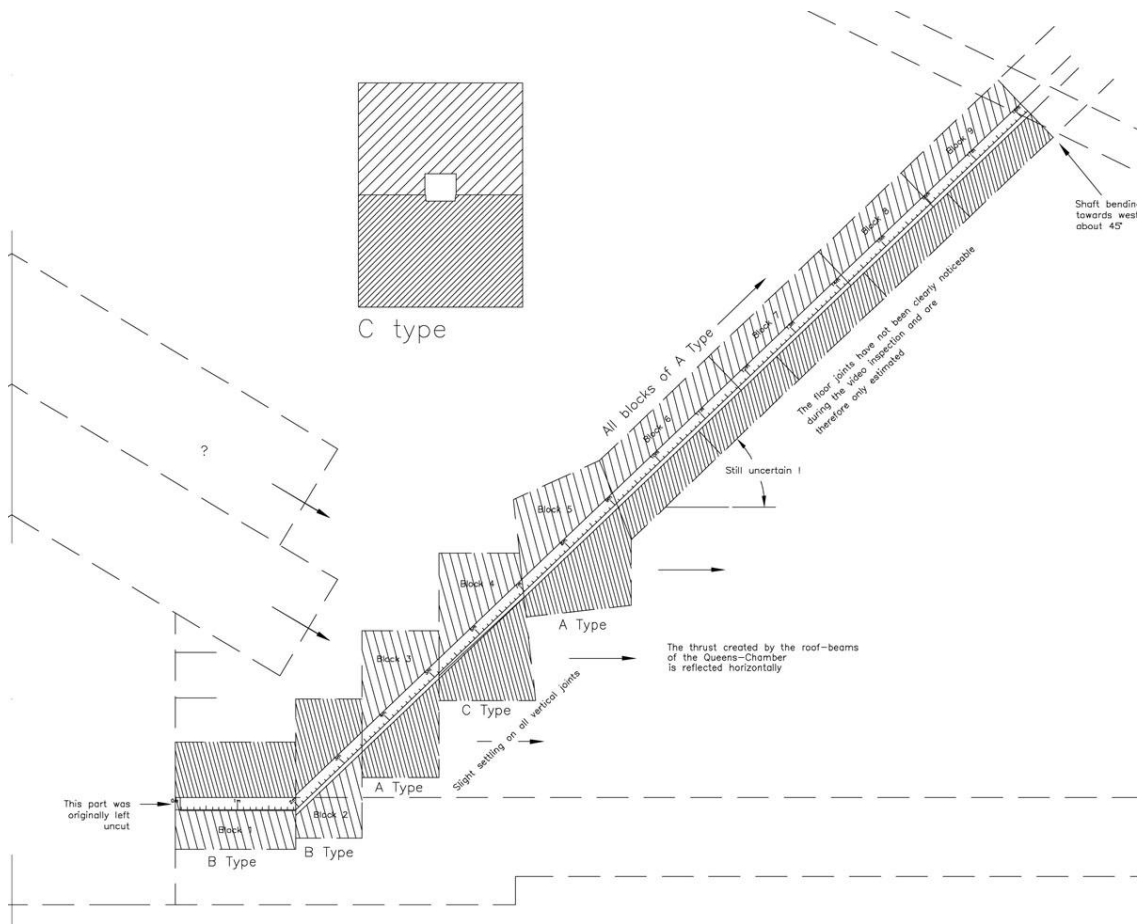
It is often reported that the shafts from both chambers are on the same vertical plane, though as we can see from above, the king's chambers shafts from the chamber are placed slightly further east than the queen's. Indeed, even in the small queen's chamber, where it is often stated that the shafts are exactly opposite each other, we can notice a strange discrepancy. Data on the location of the queen's shafts in the chamber is limited; Petrie did not provide data on it, though some data can be gleaned from M&R's and Dormion's drawings.



The above plan of the queen's chamber is from M&R's TAV 6, and here we can see that the shafts are not directly opposite each other (Dormion's plan No.9 provides similar measures). I have drawn a red line from one shaft to the other, and we can see that each shaft falls either side of this line; the line itself at some 2.88m from the chambers east wall amounts to 5.5 cubits or half the length of the chamber, which is 11 cubits. This then is the N-S meridian line of the chamber, with the north shaft east of it and the south shaft west of it. One could always cite building error, though I am more inclined to believe that this placement was intentional, and needs to be taken into account, when explanations are given for these shafts.

When it comes to the location of the King's chamber shafts, Piazzzi-Smyth gives the well preserved north shaft opening as between 98.3 to 106.6 inches,<sup>95</sup> which gives a shaft axis of 102.5 inches or a possible 5 cubits, which would place the centre of the shaft at one quarter of chamber length, which is 20 cubits.

<sup>95</sup> Life and Work, Vol 2, page 110.



The above view of the north shaft is from Gantenbrink's CAD files, and shows the limit of his robot, which could not negotiate a bend in the shaft (the dashed lines at the end of the shaft equate to the floor of the grand gallery). The masonry layout is similar to that which we see in the southern shaft; though here, we have a new block type 'C'. This block type has a small portion cut out of the pavement block. The initial horizontal portion is given as 1.93m, and Gantenbrink would state; *"Based on 14 measurements made over a distance of 17 meters, the shaft's angle of ascent fluctuates between 33.3° and 40.1°. Block No. 4 clearly shows that a change in the angle was made at this point. To that end, the builders even cut the shaft 2 cm deep into the beginning of the floor block. The extreme angle fluctuations and the changes made to Block No. 4 would seem to indicate that, at this point, the ancient Egyptians ran into a conflict with the Great Gallery, which was being constructed at the same time, and thus were unable to adhere exactly to the originally intended shaft angle."*

He would also report that blocks No. 2, 3 & 4 showed signs of minor settling, possibly due to the thrust of the ceiling beams.



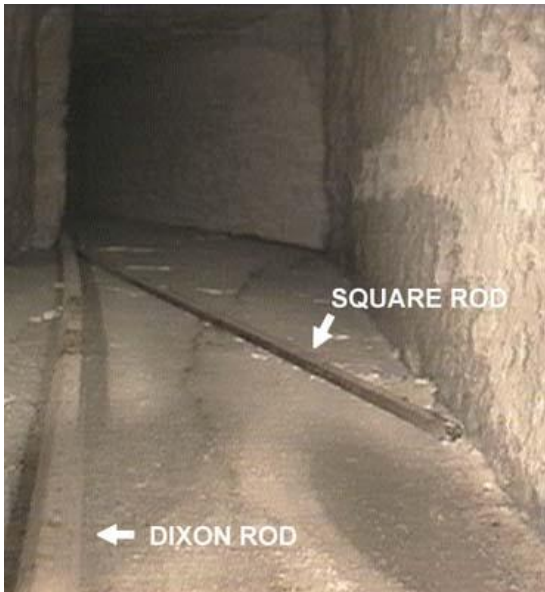
At the start of block No. 7 he reports the end of a threaded iron rod, which is shown on his image left. He would comment; *“As no "scholar" reports investigating the shaft using such a rod, we can assume it is an artifact of an unsuccessful "treasure hunt," which was supposed to remain secret.”*



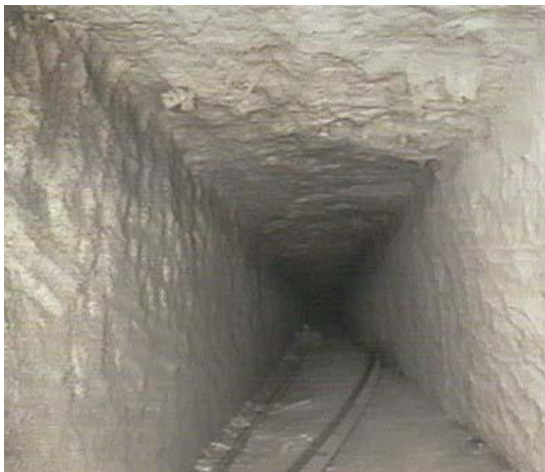
*“The west wall of the shaft, at about the middle of Block No. 8, displays a strange, broad black streak reaching from the floor to the ceiling. The streak is partially interrupted by gouges, mostly perpendicular to the streak, left by a chipping chisel.”*



*“We made an almost identical find at the beginning of Block No. 9, also on the west wall. In this case the streak is not broad, however. Instead, it is made up of two parallel lines, also interrupted by traces of a chipping chisel. But it is also obvious that here the chiseling was done only over the two parallel lines.”*



*“At the end of Block No. 9, the shaft angles about 45° to the West, in order to avoid the static structure of the Great Gallery. It is at this point that Dixon's iron rod, which is bent around the angle, apparently got stuck. Unable to remove it, he seems to have given up his probing of the shaft and then unscrewed the lower section of the rod, which otherwise would have remained protruding from the shaft entrance. Sticking out of the shaft, at the point where it angles to the West, a square rod lies on the shaft floor, extending to the East wall.”*



*“In 1993, Upuaut-2 was not yet capable of negotiating the sharp westward bend of the shaft. Nonetheless, the robot's camera provided us an initial view of the continuing shaft.”*

Gantenbrink would report that the square rod lay under the hexagonal threaded rod; these rods he reports as 2.7m in length. In

Gantenbrink's image above we can see that he has annotated the hexagonal rod as Dixon's rod: he reports the square rod as having a fractured end. The rod is often referred to by some as being left by Dixon; however, I could find nothing in the literature at the time, which suggests that Dixon inserted rods into the shaft. The only detailed account I could find of rods being inserted in this shaft is by Morton Edgar, who states;

*“I ordered several long steel rods from an engineering firm in Cairo. The length of these rods varied from thirteen to sixteen feet, and I had them threaded at each end and had screw-couplers made so that the rods might be coupled together in one continuous length. At the end of one of these rods I had a ball of wood fastened. This was to prevent the end of the rod sticking in any joint or rough pieces of masonry. The ball glided over all inequalities. I began by probing the North Air-Channel of the Queen's Chamber, pushing in the rod with the wooden ball at the end of it first, and then coupling another rod to it and pushing that inward, then a third rod coupled to the other two—and so on,*

*one rod after another. I found that all the rods that I had provided myself with in the first instance, passed up the channel without hindrance, and I had, therefore, to get a further supply of rods. These rods were of flexible steel, because the channel on the north side of the Queen's Chamber does not proceed directly upward in a straight line, but curves around toward the west to avoid the intervening masonry of the Grand Gallery. The rods, therefore, had to bend around this curved part. The North Air-Channel of the King's Chamber is also bent around the intervening masonry of the Grand Gallery on the west side.*

*I managed to push the rods up the Queen's Chamber north channel to a distance of 175 feet, and then, unfortunately, the rods broke. The strain of passing around the westward bend proved too much for them. About a week later with some fresh rods I made another attempt to probe the length of this North Channel, but again my rods broke after I had pushed them upward for 175 feet.”<sup>96</sup>*

The mystery of these rods and who is responsible might be cleared up in the report on the work carried out by the National Geographic team, and their pyramid rover. Their rover would finally pass the bend that stopped Gantenbrink, and after several attempts it managed to climb 209 feet to the end of the shaft, where they found a similar closure stone to that which closed off the southern shaft. In their report they state;

*“There are two metallic rods running along the floor for much of this airshaft’s length. The first rod appears at approximately 25 feet into the shaft. The second appears at approximately 60 feet in the shaft, just before the first turn to the left. The first rod is hexagonal with threaded connecting sections. The second rod is thinner than the first and has 4 sides with the same threaded connection sections. Both rods are similar in appearance but additional analyses must be completed in order to define the relationship between the two rods and establish the order in which they may have been inserted and subsequently abandoned. At 85-feet, one rod terminates in what appears to be a wooden ball.”<sup>97</sup>*

The above statement was made in Phase 1, when their rover managed to ascend some 90 feet into the shaft. In Phase 2, they successfully managed to reach the end of the shaft, and here they state;

*“The two metal rods remain in place, though they were moved slightly as a result of the first phase of investigation. At 84 feet we saw the knob on the end of the smaller iron rod. At 119’ we was the end of the second rod that also has a knob fixed to its end.”<sup>98</sup>*

It seems clear from the report therefore that both the square and hexagonal rods had knobs on their ends. This suggests that both rods are the

---

<sup>96</sup> Great Pyramid Passages, 1929 Pyramid Discourse, page XXI

<sup>97</sup> The National Geographic/Supreme Council of Antiquities Scientific Expedition: Final Report, 20 December 2002. Zahi Hawass, Meg Watters & Chris Sondeal. Page 16

<sup>98</sup> Ibid, page 21 (there is a typo in this statement after the 119’)

broken remains of Morton Edgar's rods: we recall from Edgar's account that he fitted wooden knobs to the end of his rods; moreover, both attempts failed with the rods breaking. The attempts were a week apart, and it's possible he obtained different rods for his second attempt, which is why one is square and the other hexagonal.

The shaft like the others has various bending points along its length; unfortunately the National Geographic team don't provide any CAD files, but they do give the following statement.

*"The expedition reconfirmed that the shaft is oriented to North as it heads away from the Queen's Chamber. At 60', the shaft bends to the left at an angle of approximately 45 degrees. At 76' and 84' the shaft bends to the right at an angle of approximately 20 degrees. At 84 feet, there is another turn to the right at approximately the same angle. At 96' the shaft bends slightly to the left."*<sup>99</sup>

Numerous suggestions have been made as to whether these small shafts point to particular stars or constellations; but given their bends and relatively small size it's difficult to see how they could be trained to any particular part of the sky. We often only see these shafts in a 2 dimensional vertical cross section of the pyramid in diagrams, but this often gives a false impression of the shafts, when in reality they tend to meander all over the place.

The Nat Geo Final Report is not as detailed as one would hope, in comparison to Gantenbrink's report, from his sadly now defunct website. Some poor quality images of the north shaft can be found at the end of an article by Zahi Hawass;<sup>100</sup> but a clearer picture would not emerge until a series of over 50 images was shown on Matt Sibson's 'Ancient Architects' YouTube channel. Here a long sequence of images allows us to follow up the shaft; the route of the rods is clear, along with their ends, complete with wooden knobs. The construction appears similar to that of the south shaft, and like in the south shaft, we see fine limestone construction at the shafts end. The similar closure stone in the north shaft has not been drilled through. Sibson would point out some unusual features of the shaft in his video, which the reader can easily access.

Sadly, the poor data from the north shaft is unfortunate, but given the location of the queen's chamber, in that it appears to have been purposely placed in the mid-point of the pyramid, it suggests that the shafts were likely to have been planned as symmetrical; albeit with modifications to the north shafts construction in order to circumvent the grand gallery. The grand gallery masonry would have a sizeable depth of good quality stone, similar to the breach in the niche of the queen's chamber, which the shaft would have to avoid, and must have been a major challenge for the builders.

---

<sup>99</sup> Ibid, page 21

<sup>100</sup> The so-called secret doors Inside Khufu's Pyramid, CASAE, 43, 2014

Difference in opinion as to the design idea behind these shafts is unsurprisingly apparent. For example, if we accept that the pyramid displays an angle of 14:11 (related to the 22/7), then it has been suggested that the queen's shafts have been set at an angle of 11:14; this design allows the shaft to intercept the pyramid face at a 90 degree angle. The angle of the shaft from 11:14 amounts to 38°9', which compares to Gantenbrink's reading of 39°36' for the south shaft.

Another example is from Legon's work, who would relate the queen's shafts to a similar geometric construction as the king's shafts. Here, he would point out that the queen's north shaft was directed at the same focal point as the king's north shaft, which gave an angle of 14:17, or 39°28', which is closer to Gantenbrink's value for the south shaft, and assuming the north shaft was to be symmetrical. Legon would suggest that the shafts would have opened out on the 90<sup>th</sup> course, and that; *"This course marks one of the great 'stages' in the core-masonry of the pyramid, being noticeably thicker than any of the preceding 44 courses—"*<sup>101</sup> Other examples exist, but it highlights the difficulties in trying to decipher the architect's intents.

The pent ceiling of the queen's chamber is also a first inside a pyramid; prior to this, the solution was to create corbelled ceilings. The upper chamber in the Red pyramid, whose width was 8 cubits, or 2 cubits less than the queen's chamber has an impressively high corbelled ceiling, and if this solution was used in the queen's pyramid, the ceiling would be taller still. There was nothing to prevent this solution being used in the queen's chamber, as the chambers in the Bent Pyramid have a similar width, and indeed they used this solution for the grand gallery. One reason for this new introduction of pent beams might be due to the architect's unified scheme for Khufu's pyramid, and the architects desire not to have such a tall corbelled ceiling under the grand gallery. One could also suggest a symbolic notion in that the architect wished to point out the unusually thick 35<sup>th</sup> course, which incorporates the level which is 1/5<sup>th</sup> the height of the pyramid; indeed, the level in which the pyramids volume is halved, might also have been intended; as if things are not confusing enough.

One can play no end of mathematical models on what one thinks the architect intended; but frankly the data on the structure is incomplete and inconsistent, with Petrie's work still largely being the standard bearer. Whilst the outside of the structure has been measured numerous times, we still don't know how accurate Petrie's and Piazzi-Smyth's work is for the interior of the pyramid. We recall how Petrie accepted some of Smyth's values; whilst some values were not

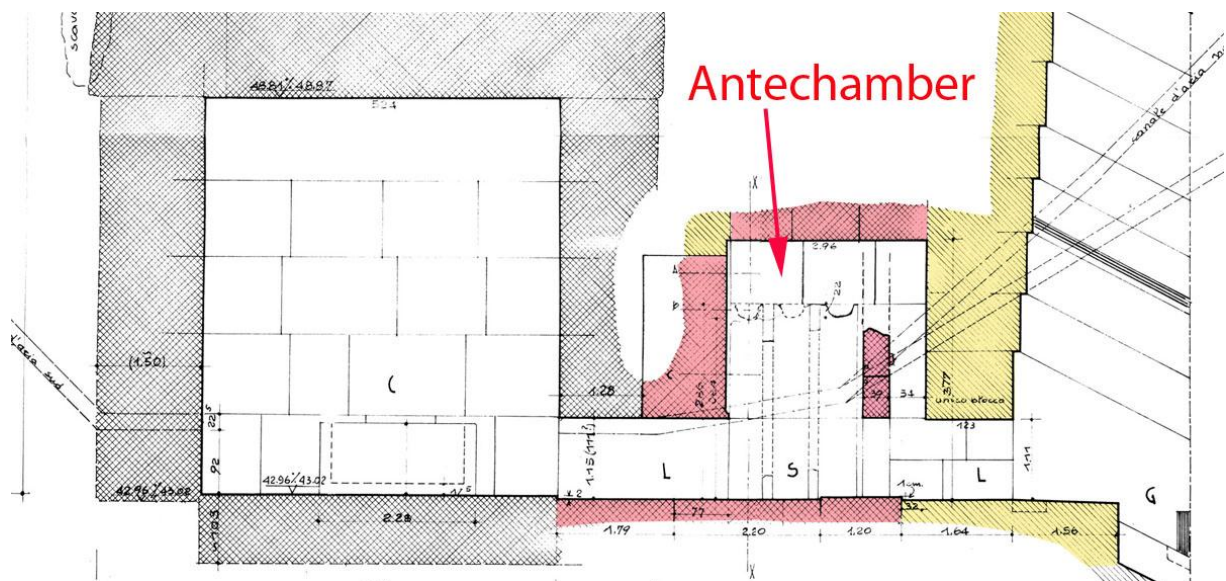
---

<sup>101</sup> The Orion Correlation and Air-Shaft Theories, Discussions in Egyptology 33, 1995, page 54-55



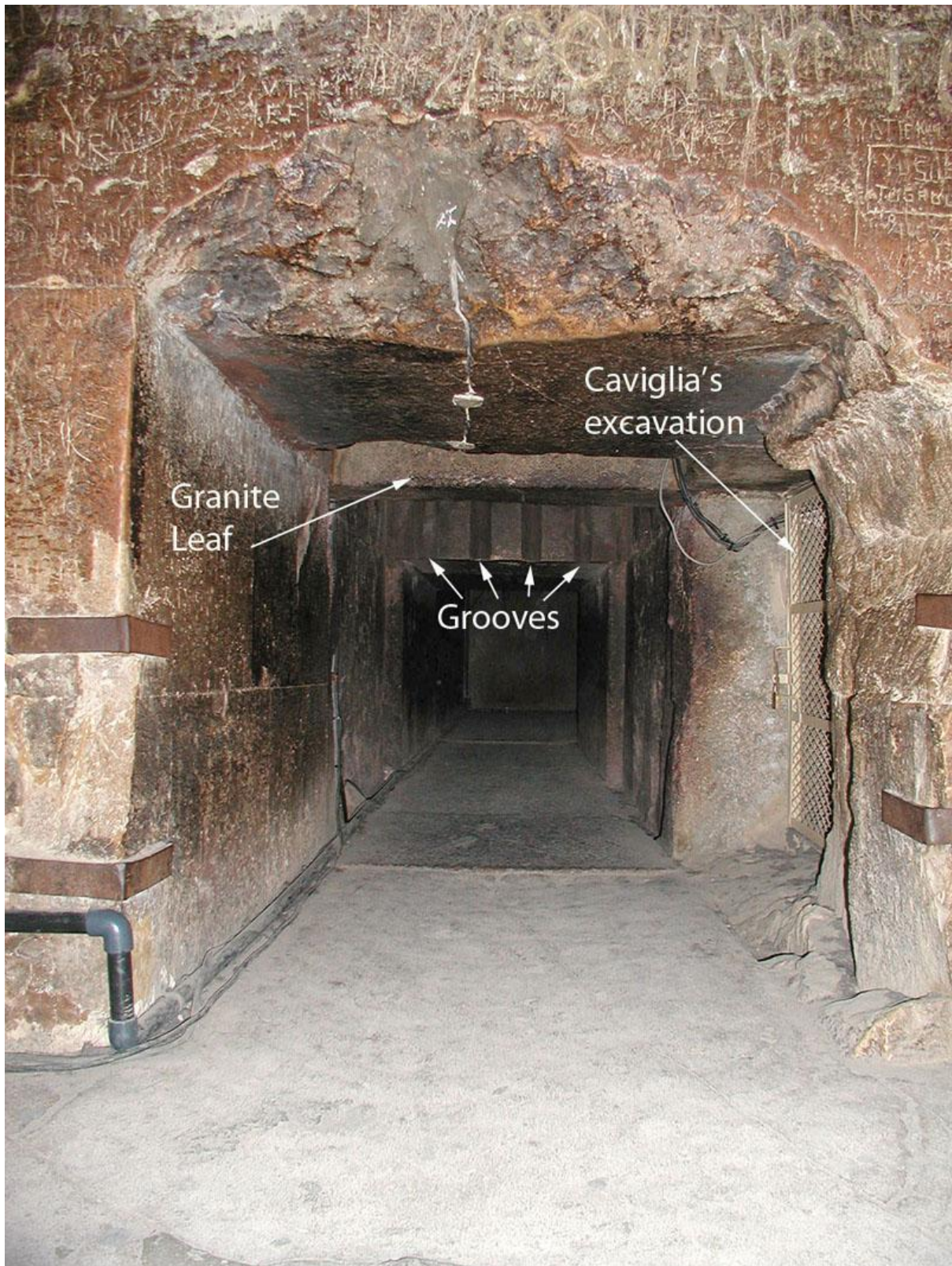
measured; so it seems strange that with today's highly accurate technology, be it laser scanning etc, that a modern survey of the interior of the pyramid has not been carried out and published. Such a survey might highlight major discrepancies in the earlier data and upset many a mathematical model. Any theory can only survive contact with accurate data, but do we have accurate data? We need to remember that the work of Petrie and Smyth was in the 1800's under difficult conditions and limitations, and I doubt either gentleman would object to having their work checked under more modern conditions.

### The Antechamber



The next security feature for would be robbers to circumvent would be the so called antechamber, which should really be named the portcullis chamber. This small space would accommodate three granite portcullises to protect the king's chamber. The above section is from M&R's TAV7, and I have highlighted the granite and limestone masonry which surrounds the chamber. The north wall of the antechamber is the rear face of the large masonry blocks which form the south wall of the grand gallery. Beyond this, as we approach the king's chamber they have sensibly used granite to prevent robbers from bypassing the portcullises; though one small block of limestone is used in the upper corner of the chamber. Entry to the portcullis chamber is through a 2 cubit wide passage from the grand gallery, which Petrie gives as 52.02 inches long. The height of the passage, which continues through the south wall of the antechamber, varies somewhat due to the irregular levels of the inserted paving (previously I have suggested that this passage might have been intended to be 2 cubits square, as shown in the Red Pyramid). From Petrie's tables the south wall of the grand

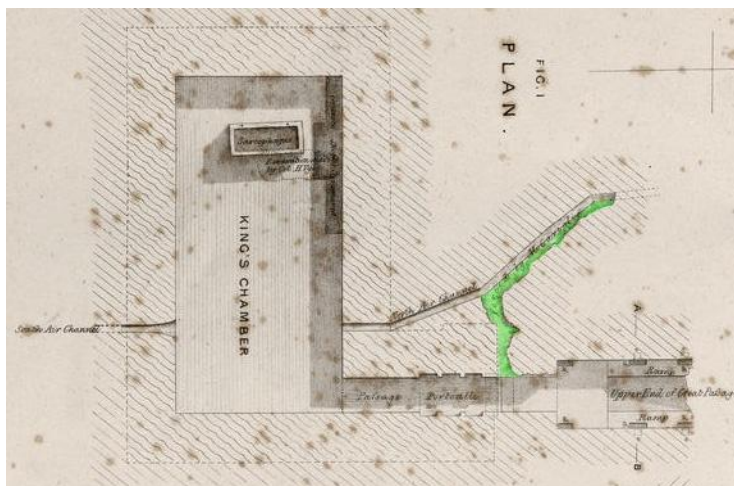
gallery to the north wall of the king's chamber amounts to 268.9 inches or 13 cubits (or 16 cubits from the face of the great step, or pyramids E-W axis).



*Image courtesy of Jon Bodsworth*

In the view above, we are looking along the short entrance passage into the antechamber; the cracked ceiling stone is part of the masonry which forms the south wall of the grand gallery: also visible on the floor is the end of the limestone flooring and the beginning of the granite flooring. The metal grill prevents access to Caviglia's excavation to intercept the northern shaft (this is not shown on M&R's section on the previous page). The granite leaf as it is often termed is two pieces of granite, highlighted on M&R's section; it is embedded in a groove, which only extends down to passage ceiling level. Beyond the granite leaf we can see grooves cut into the south wall of the antechamber, these provided clearance for the ropes used in lowering the portcullis. The south wall of the king's chamber can be seen in the distance.

I have not been able to find much data on this Caviglia excavation, but

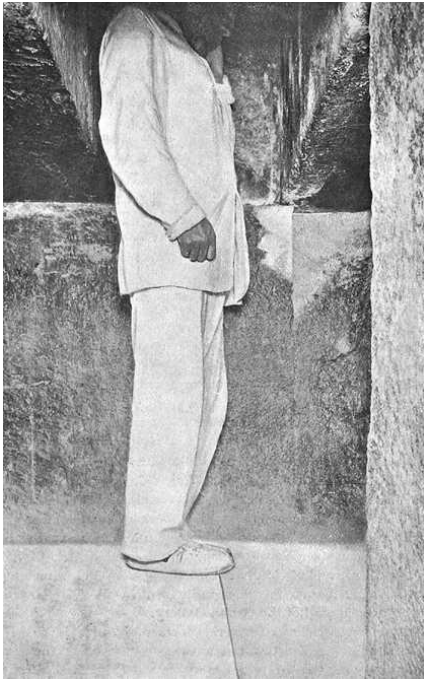


such excavations provide us an opportunity to examine their masonry processes.

In this drawing by Perring I have highlighted Caviglia's excavation in this area, as he attempted to intercept and follow the north shaft. Being much closer to the grand gallery, the king's northern

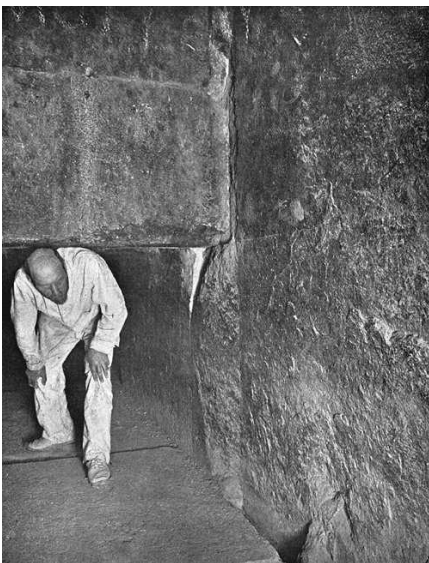
shaft bends much sooner than the queen's shaft. Gantenbrink would take advantage of Caviglia's excavation, which allowed his robot to avoid many of the bends.

What are difficult to make out in the photograph on the previous page are the wainscots and pilasters which guided the portcullises as they were lowered. These have been badly damaged and not necessarily by the original robbers as they smashed their way through the portcullises, but more likely by tourists. Early accounts describe how tourists used to bash the granite sarcophagus in the king's chamber to obtain a fragment of it as a souvenir. Some tourists would find such actions sacrilegious, and the guides would offer a fragment from the antechamber instead.



In this image from the Edgar's, we can see one of the brothers standing in the space between the north wall of the antechamber and the granite leaf; the floor joint is where the limestone gives way to granite: this image is taken from inside Caviglia's excavation. The antechamber has attracted a lot of attention from pyramidologist's who see a lot of religious and mathematical symbolism in its design; for example, the joint in which the granite starts has a distance to the south wall of the antechamber of 103.2 inches (Petrie); this measure appears to be replicated in the height of the east wainscot (which is set lower than the west wainscot). This measure equates to 5 cubits,

and they suggest that these measures draw ones attention to a square of 5 cubits, and that the area of such a square is equal to a circle whose diameter is equal to the length of the antechamber or 116.30 inches (Petrie).



Here one of the Edgar's bends down under the granite leaf, which is made of two granite pieces; the horizontal joint is visible. The pilasters which guided the portcullises have been knocked away, but their outline is still visible; in the bottom right hand corner we can see a remnant of a pilaster at floor level. Petrie would comment on the granite leaf; *"The granite leaf which stretches across the chamber, resting in grooves cut in the granite wainscots, must be somewhat less in width than the breadth between the grooves, i.e., 48.46 to 48.76. Its other dimension were carefully*

*ascertained, as much theoretic importance had been attached to them; though to anyone looking at the object itself, the roughness and irregularity of it would put any accuracy of workmanship out of the question. The thickness of the two stones that form it was gauged by means of plumb-lines at 33 points; it varies from 15.16 to 16.20, but the details are scarcely worth printing. This leaf is not simply a flat slab of granite, but on both its upper and lower parts it has a projection on its N.side, about 1 inch thick, where it is included in the side grooves. The edge of this projection down the W. Side has been marked out by a*

*saw cut; and the whole of the granite on the inner side of this cut has been dressed away all over the face of the leaf, leaving only one patch or boss of the original surface of the block.*”<sup>102</sup>



*Image courtesy of Jon Bodsworth*

The boss that Petrie mentions is to be found on the upper granite piece, which faces the north wall of the antechamber (i.e. in the space that Edgar is seen standing on upper image of previous page). The boss is semi circular in shape with a flat lower edge; its depth is about an inch to match that which has been left at the east and west ends, which fill the grooves in the wainscots. The flat ledge of the boss according to Smyth is about 5 inches above the joint between the two granite pieces. It is also not exactly centered in the leaf, with Smyth giving the boss centre as 19.5 from west wall and 21.5 from east wall.

The granite leaf has always been a bit of a mystery, some early explorers would suggest that it was a portcullis that was not lowered; though this is generally dismissed, as the groove in which it sits only extends down to passage roof level. But it is a strange item, especially given the work in dressing an inch off its north side, and the leaving of this boss.

<sup>102</sup> Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 78



*Image courtesy of Jon Bodsworth*

In the above image we can see the shape of the boss a bit more clearly, along with the joint between the two granite pieces. The distance between the dressed face and the north wall of the antechamber is about 21 inches, and possibly intended to be a cubit. The quality of workmanship in the antechamber is not as good as we see elsewhere; indeed, Petrie would state; *“Coming now to the details of the walls, the rough and coarse workmanship is astonishing, in comparison with the exquisite masonry of the casing and entrance of the pyramid; and the main object in giving the following details is to show how badly pyramid masons could work. The great variation in the foregoing measures illustrates this.”*<sup>103</sup>

The rough workmanship of the antechamber should come as no surprise; it was a utilitarian space to house three portcullis blocks and hardly required a fine finish.

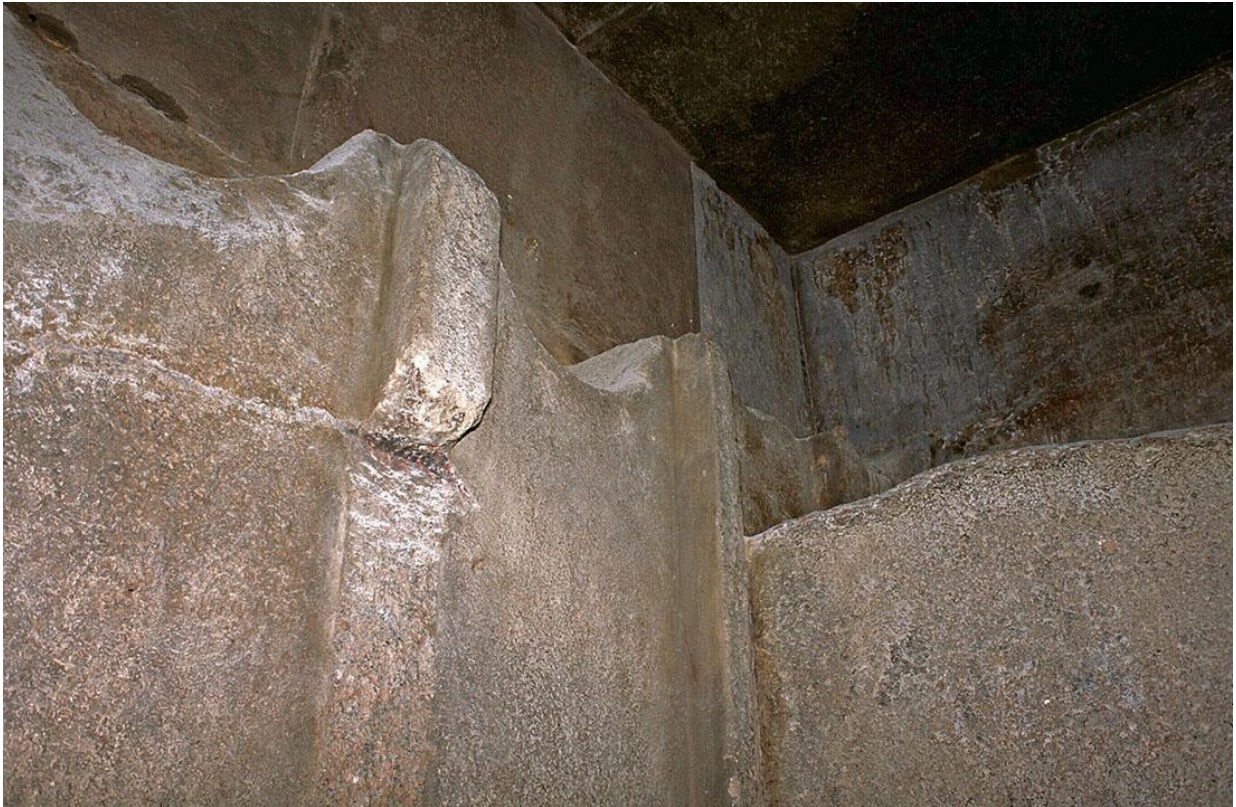
---

<sup>103</sup><sup>103</sup> Ibid, page 77



*Image courtesy of Jon Bodsworth*

Looking at the south side of the granite leaf we can see some of the surviving pilasters. The upper edge of the leaf appears damaged, more so on the east side, where we can see more damage occurring to the top of the pilaster. We can just make out the upper edge of the east wainscot, and above this the antechamber widens. According to Smyth he gives the height of the antechamber as between 149.2 to 149.5 inches with the top of the east wainscot being some 46.2 below the ceiling, which gives the height of east wainscot above irregular floor as 103 to 103.3 inches, or about 2.62m. The west wainscot is higher, being only some 37.5 inches below the ceiling, and unlike the top of the east wainscot it is not a flat ledge but it has three rough semi circular depressions cut into it.



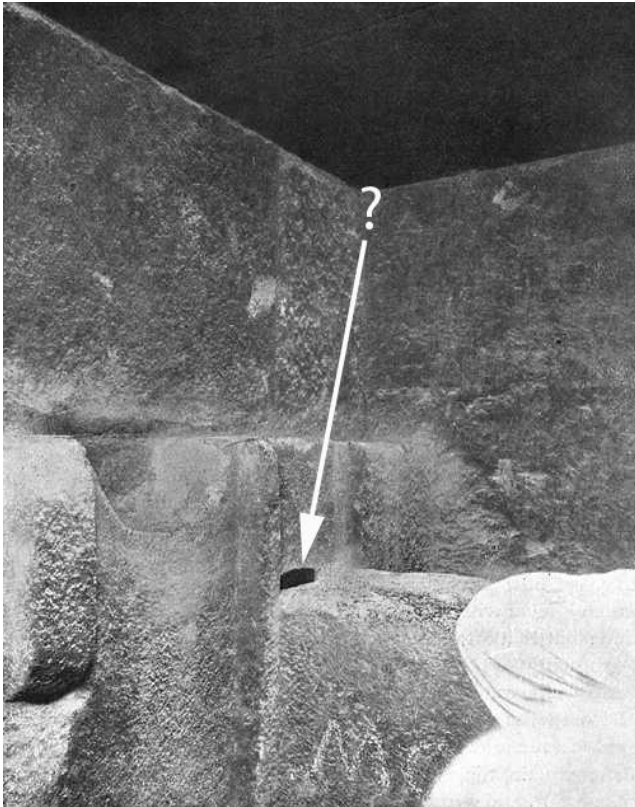
*Image courtesy of Jon Bodsworth*

Looking up into the northwest corner of the antechamber, we can see two of the three semi circular depressions on top of the higher west wainscot. The top of the granite leaf is visible, and behind that we can see how the limestone at the north end of the antechamber gives way to the granite masonry for the remainder of the antechamber. The antechamber is roofed over by three granite blocks. Above the wainscots, the antechamber according to Smyth widens to some 65 to 65.3 inches.<sup>104</sup> The width between the pilasters is around 41.4 and 42 to match the 2 cubit width of the passage; whilst the grooves between the pilasters showing a width of about 48.1 inches. The bottom of the semi circular depressions appear to be at the same level as the top of the east wainscot, and it seems likely that wooden logs were placed inside these, with their other ends resting on the flat shelf of the east wainscot. The question to ask is why both wainscots were not at the same level, and with circular depressions; was this building error or was there some deliberate reason behind it.

---

<sup>104</sup> Piazz-Smyth provides more measures and his tables can be found in his Vol 2, pages 92-100. Petrie's can be found in his 1<sup>st</sup> ed, pages 77-79





In this early image by the Edgar's we have a similar viewpoint to the previous image, but taken at a higher elevation. The interesting thing about this image is the dark area which I have arrowed; what is this? In their work the Edgar's would state; *"A close examination of the Granite Leaf makes it quite certain that the architect did not design it as a fourth portcullis, not only because it never has been, nor could have been effectually so used, but also because it is firmly cemented into its present position (and, probably, also mortised into its place, although this is not easy*

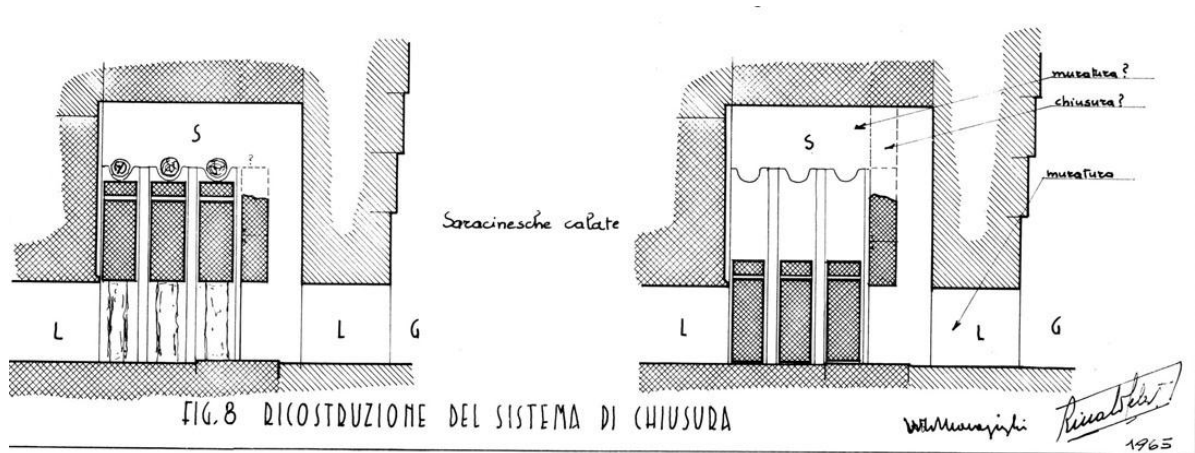
*to determine).*"<sup>105</sup> I can find no further information on this dark area, but first impressions seem to suggest that we are looking into a possible mortise let into the granite leaf groove: did a tenon exist on the upper leaf, which would limit the vertical travel of the leaf as a further security feature. For example, one could imagine that the boss on the upper leaf was a levering point; the rigging for the portcullises would be fed between the two leafs, with the weight of the upper leaf clamping the rigging. Come the time to lower the portcullises, a sturdy baulk of timber would be placed at an angle under the boss, and a hefty blow at the base of this baulk would lever the upper leaf up, thereby releasing the rigging and allowing the portcullises to fall under their own weight. After release they could have placed a bed of mortar between the two stones as extra security (though it's not exactly clear in the reports as to what areas of the leaf contain mortar).

As to the irregular top edge of the upper leaf we have differing opinions as to whether this is deliberate damage; Petrie for example, thought it to be the natural surface of a granite boulder.<sup>106</sup> Others suggest that the upper leaf would be more regular and extend higher. According to Smyth the lower leaf is between 27.5 to 28 high; whilst the upper leaf varies from 18.0 on east to 23.5

<sup>105</sup> Great Pyramid Passges, Vol 1, 1923, page 302

<sup>106</sup> Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 79

high on the west; so a considerable difference in height. If Petrie is correct, it might explain why the boss is slightly offset from the centre towards the west wall, as this boulder would be slightly unbalanced with its weight more to the west side.

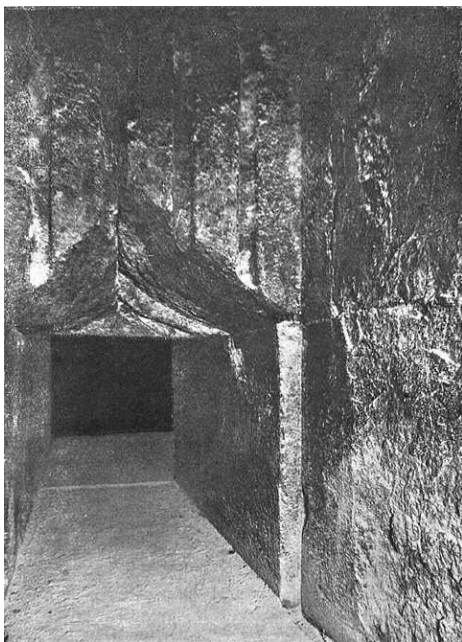


The above fig 8 from M&R's TAV 7, shows their reconstruction of the portcullises in the antechamber. In the left image the portcullises are resting on wooden baulks, which is logical, as one would hardly place rigging under strain for what would be many years, awaiting the death of the king. In this image they reconstruct the upper leaf with a question mark. In the right image the portcullises are lowered and the suggestion is made that further masonry was fitted on top of the leaf for added security. The problem with the antechamber design as many have noted, is that the gap between the leaf and the north wall of the antechamber allows a bypass circuit for robbers, who merely have to climb over the leaf, and walk along the top of lowered portcullises and attack the base of the chambers south wall to gain access to the passage and hence the prize of the king's chamber.

Of course if Petrie's observation that the irregular upper part of the leaf is natural and not human damage, then this could exacerbate the security even more. It would seem unlikely that the design of the portcullis chamber would allow such an obvious bypass. One solution, given that the upper ledges of the wainscot's extend all the way back to the chamber north wall (albeit one ledge is lower than the other) would be to fit a covering stone over this gap, to prevent robbers from bypassing the granite leaf. One could think of several permutations here; for example a 'T' shaped covering stone, which would extend below the upper edges of the wainscots, and covering part of the upper leaf. The portcullis operation and design may have been tested, before the chamber ceiling blocks were placed; once satisfied in correct operation and

rigging solution, the portcullises would be raised to their storage position and supported on wooden beams. The wooden logs and rigging reset, with the rigging coming through the gap between the two parts which make up the granite leaf; this gap would be held open by a spacer. A suitable covering stone would conceal the gap between the leaf and the chamber north wall. Here the whole assembly would rest, with no tension placed on any of the components until the day of the king's burial.

It is also possible that as part of the security arrangement, the small passage from the grand gallery was sealed. The great step is 3 cubits deep and 4 wide, and as the passage is 2 cubits wide, a stone 1 cubit thick could have been stored either side of the great step. Stones or a single stone could have sealed off the passage opening; M&R thought that the damage visible on the image on page 74 might be indicative of robber's trying to cut through a sealed passage.



In this early Edgar image we can see the damage done to the south wall of the chamber, which had four grooves cut into it. The south wall is mainly a singular large granite block, apart from a small portion at the top, which is of limestone. Today this damage has been restored, as can be seen on the image on page 74. Though this restoration is not how Petrie describes the ends of these grooves, he states;

*“The south wall has four vertical grooves all up it, which have been hitherto supposed to have extended down to the top of the passage to the King's Chamber. This was not the case, however; for, though much broken away, it is still clear that they became shallower as they neared the bottom, and probably ended leaving an unbroken flat surface over the doorway.”*<sup>107</sup>

This damage above might be indicative that the robbers had managed to bypass the granite leaf or breached the first portcullis, and bypassed the other two by attacking the base of the south wall.

---

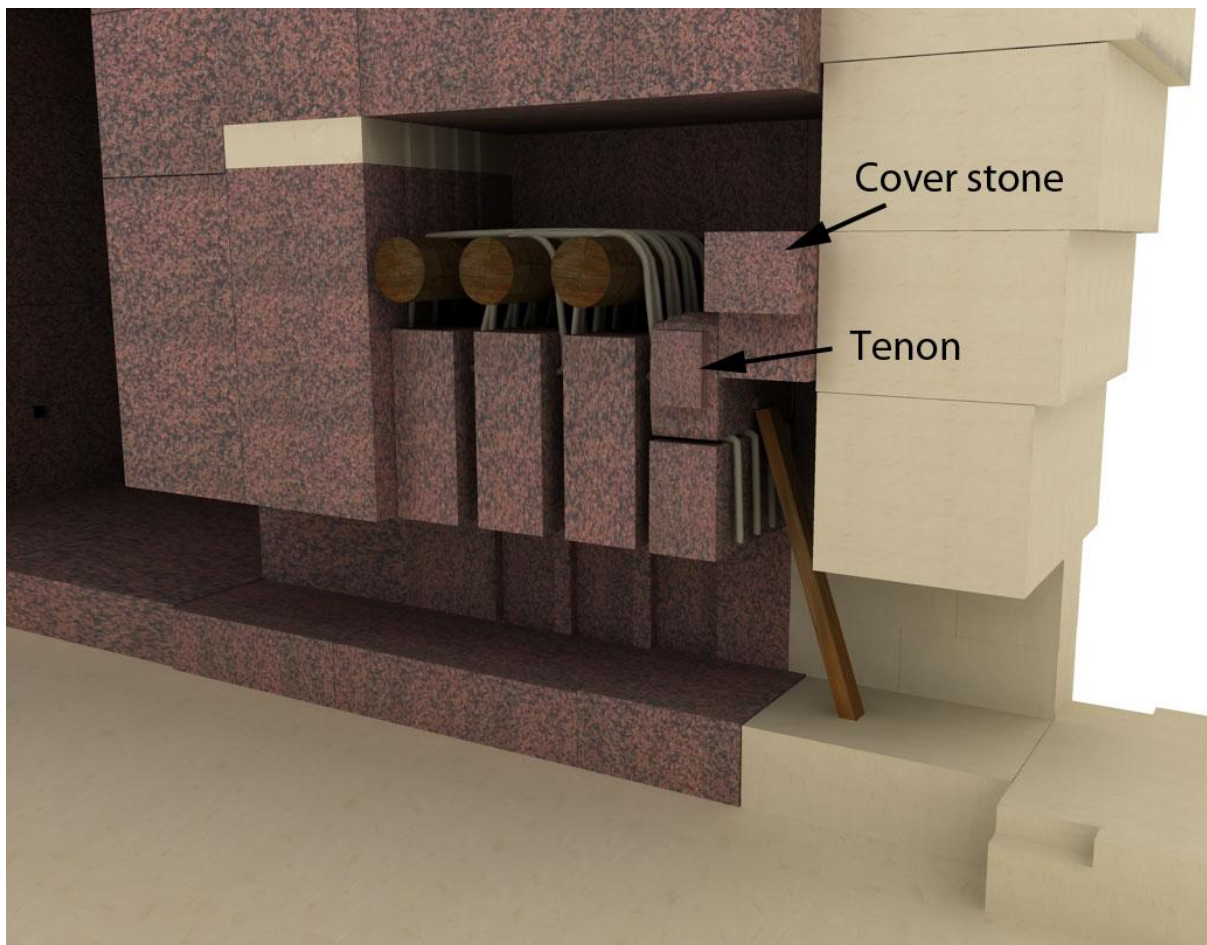
<sup>107</sup> Ibid, pages 77-78



*Image courtesy of Jon Bodsworth*

Looking up the south wall we can make out the rounded profile of the grooves, and the small limestone block at the top of the wall. These grooves would provide a space for the rigging, so as not to interfere with portcullis operation.

The grooves which guided the portcullises vary slightly in width; for example, on east side, Smyth would report, starting from north end 22.0, 21.4, & 21.1 inches, and for comparison, west side, 22.1, 21.0, & 20.4. The granite stone by the original pyramid entrance, complete with holes for rigging, is likely a piece of one of the portcullises, and is about 1 cubit thick, 20.6 inches; and clearly a suitable amount of clearance between the pilasters would be required; especially if the release of the portcullises was carried out remotely, and one could not gain access to the rigging etc.



In the above schematic reconstruction I have shown one example of many possibilities, it is therefore very tentative based on the limited data of this chamber. Prior to operation, the rigging through the granite leaf would be clamped tight by removing any spacers and letting the upper stone clamp the rigging securely. Any props supporting the portcullises during their long storage would be removed, and the whole system along with the rigging would be under load (the rigging above is purely schematic, and I would leave that solution to the experts in such matters; I struggle with shoe laces). I have placed a tenon on the upper leaf, in case a mortise exists in the wainscot, and a T shaped cover

stone to prevent robbers from bypassing the leaf. Once the system is locked and loaded, a strong piece of timber could be angled under the lower edge of the boss. A sharp blow to the bottom of this timber would lever up the leaf and release its grip on the rigging, allowing the chain of portcullises to lower under their own weight, and finally seal access to the king's chamber.

The weak link would be the cover stone, which like the upper leaf, is of unknown size. Robbers could attempt to lever this stone up first and bypass the leaf and attack the south wall. There are no grooves on the floor of the passage in which the portcullises would sit to prevent against levering, such as we see in Khafre's pyramid.

As previously noted, the semi circular depressions for logs only exist on the higher west wainscot; the log ends would merely rest on the flat shelf of the east wainscot. This layout seems unusual as one end of the log is not fixed, but has the ability to float about; that said, I suspect that it would not affect the operation in lowering the portcullises. Indeed, it may have even been planned that way as another obstacle to robbers; as any robbers who smashed through the leaf and hoped to use the ropes to raise the portcullis might have encountered difficulty due to one end of the log being floating.

At the end of the day, the chamber can only be guess work, what data we hold is quite old, and largely a mixture of inconsistent measures and opinions. One would like to see more masonry analysis of the chamber; even a more forensic look at the granite leaf would help; for example, what is the dark area in Edgar's image, and where exactly is the mortar reported on the leaf.<sup>108</sup>

### **The King's Chamber**

The King's chamber is an all granite affair; even if some robber thought they could tunnel around the portcullis chamber, they would still be met with large blocks of granite which form the walls, ceiling and floor. The chamber is a large rectangular space, some 10 cubits wide and 20 cubits long. The walls consist of five courses of granite, all of equal height, and as previously mentioned the thick granite flooring was inserted between the walls in such a manner that its upper surface was at a higher level than the granite base of the walls. This provides the chamber with two heights for theorists, the first being the height of the five courses, and the second being the height from the floor, which is less.

---

<sup>108</sup> Various schemes on how the antechamber may have worked have been displayed by others, and Dormion shows a solution also in his work.

Petrie would give the mean height of the five courses as some 47.045 inches, which is in close agreement with Piazzi-Smyth's findings.

Directions bearing from centre.	Height of first course from floor.	Height of second course from floor.	Height of third course from floor.	Height of fourth course from floor.	Height of fifth course from floor.	Sum of heights of courses.	Height of room in same part by a previous independent measure.
E.-N.-East,	42.1	47.0	47.1	(47.0)	(47.0)	230.2	230.8
East, .	42.4	47.0	(47.0)	(47.0)	(47.0)	230.4	...
E.-S.-East, .	42.7	47.1	47.0	(47.0)	(47.0)	230.8	230.8
S.-S.-East, .	Wall much fissured through several courses.						...
South, .	41.1	47.0	(47.0)	(47.0)	(47.0)	229.1	229.5
S.-S.-West,	41.4	47.0	47.0	(47.0)	(47.0)	229.4	} 229.9
W.-S.-West,	41.6	47.0	47.0	(47.0)	(47.0)	229.6	
West, .	41.6	47.0	(47.0)	(47.0)	(47.0)	229.6	...
W.-N.-West,	41.2	46.9	47.0	(47.0)	(47.0)	229.1	229.2
N.-N.-West,	Hole in floor caused by removal of three blocks.						...
North, .	42.0	47.1	(47.0)	(47.0)	(47.0)	230.1	229.7
N.-N.-East,	42.3	47.0	47.0	(47.0)	(47.0)	230.3	230.8

In Piazzi-Smyth's table above,<sup>109</sup> we can see his course heights and the irregular level of the floor (first column-'height of first course from floor') as previously mentioned by Petrie. In Petrie's work he would give the floor as varying some 2.29 inches below the first course joint from 42.94 to 40.65 inches.<sup>110</sup> Clearly care was taken in the manufacture of these wall blocks, of which 100 blocks is thought to make up the walls of the chamber. The construction of the walls is quite exceptional with fine joints, other than some areas where seismic activity or settlement has opened a few joints. Correcting for open joints Petrie determined the best value for the cubit from the chamber as 20.632+/-0.004 inches. If we accept a cubit of 20.63 then the height of each course amounts to 2 cubits 2 palms or 64 digits, or 47.15 inches (63 digits would give 46.42).

This would mean that the total height of the 5 courses was 5x64=320 digits, and as the chamber is 20 cubits long or 560 digits: it follows that the circuit of the long wall is 1760 digits. This number would agree with the perimeter of the pyramids base of 1760 cubits; moreover, if we divide the

<sup>109</sup> Life and Work, Vol 2, page 107

<sup>110</sup> Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 82

circuit of the long wall with the width of the chamber i.e. 280 digits (pyramid height 280 cubits), we obtain the same 22/7 ratio exhibited on the exterior of the pyramid. Petrie would comment on the theories attached to the pyramid, including the king's chamber, as shown below.<sup>111</sup>

To determine the origin of this form, the King's Chamber theories must be referred to. One theory, that of the chamber containing 20 millions of the mythical Pyramid inches cubed, is cleared away by measurement at once. Taking the most favourable of the original dimensions, *i.e.*, at the bottom, it needs a height of 235.69 to make this volume, and the actual height differs half an inch from this, being 235.20±.06. The only other theory of the height of the walls is similar to one of the best theories of the outside of the Pyramid; it asserts that taking the circuit of the N. or S. walls, that will be equal to the circumference of a circle whose radius is the breadth of the chamber at right angles to those walls, or whose diameter is the length of those walls. Now by the mean original dimensions of the chamber the side walls are 412.25 long, and the ends 206.13, exactly half the amount. Taking, then, either of these as the basis of a diameter or radius of a circle, the wall height, if the sides are the circumference of such circle, will be 235.32±.10, and this only varies from the measured amount within the small range of the probable errors. This theory leaves nothing to be desired, therefore, on the score of accuracy, and its consonance with the theory of the Pyramid form, and (as we shall see) with a theory of the coffer, strongly bears it out.

The second height of the chamber that from the top of the floor has also generated several theories, some of which is discussed in Petrie's *Theories compared with facts* section in his work.<sup>112</sup> Petrie would suggest that the simplest theory was that the floor was raised a quarter of a cubit above the base of the walls. The squaring of the chambers dimensions may have been intended as integral numbers, with the squares of the diagonals being integers. However, the irregular level of the floor allows various theories a possible placement. I have previously mentioned a possible two cubit height and that the floor would in this scenario be placed 2 palms above the base, which is 1 digit more than a quarter cubit. Given a 20.63 cubit we have either 5.16 or 5.89 inches, or the floor level below first course joint would be either 41.99 or 41.26 inches; both of which fit inside the varying range of the floor. But it again highlights the difficulty in obtaining the architects intents. Some authors are so convinced of their theory, often to numerous decimal places, but extreme care is required, especially when dimensions vary widely.

---

<sup>111</sup> Ibid, page 190

<sup>112</sup> Ibid, pages 195-195





*Image courtesy of Isida Project*

When one first enters the chamber the first thing to attract your eye is the huge amount of damage surrounding the opening of the southern shaft.



*Image courtesy of Isida project*

In the above image looking at the east wall, with entrance in north-east corner, the shadows better reflect the depth of the damage. Who created this damage is lost to history, but it is the most brutal scar to afflict this chamber.

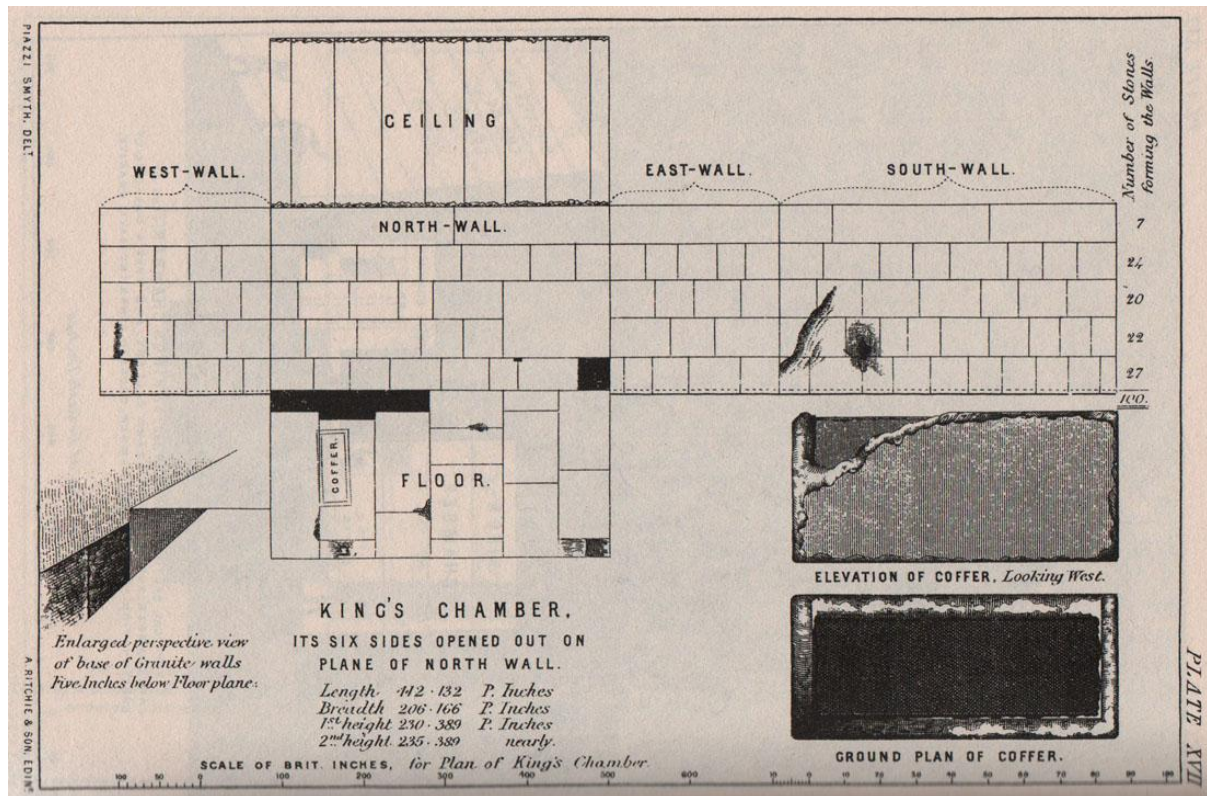


*Image courtesy of Jon Bodsworth*

Looking at the west end of the chamber we can see the damaged sarcophagus; we do not know its original location in the chamber, but if we take the passage axis system as 14 cubits east of the pyramids north-south axis, then the last quarter of the chamber (5 cubits) will be placed in the west, and it's possible that the king was buried in this western portion. We can make out the five courses of granite blocks, and it's interesting to note that the top course is just one block of granite (large blocks are also to be found on top of the other walls).

The granite flooring looks intact, but in Prof Greave's visit he reports a large stone having been removed adjacent to the sarcophagus and an

excavation under it; the damage to the southern shaft appears also to be noted by him as he describes it as somewhat large and rounder than the north shaft.<sup>113</sup>



In the above plate by Piazz-Smyth we get an idea of block layout inside the chamber; how accurate this layout is, and block dimensions is questionable.<sup>114</sup> As we can see from the block layout on the floor, we have some quite sizeable stones, and just north of the coffer we have three stones removed, and here the excavation noted by Greaves appears to have been enlarged by Vyse. The thickness of the floor stones is not recorded, but M&R's TAV7, fig 1, suggests a thickness of 2 cubits.

Above the doorway we can see a large lintel which takes up two courses, Petrie would report; *"There is a remarkable diagonal drafted line across the immense block of granite over the doorway; it appears not to run quite to the lower corner on the E. side; but this is doubtless due to the amount by which the block is built into the E. wall, thus cutting off the end of the diagonal line."*<sup>115</sup>

Petrie would also report some 15 traces of bosses all on the lowest course that had not been fully dressed away.

<sup>113</sup> Pyramidographia, pages 643-644

<sup>114</sup> Smyth would provide some tables of what he could measure in Vol2, along with measures by Aiton & Inglis, which in places differ; ideally a more modern survey is required.

<sup>115</sup> Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 83



*Image courtesy of J.D.Degreef*

The chamber is spanned by 9 large granite beams, and as the image above shows, practically all these beams have been cracked on the south side of the chamber. Petrie would report;

*“These openings or cracks are but the milder signs of the great injury that the whole chamber has sustained, probably by an earthquake, when every roof beam was broken across near the South side; and since which the whole of the granite ceiling (weighing some 400 tons), is upheld solely by sticking and thrusting. Not only has this wreck overtaken the chamber itself, but in every one of the spaces above it are the massive roof-beams either cracked across or torn out of the wall, more or less, at the South side; and the great Eastern and Western walls of limestone, between, and independent of which, the whole of these construction chambers are built, have sunk bodily. All these motions are yet but small—only a matter of an inch or two—but enough to wreck the theoretical strength and stability of these chambers, and to make their downfall a mere question of time and earthquakes.”<sup>116</sup>*

Also in the image above, we can make out some stains on the ceiling stones; these stains also appear on the north side. Lehner and Hawass, would comment on these stains; *“Dark rectangular patches on the underside of the granite ceiling beams may also relate to these structural difficulties. The patches, about*

---

<sup>116</sup> Ibid, page 80

*30cm (12 in.) wide and extending about a metre (3 ft) from the join of the ceiling beams with the long sides of the chamber, appear to be stains produced by some structural element. One interpretation is that they were left by the resinous tops of wooded upright posts or struts set up to ensure that the massive granite beams did not collapse, perhaps after the cracks appeared and about the same time as the attempts at repair in plaster noted by Petrie. However, it would have been difficult if not impossible to introduce wooden posts this long through the Antechamber, so if the patches do indicate wooden supports, they would probably have been introduced as the granite beams were laid in place and before the chamber was completely roofed.*"<sup>117</sup>

They would also mention other suggestions by some authors, such as that some sort of internal frame work may have been fitted to create a shrine inside the chamber. Though at some 1m from the walls, it would appear to take up a sizeable part of the room, which is only 5.24m wide; moreover, why dress the granite walls to such a fine finish; a hard stone which could have been simply left as the rougher finish described by Petrie for the ceiling slabs: especially if they were going to be covered with a shrine? Indeed, it's possible that the walls were assembled with excess stock on their face to protect them; with final dressing taking place after the walls had been completed: dressing from the top down, it might explain the boss traces on the lowest course. So a lot of work remained to be done inside the chamber after the ceiling slabs, were placed, and inside this chamber, if the wooden beams could not be passed through the antechamber, would be a large pile of timbers along with the sarcophagus.



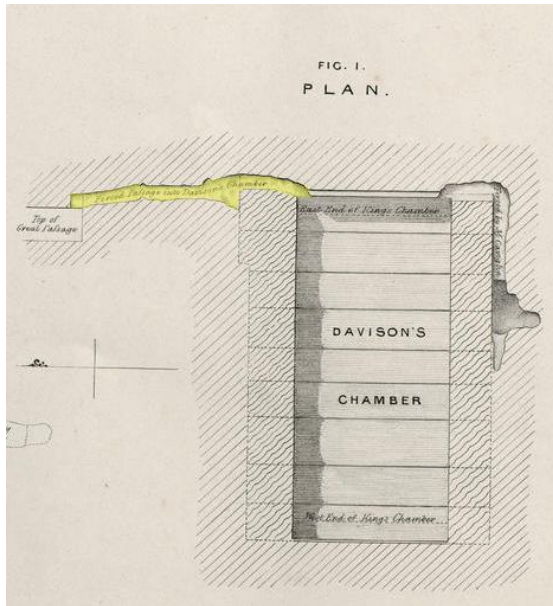
I found no difficulty in bringing beams of the dimensions reported by Lehner & Hawass through the antechamber; I used the height of 230 inches (5.84m) for the chamber from the floor. Yes, the chamber has a width of only 5.24m, half a metre less than the beams, but the passage is over a metre wide, and I found it easy in my CAD model to bring the beam in with room to spare. With the beams installed under each roof stone we would have something like the view left. Where I did find a problem

in the introduction of the beams is at the junction of the ascending and descending passages; here I could not get the beams to pass this junction (one would need to chamfer the ceiling considerably, and lose any covering stone).

---

<sup>117</sup> Giza and the Pyramids, 2017, page 154

If these beams were brought in to shore up the ceiling, the only possibility would seem therefore, that they were brought in via the robber's tunnel (the data on this tunnel is not ideal, and it may have been subject to enlargement at some later time); this in turn might suggest that any shoring up was a restoration effort. The robber's tunnel, often referred to as Mamun's tunnel, as discussed in part 1, could have been created by the original violators of the pyramid. The plastering into some of these cracks as reported by Petrie is purely cosmetic and need not necessarily be contemporary to Khufu.



The tunnel from the top of the grand gallery to Davison's chamber is often suggested as being made by the builders to inspect what damage had been done to the chamber above; but would the mason's have done such a thing? The cracks in the ceiling beams would tell them all that they needed; why dig into the masonry to create this tunnel and undermine the masonry integrity more. It's not as if they could enact any repair in the chamber above; moreover, if these beams cracked during Khufu's time, there was probably a large mass of the pyramid completed above, which caused

the stress. Nothing could be done unless one wished to dismantle a huge part of the pyramid. They could simply shore up the roof, and if the beams were too long to pass the AP/DP junction, they could bring them up in smaller sections. It has been suggested that this damage would have occurred during the build; however, we cannot know this for certain. The tunnel highlighted left from Perring's drawing could just as well be a searcher's tunnel, interested in what was above the king's chamber ceiling. Egypt has a long history of earthquakes, and we have no way of knowing how often the structure has been rattled by such events or when these beams cracked with 100% certainty; or if the cracks are just a result of settlement and unrelated to seismic activity.

## The Sarcophagus



*Image courtesy of Jon Bodsworth*

For some reason the above badly damaged granite box has attracted much attention by theorists. One only has to look at the tables of dimensions by Piazzi-Smyth and Petrie, to show that they both spent much considerable time on measuring this box; even the brief account by Prof Greaves provides detailed measures on it. Petrie would describe the box as;

*“The coffer in the King's Chamber is of the usual form of the earliest Egyptian sarcophagi, an approximately flat-sided box of red granite. It has the usual under-cut groove to hold the edge of a lid along the inside of the N., E., and S. sides; the W. side being cut away as low as the groove for the lid to slide over it; and having three pin-holes cut in it for the pins to fall into out of similar holes in the lid, when the lid was put on. It is not finely wrought, and cannot in this respect rival the coffer in the Second Pyramid.”<sup>118</sup>*

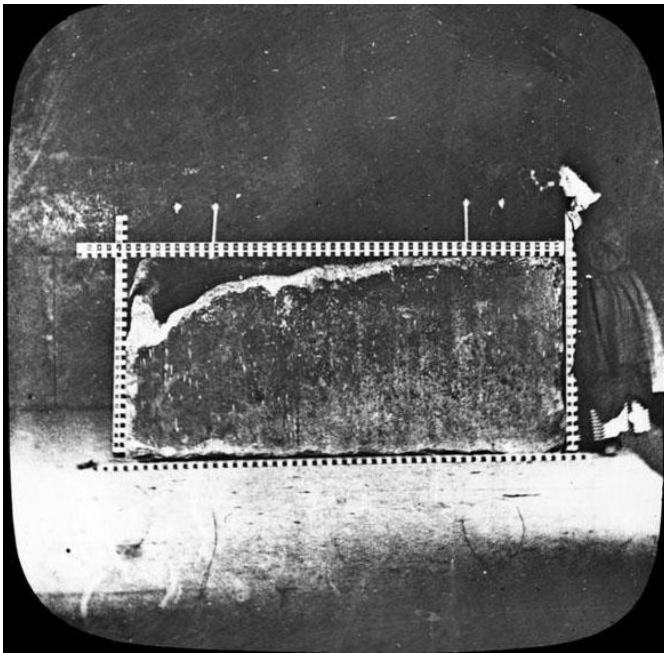
---

<sup>118</sup> Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 84

N. end thick	5'67	E. side thick	5'87	Inner depth	34'42
Inside length	78'06	Inside width	26'81	Base thick	6'89
S. end thick	5'89	W. side thick	5'82	Outer height	41'31
Outside length	89'62	Outside width	38'50	Ledge depth	1'70

The above image from Petrie's work shows his mean measures for the box; whilst below I have placed Piazzzi-Smyth's mean measures in the image, for comparison. (Smyth would only provide mean thickness of 4 vertical sides, of 5.99 – all measures in inches)

N. end thick	77.93	E. side thick	26.73	Inner depth	34.34
Inside length	77.93	Inside width	26.73	Base thick	6.92
S. end thick	77.93	W. side thick	26.73	Outer height	41.27
Outside length	90.01	Outside width	38.65	Ledge depth	1.72



In the image left by Piazzzi-Smyth we can see some of the equipment used by him to measure the box. Whilst mean measures above differ slightly, it does not necessarily mean that any particular gentleman is more correct, as approaches to measuring can differ between the two. It also has to be noted that these are mean measures, and that any particular value can move markedly from the mean value. For example, Petrie provides an example in his work, highlighting the variation in

length on one side; he would note a measure at 4 inches above bottom, "*which is about the lowest point uninjured*". Here the mean length of 89.62 requires .13 and .54 from the ends, to be added to give the length at this point of 90.29 inches.<sup>119</sup> A difference from the mean of 0.67 inches or 1.7cm.

Clearly as Petrie suggests, this is not finely wrought; that said, it is still an impressive piece of work: as we say in my part of the world, 'a man in a

<sup>119</sup> Ibid, page 88



galloping horse would hardly notice the difference'; though certainly not in the same league as the exceptional box found inside the pyramid of El-Lahun.

These fluctuating measures allow all manner of theorists to fit any particular design intent; indeed, Petrie would state;

*"The theories of the coffer itself are almost interminable, and they find ample room for discrepancies between them in the great irregularities of the working of the coffer. The various theories have so much connection with each other, and each have so many consequences which may be geometrically traced, that it is difficult to select the best phase of each theory."*<sup>120</sup>

Petrie would give a selection of the theories in his work, which the reader can freely pursue. From the work by Smyth and Petrie, we can gather a few clues; for example, the east side of the box appears to have the finest plane; Smyth would report that the other three sides had noticeable concave sides of 0.3 and 0.5, whilst the errors on the east side were under 0.02.<sup>121</sup> Why is this? In my basic engineering training, too many years ago, we would often be tasked with making a test piece, such as making a rectangular bar from a very rough piece of metal. One of the first things to do in such a task was to create a very flat and accurate side first; this we would term our master side and any subsequent measures for the other sides would be referenced to this master side. A similar process may have been used on our sarcophagus.

A quick experiment in reducing the data to Egyptian digits (based on a cubit of 20.63 inches and not going lower than a third of a digit), I could make the following suggestion; External length 122d, height 56d and width 52 $\frac{1}{3}$  d. The side thickness at 8d, and the thicker bottom at 9 $\frac{1}{3}$ d. The box height appears to be intended as 2 cubits high, but what of the missing lid? If the floor was intended to be 2 cubits below the first course joint, then the box would be level with this, and any lid would be above it. The wall course height of 64 digits seems important to the design of the chamber, and if this was intended to be the intended height also of the complete sarcophagus, then the lid would be 8 digits high (2 palms) the same thickness as the sides of the box. The lid in this configuration, would be 1/7<sup>th</sup> of the volume of the solid box, and it might have been intended that the thicker base of the box was 1/6<sup>th</sup> the volume of the solid box. One might argue that such a lid seems thin compared to Khafre's, but lids can be thin, as displayed in the fine alabaster sarcophagus of Hetepheres found next to the pyramid, which has a lid only 9cm thick (3.54 inches or about 5 digits).<sup>122</sup> Indeed, there may have been an attempt to make components of the sarcophagus, be it sides, base etc direct fractional relationships of the solid whole; and of course it has been noticed that the empty volume is a close approximation to the remaining bulk of the box.

---

<sup>120</sup> Ibid, page s 195-196

<sup>121</sup> Life and work, Vol 2, page 117

<sup>122</sup> A History of the Giza Necropolis Volume II, Reisner&Smyth, page 16

At the end of the day one can play with figures all day long and make many a theory fit the variable dimensions of this box; but ultimately the great variability of measures in this piece practically allows any theory.



On the western edge of the sarcophagus three holes were made; these would have received security pins which would fall down from the lid when it was slid along the grooves cut into the top of the box. This would prevent robbers from sliding the lid back; a similar method was used in Khafre's better preserved sarcophagus, but here only two holes were used.

Petrie would report many saw lines visible on the exterior of the box, along with tube drill marks in the interior, which were used to hollow out the box.

*Image courtesy of Jon Bodsworth*

Petrie would report a large flint pebble under the sarcophagus which he thought important; he states; *“The flint pebble that had been put under the coffer is important. If any person wished at present to prop the coffer up, there are multitudes of stone chips in the Pyramid ready to hand. Therefore fetching a pebble from the outside seems to show that the coffer was first lifted at a time when no breakages had been made in the Pyramid, and there were no chips lying about. This suggests that there was some means of access to the upper chambers, which was always available by removing loose blocks without any forcing. If the stones at the top of the shaft leading from the subterranean part to the gallery had been cemented in place, they must have been smashed to break through them, or if there were granite portcullises in the Antechamber, they must also have been destroyed ; and it is not likely that any person would take the trouble to fetch a large flint pebble into the innermost part of the Pyramid, if there were stone chips lying in his path.”*<sup>123</sup>

Interestingly enough this pebble appears to have been noticed by Piazzis-Smyth and survived in position until Petrie's time. He states; *“It is, moreover, tilted up at its south end, by a black flint pebble, about 1.5 inch high, pushed in underneath the south-west corner.”*<sup>124</sup>

<sup>123</sup> Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 85

<sup>124</sup> Life and Work, Vol 2, page 114

This pebble was likely brought in by searchers who wish to move the box, by placing a round stone under a corner, and pivoting the box around it; I have done something similar in the past, when trying to move a heavy load, it is surprising effective. The fragments of masonry of which there would be many would unlikely provide a suitable stone, and so it should be no surprise that one was brought in from outside.

Piazzzi-Smyth would find another stone inside the sarcophagus, he states; *‘What is this great stone doing here, Alee?’ I inquired. ‘Why, the travellers want it whenever they come,’ returned he, ‘to hit the coffer with hard, and make a sound like a bell’. ‘Then just have the goodness to take it out, and throw it down into that deep excavation under the floor-’*<sup>125</sup>



In this early image by the Edgar’s we can make out the hole in the floor, bottom right. Numerous graffiti is also visible on the walls, and now all cleaned away; but one piece of graffiti may yet survive inside the chamber, and that of Petrie himself. In his journal he reports the operation in lifting the sarcophagus in order to measure its bottom, and after completion he states; *“Then we lowered the coffer*

*again onto its stone, first cleaning out everything but fine dust from under it: and (the only time I ever did such a thing) I chalked on the bottom of the coffer “Lifted 9 April 1882 W. M. F. Petrie”, Ellis putting his name & date on the floor under it.”*<sup>126</sup>

## The Shafts

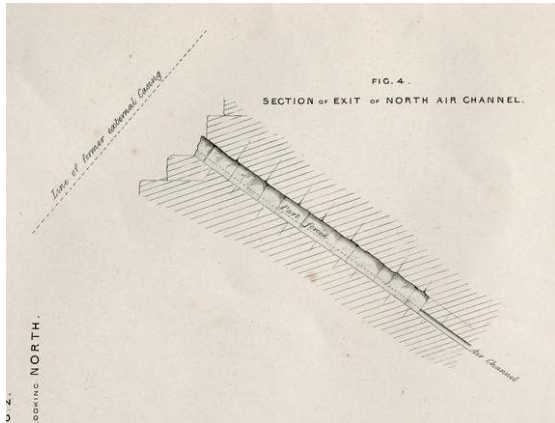
Unlike the queen’s chamber shafts, these shafts appear to have been left open. The clearing of debris from the shafts was undertaken by Vyse. Perring reports;

*“Figs. 1 and 2, Plate III., shew the excavation made by Mr. Caviglia, along the Northern Air Channel; and Fig. 4, Plate IV., is a section of the exit of the same, which for 47 feet 6 inches from the exterior has been forced downward. When discovered, this forced part and the channel itself was filled up with desert sand, which has been cleared out, as well as the Southern Air*

<sup>125</sup> Life and work, Vol 1, page 90

<sup>126</sup> Petrie Journal 1881-1882, page 207, Sunday, April 9<sup>th</sup>. His journals are available online.

Channel, by Colonel Howard Vyse, and the ventilation of the Pyramid has been restored.”<sup>127</sup>



Perring’s fig 4, is shown left, and here we can see the excavation apparently made by Caviglia; like his excavation attempt from the chamber end, it only extends a short distance. He would also make a small excavation from one of the relieving chambers in an attempt to intercept the southern shaft.

The shafts appear to have become blocked again for Morton Edgar obtained permission to clear the shafts in 1928. He tells us;

*“When I was at the Pyramid in 1928 I got permission from the Egyptian government to clear the debris from these channels. During my first visit in 1909, the South Air-Channel of the King’s Chamber was quite open and a good breeze constantly passed through it, but the North Air-Channel of this chamber was entirely stopped up with stones and hardened dust. My object during this last visit was to clear out this obstruction from the North Channel. The South Channel had also during the past twenty years become blocked with debris. However, I found it a comparatively easy matter to remove the debris from the South Channel, but work on the North Channel was much more difficult. I employed several Arab workers to push down a long boring rod from the outside of the Pyramid on the north side. At the end of this rod was a scoop of metal by which they were able to extract the debris a little at a time. As the North Air-Channel is over 200 feet in length, and only 9 inches square in bore, it was an arduous task to remove all the hardened debris. My men worked on it for six weeks continuously. I am glad to say that their labors were entirely successful, every particle of debris being removed; and now, seeing that both South and North Air-Channels of the King’s Chamber are quite open, there is a constant cool air-current passing through the Pyramid.*

*In order to prevent these channels again becoming stopped up with debris, I directed my men to construct certain masonry work at their outer ends. This masonry is arranged in such a way that it will be impossible for dust or stones to again be washed into the channels by rain.”<sup>128</sup>*

Today modern ventilation systems installed with the help of Gantenbrink take advantage of these shafts. We don’t know if the shafts opened through the casing originally, which might seem doubtful; would one take the chance of heavy rains pouring through the shafts and damaging funerary items stored in

<sup>127</sup> The pyramids of Gizeh, from Actual survey and admeasurement, part 1, page 2

<sup>128</sup> Great Pyramid Passages, Pyramid Discourse-1929, page xix-xx

the chamber: even small bats might make the journey. Though Edgar reports that both shafts were cleared of every particle of debris, and precautions fitted to prevent debris getting in, they appear to have not been wholly successful, for Gantenbrink found the shallower north shaft to be requiring a major clearing effort.



In this image from Gantenbrink's website we can see Ulich Kapp, squeezing down into Caviglia's excavation in the north shaft.



This further image shows the inside of Caviglia's excavations, which they would term the Mankiller.



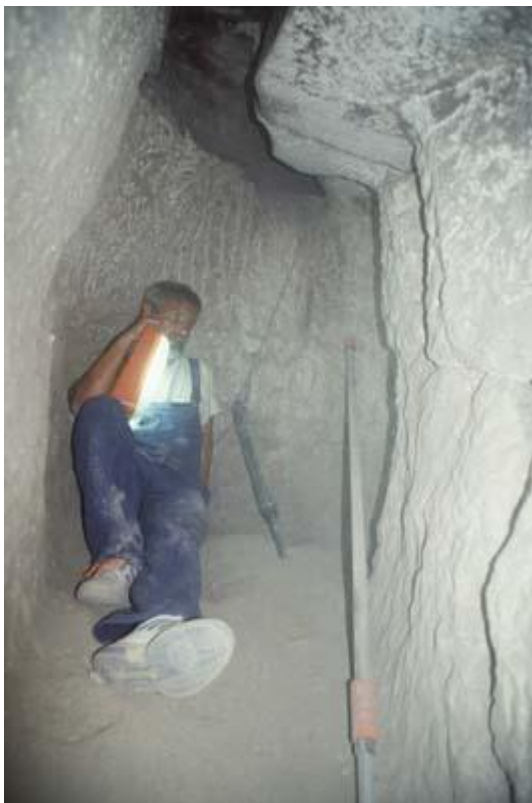
Inside this excavation the team recovered a badly corroded 30kg iron battering ram on wheels; who this belongs to is a mystery. Edgar cleared the shaft in 1928, could he have used it, or maybe it originates from the time of Howard-Vyse.

Gantenbrink, would describe how they went about clearing the north shaft of debris;

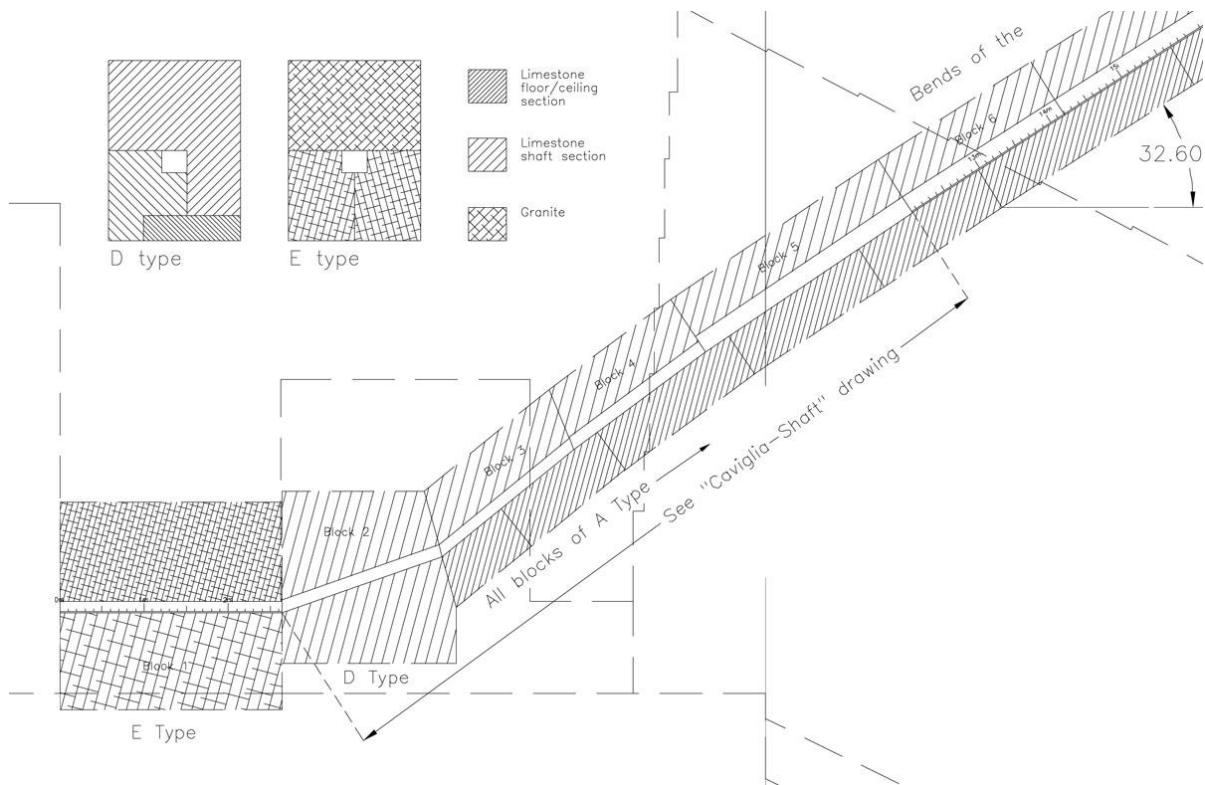
*“We fashion our own, hopefully more effective ram by sharpening one end of a truck axle and welding a large chisel onto it. We carry this 40-kilogram construction up to the entrance to the Mankiller.*

*There we attach a rope to the rear end of our improvised ram and then send it sliding down the chute. It accelerates for a few seconds and then crashes into the plug of debris, with the desired effect of breaking up the larger stones into smaller pieces, some of which slide down the shaft. But once is not enough.*

*Only on our third run do we achieve our breakthrough, and hundreds of kilos dust and debris, surrounding our axle, pour down in the Caviglia Tunnel. The interior of the Pyramid is clouded with dust for several hours – but for the first time in at least hundreds of years, the upper northern shaft is clear.”*



Clearly Gantenbrink was not aware of the work of Vyse or Edgar, who both report that they had cleared this shaft. The image left shows Ulich Kapp inside Caviglia’s excavation, which starts from the antechamber. All the debris would flow down into this location; the original shaft is at top of picture. The team would fit a plastic pipe through Caviglia’s excavation and protect the outlet from further ingress of debris. It would be interesting if we could obtain detail masonry layout of these excavated areas to see how they solved the problems of placing masonry, which was often laid at different angles to adjacent masonry; i.e. shaft masonry and gallery masonry follow different inclines.



The above section is part of Gantenbrink's CAD files, and like in the queen's shafts the majority of the masonry which makes up the shaft is of type A blocks. The large granite blocks of the chambers walls are termed Type E, and are similar to the north shaft block in the queen's chamber. The type D seems unique to this shaft, and this block along with blocks 3 & 4, bend to the north-



west to avoid the large masonry of the gallery (see plan on page 65). In the view left, we can see the joint of the two granite wall blocks run along the floor of the shaft. This wall joint according to Piazz-Smyth's tables is 103.3 inches from east wall, or 5 cubits.<sup>129</sup>

*Image courtesy of Larry Pahl*

<sup>129</sup> Life and Work, Vol 2, page 109



*Image courtesy of Larry Pahl*

Though the mouth of the southern shaft is badly damaged, we can still make out the well preserved floor and joint line of the shaft. This wall joint according to Smyth's tables is some 100.1 inches from east wall: in the same table Aiton and Inglis give 100.4 inches. Strangely M&R give 2.46m for the axis of the shaft from the east wall on their TAV 7, or 96.9 inches (however, on fig 2, TAV 8 they give 2.48 to east side of shaft, with fig 1 giving the joint as 2.54m or 100 inches). From images the joint line in the south shaft, appears not to be equidistant, with the greater part of the floor west of the joint; which might have been done to keep the shaft close to the 5 cubit mark. The better preserved mouth on the north wall is given as 8.3 wide and 5.7 inches tall.





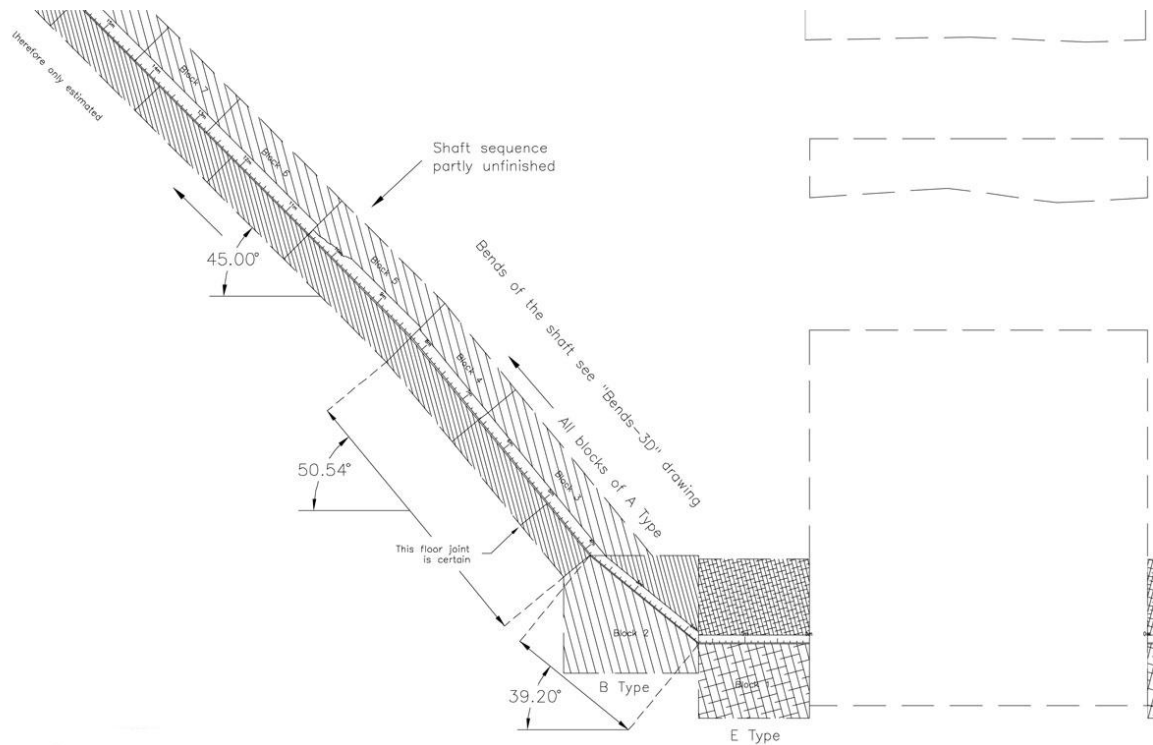
*Image Courtesy of Jon Bodsworth*

In the above image I have highlighted part of the massive lintel above the chamber's entrance, which takes the height of two courses. This large block is given by Smyth as some 122.7 inches (3.12m) wide, whilst its height would be about 2.39m, and according to M&R's TAV 7 it is some 1.28m thick. The block as we see it above is about 6 cubits wide, and it might have been intended to overlap the joint below by a cubit; the amount built into the east wall is unknown, but if we give it a cubit overlap as well, we could have a block of some 11 cubic metres, or over 30 metric tonnes; though the ceiling beams would weigh considerably more than this.

There is inconsistency in measures of course blocks, and even in the horizontal length of the north shaft before it commences its angle upwards. The block by the doorway under the lintel is a single block which extends to the south wall of the antechamber some 100.8 inches (Petrie) 2.56m, away. Gantenbrink's CAD drawing suggests that the shaft is level throughout this distance, he states that this horizontal section is 2.63m; however, M&R's TAV 7, fig 1, suggests that it is not (see image on page 73). This shorter distance is also reflected in Perring's plate III drawing. Who is correct I know not, but the

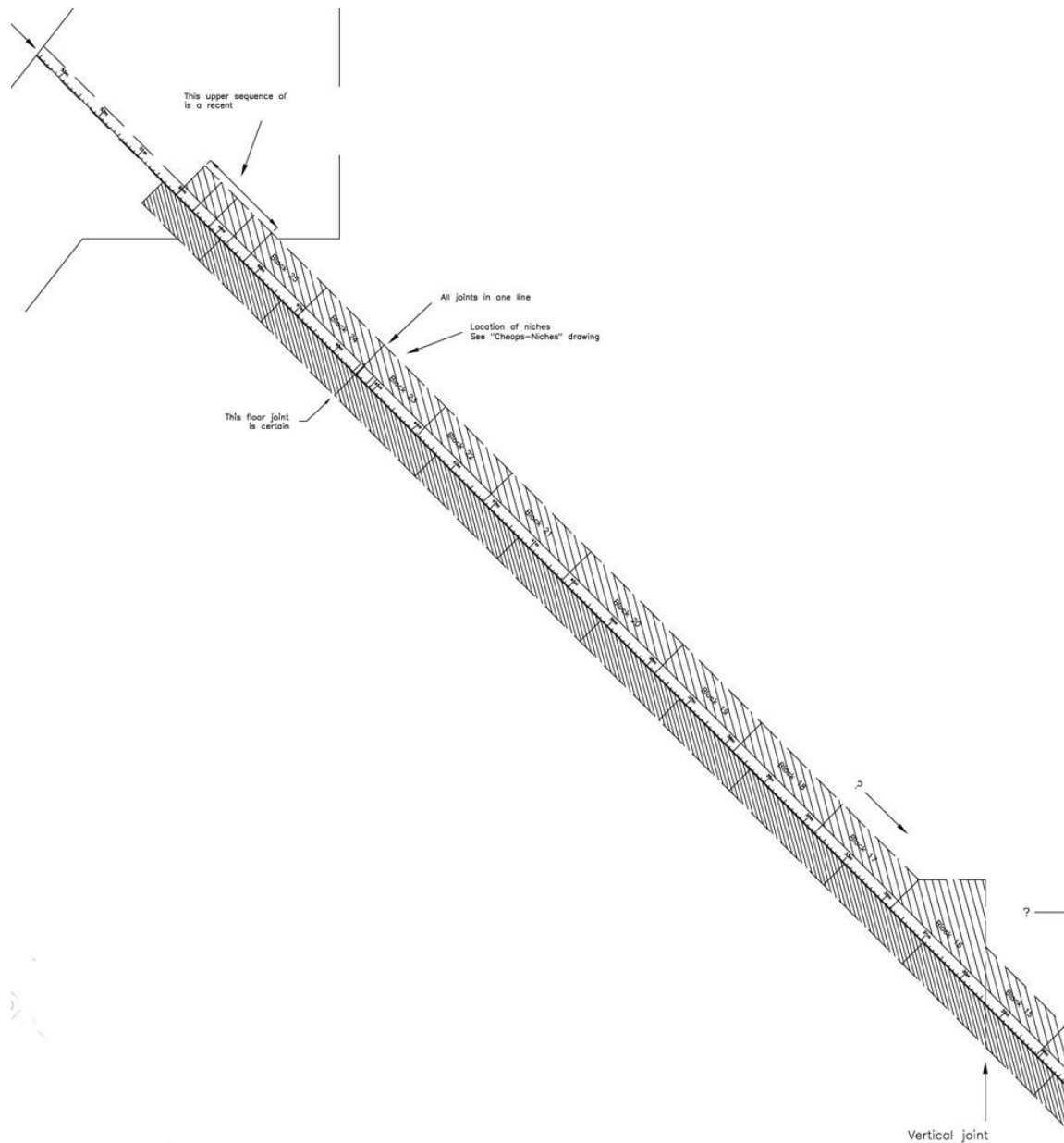
whole pyramid is littered with inconsistencies and conflicting data; most of which I refrain from mentioning, if only to keep this guide as short as possible.

In both shafts, Gantenbrink reports that there is unfinished blocks; indeed, the longest block found in the north shaft, block No. 23 measured some 4.37m long, whose ceiling was partially unfinished.

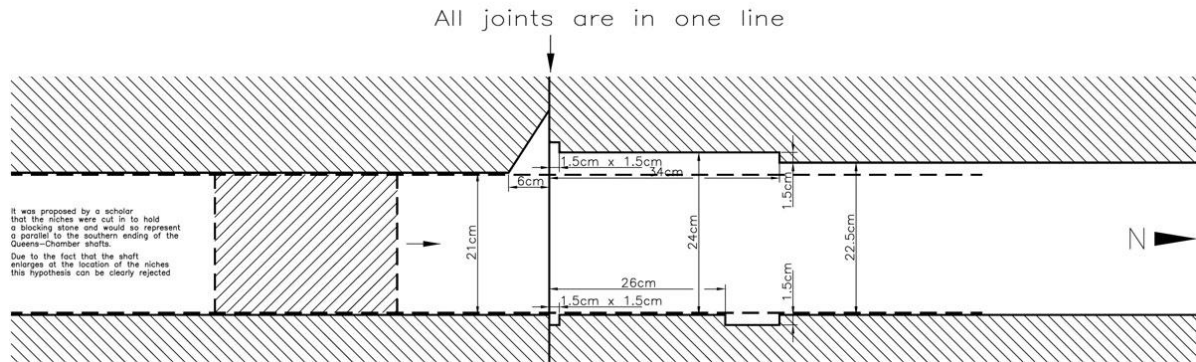


From Gantenbrink’s CAD drawing, we can see the start of the south shaft from the king’s chamber. Block 5 was a major obstacle due to its unfinished nature, providing a ceiling height of a slim 9-10 cms. Gantenbrink would state;

*“This is an obvious example of inferior workmanship, what we refer to as a "Monday morning block." Block No. 5 was almost certainly inserted without authorization from the architect or master builder. The discovery of a number of such unfinished blocks in both upper shafts and in the lower southern shaft as well would seem to indicate that the "shaft builders" made up a separate working group. This group apparently lagged behind at times, pressured by the rapid rate of growth of the pyramid layers and the construction of the chambers. This would also explain the extreme angle fluctuations in the vicinity of the King's Chamber.”*



Further up the south shaft, we have two unusual features, one is a vertical joint; Gantenbrink would state, *“Between Block No. 15 and 16 we discovered a vertical joint. In the shafts such joints, which have a distinct static function, otherwise occur only proximate to the chambers. It is a complete anomaly to find a vertical joint fully isolated in the nucleus of the pyramid. Since it requires much greater effort to shape and fit the blocks in such an arrangement, we can assume that the builders must have had significant structural justification for going to the trouble of deflecting forces into the horizontal plane.”*



The other interesting feature is what Gantenbrink terms ‘niches’ in both shaft walls at the end of block No.23. His plan view of the area is shown above.



In this image we can make out the laser dots hitting the niches on the sides of the shaft. Gantenbrink would comment on this area, from his website;

*“Prof. Stadelmann suggested (see MDAIK 50 / 1994) that this might constitute a parallel to the "closure stone", i.e., the "slab", in the lower southern shaft. He meant that the*

*niches could have formed part of a former mounting structure for a shaft closure stone. At first glance, this hypothesis would seem to make sense. But closer examination of the data we collected makes it highly questionable.*

*1. The eastern niche forms a groove; the western niche a recess, extending to the end of the block. So a small plugging stone of the kind envisaged by Prof. Stadelmann would be held in place on only one side. The groove on the eastern side would serve no purpose.*

*2. A small plugging stone could not have been lowered into the shaft from above, as Prof. Stadelmann suggested, because the shaft in block No. 23 is wider than block No. 24. (In 1992, Upuaut-1 made laser measurements of all relevant widths and heights in both upper shafts.) Thus, a plugging stone narrow enough to fit the dimensions at the top of the shaft would simply slip past the niches.*

*3. Prof. Stadelmann's hypothesis allows for the possibility that the plugging stone was embedded in place during construction of the shaft itself. He doesn't*

*explain, however, how this stone, embedded 12 meters deep into a shaft measuring only about 20 x 20 centimeters, was later removed without doing even the slightest damage to the niches.*

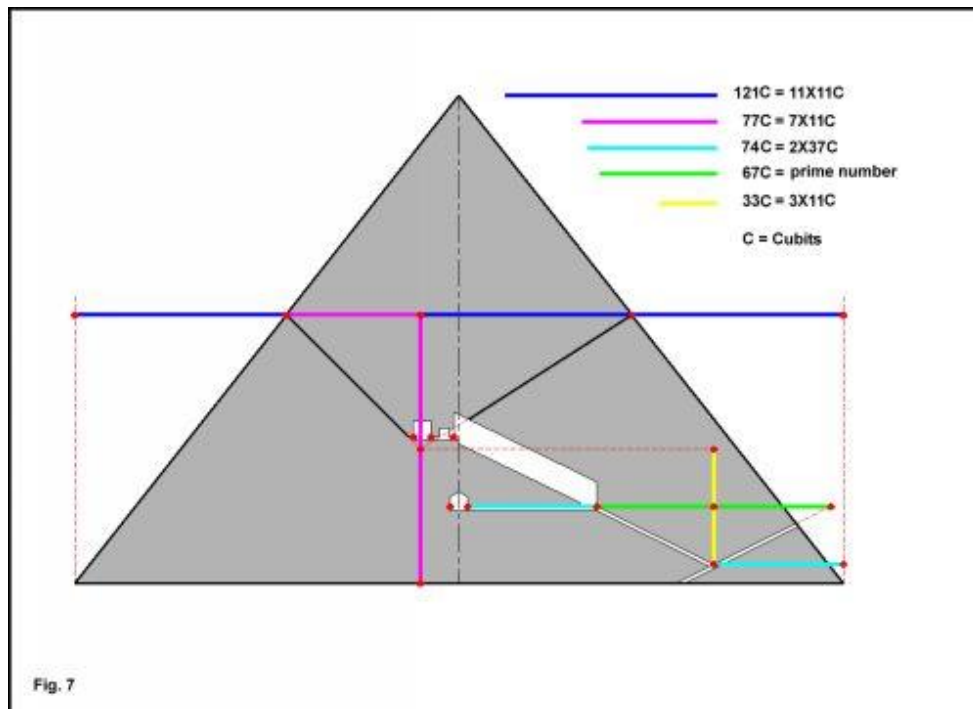
*4. Even if we choose to assume that the groove and the recess originally held a stone slab, we still face the problems mentioned above. Any such slab would have to have been inserted before the corresponding block was set in place, and thus could not have been removed later without damaging the niches.*

*The vague possibility remains, of course, that a stone slab was planned at this spot, but never actually built into the construction. Even this case, however, does not constitute an exact parallel to the situation in the lower shaft, because the upper shaft ceiling has no recess like that in the lower southern shaft at the slab.*

*The upper butt joint of Block No. 23 is also unusual, in that it forms a rectangular concave profile. It is also remarkable that here the floor joint is aligned with the shaft joints.”*

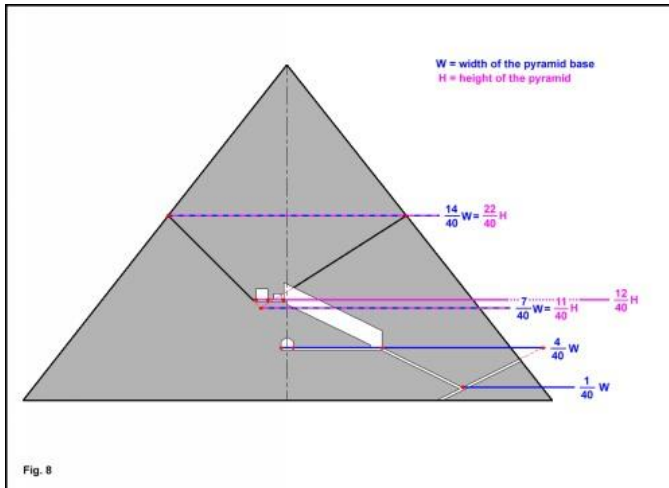
Stadlemann’s idea of a door in this location is certainly possible, though it would likely need to be in place before the next narrower stone was laid. As for the lack of damage to the niches, the door could be thin like that in the queen’s chamber shaft, and easily fractured, with fragments easily falling down the shaft to be mixed with the other debris. A possible niche may also have existed in the shallower north shaft; however, we may never know, as this area coincides with Caviglia’s excavation, and if a niche did exist here, it has been long destroyed.

Regardless of the various bends in the shafts, it does seem that for both sets of shafts (king’s and queen’s) that an attempt has been made that they both should exit on the same level. For the queen’s shafts, this is easier done as the chamber is on the east-west axis and can be made symmetrical. However, as the king’s chamber is displaced south of this axis, adjustments to the angles of the shafts have to be made in order that they both exit on the same level. Various suggestions have been made on the likely design scheme for these shafts. These can range from no planned scheme, shafts aligned to certain constellations or stars, or plain geometric relationship to the pyramid structure.



In Gantenbrink's fig 7 above, he developed his own model on the data available to him (when this was done, the limits of the queen's northern shaft were unknown and neither had the hole been drilled though his door in the queen's southern shaft.) Here he colour codes some quantities which appear to occur regularly between certain construction points. It can be noted (as in Legon's article) that the unit of 121 cubits is visible; this number appears to be repeated in the length of the queen's chamber shaft's, and possibly confirmed with the hieratic found behind Gantenbrink's door (the queen's shafts don't show in his scheme as the data was still incomplete at his time; moreover his measure for the south shaft seems in error). Gantenbrink would comment on these construction points;

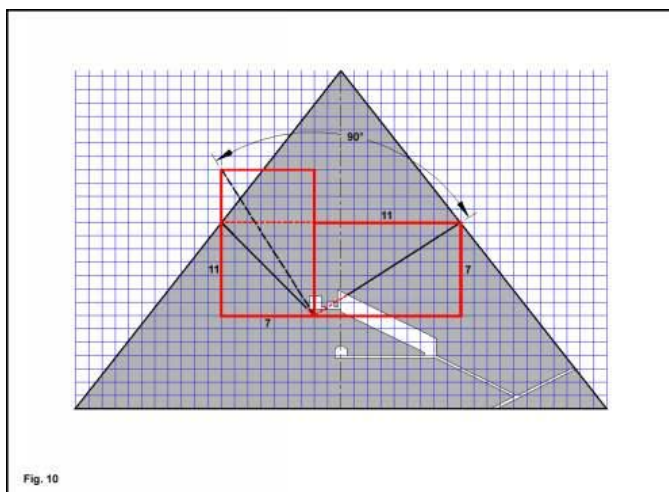
*“The heights of all construction points are essentially either one 40th of the basic width of the pyramid or one 40th of their height or, in two cases, even one 40th of both (these designate the construction points of the upper air shafts). This is all the more surprising when we consider that the base of 440 cubits when divided by 40 produces 11 and the height of 280 cubits when divided by 40 produces 7. Two exceptions apart, as we have already seen, all distances of the same length are divisible by 7 or 11 or both. This clear sub-division into 40ths leads us to suspect that the architect of the Cheops Pyramid worked in a scale of 1:40 when placing his plan on papyrus (?)”*



In Gantenbrink's fig 8, we can see some of the height relationships that he noticed; so for example, the height where the king's shafts would exit would be 22/40 or 154 cubits above base. In Legon's work he would agree that the shafts exited at 154 cubits above base; moreover, if

we could lift the top of the pyramid at his point, it's base would be 198 cubits, as both exit points are 121 cubits horizontally from the pyramids base; i.e.  $121+121+ 198 = 440$ .<sup>130</sup>

This base of 198 would agree with the height from the granite pavement of the king's chamber to the pyramids apex, which would also be 198, as the pavement would be set at 82 cubits from base (i.e.  $82+198=280$ ). Further, the diagonal of a square base of 198 cubits would be 280, or equal to the height of the pyramid. The chamber floor at 82 cubits was noted by Petrie as being at the level of the pyramid, where the base area at this level is half the base area of the pyramid.<sup>131</sup> Further, the diagonal of the pyramid at chamber level is equal to the base of the pyramid, i.e. 440. Below we have Gantenbrink's fig 10, and how he sees the simple geometrical relationship. He states;



*“Since the theoretical, lower intersection point of the shafts is also staggered against the axis of the pyramid by a whole number, it is clear that the Bauval theory that these shafts were aligned on certain stars does not add up. The shafts are clearly designed by whole numbers and according to clear*

*geometrical rules. On their being aligned on certain stars, the same exit height would, moreover, be all too much of a coincidence.*

<sup>130</sup> For legon's work, see Discussions in Egyptology 33, 1995, pages 45-54

<sup>131</sup> Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 186-187

*It is interesting that the shifting of the lower construction point of the shafts from the pyramid axis amounts to exactly 22 cubits, i.e. 2 x 11 cubits. This shift resulted in quite substantial problems during execution of the works, because the exit points clearly had to lie at equal height. For this, not only had two angles to be determined but so had the ratio of the two angles to each other and to the axis of the pyramid, in order for them to be precisely executed structurally.*

*Fig. 10 shows the mathematical geometrical principle with which this problem was easily solved. A grid of 11 x 11 cubits was placed above the pyramid. The grid therefore corresponds to a scale of 1:40 referred to the pyramid base. This grid is irrelevant to the height of the pyramid. In actual fact, the Cheops grid, as I ascertained during my ongoing work, is not square but rectangular, in a ratio of 7 to 11 cubits, i.e. one 40th of the height to one 40th of the base. We are using the square grid here only to clarify the design process more effectively. The right northern shaft is clearly designed in a ratio of 11:7 grid points and the left southern one in a square ratio of 7:7 grid points. By reversing the ratio of 11:7 to 7:11, I obtained the counter-angle in the diagonal (shown by a broken line), which lies at 90° to the northern shaft. The angle, the counter-angle and the square counter-ratio can therefore be geometrically determined. When we remember that the ancient Egyptians had to rely on only imperfect drawing aids when planning this gigantic structure, i.e. when drawing they could not determine with sufficient precision in a grid whether the line drawn and the grid actually intersected or only seemed to do so through the small scale, we can see that draughtsmanship alone was insufficient to enable such precise building work. An additional means was therefore needed to prove the assumed intersecting points mathematically. We do know from the Rhind Papyrus that the ancient Egyptians calculated with fractions. I believe that this simple, mathematical knowledge can also be imputed to the Old Kingdom. Ratios of the kind arising with the shafts can of course also be expressed in fractions. In doing so, the X quantity forms the denominator and the Y quantity the numerator. We therefore say that 11/7 forms the counter-angle of 7/11.”*



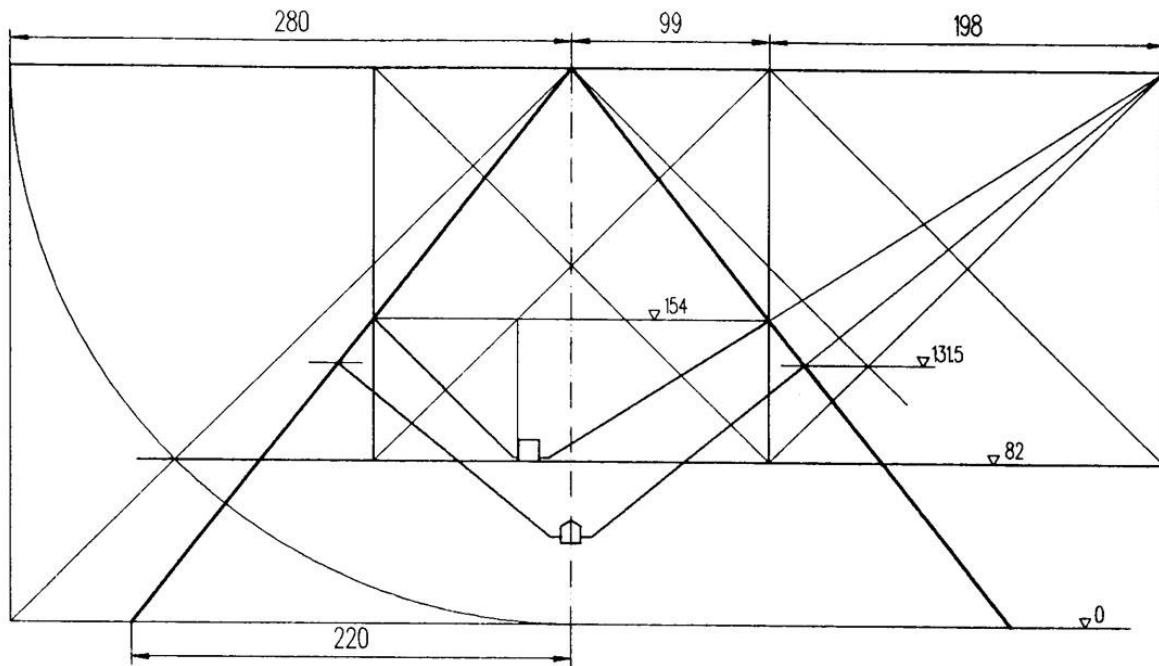


Fig. 2 The Geometry of the Air-Shafts

Dimensions in Cubits (0.52375 m)

From legon's work we see his shaft scheme above, and here he also deals with the geometry of the queen's shafts; he states;

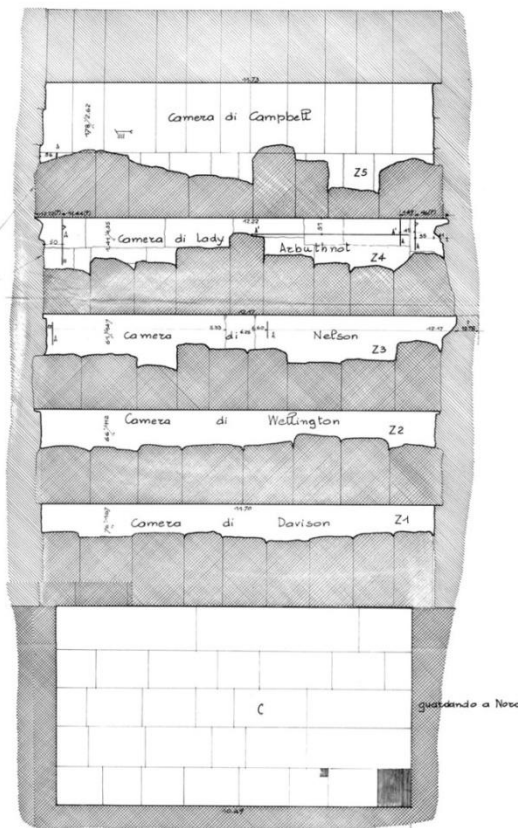
*“Now turning to the shafts leading from the Queen's Chamber, it so happens that the northern shaft is directed towards the same geometrical 'focal point' as the northern shaft from the King's Chamber, and that the lines of these shafts derive from the same geometrical construction. I have previously noted that if the shafts from the Queen's Chamber had been completed, they would have opened through the sides of the pyramid at the level of the 90th course, which is 2711.1 inches or 131.48 cubits above the base according to Pétrie's data. This course marks one of the great 'stages' in the core-masonry of the pyramid, being noticeably thicker than any of the preceding 44 courses; and it is exactly defined by the centre of the square with the side of  $(99 \cdot 198)$  or 297 cubits, which is already given in figure 2 by the distance from the apex of the pyramid to the focal point of the shafts. The level for the outlets is therefore constructed as  $(280 - 297/2)$  or 131.5 cubits over the base of the pyramid, giving a profile of 1 rise on  $(2 - 11/14)$  base, or 14 rise on 17 base, with a theoretical angle of  $39^{\circ} 28' 21''$ .”* (While this angle closely matches the south shaft angle given by Gantenbrink, other suggestions include that the angle is inverse to the casing angle, such that the shafts would form a right angle at the casing; i.e. 14:11, which gives an angle of  $38^{\circ}9'$ )

Legon would go on; *“the level of 131.5 cubits for the outlets of the shafts from the Queen's Chamber is that at which the diagonals of the cross-section measure exactly 330 cubits or  $3/4$  of the sides of base.”*

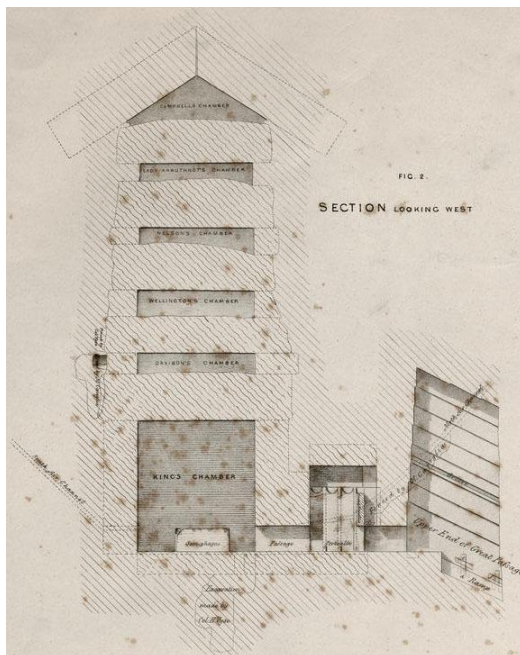
The reader can make what they will of the above observations by Gantenbrink and Legon; though for my own part, I feel that they are

commendable solutions worthy of further investigation. Aspects of the geometry also seem to appear in the giant pyramids at Dahshur; however, as bad as the data is on the Great Pyramid, matters are so much worse on those giants.

### The Relieving Chambers



In the section left from M&R's TAV 8 fig 3 (looking north), we can see the somewhat irregular nature of the granite ceiling beams, which span the empty voids above the king's chamber. Data on these spaces is somewhat scant and images largely concentrate on the contentious Khufu hieroglyphs. As previously mentioned in Part 1, I have no issues with the hieroglyphs or mason's markings found in these chambers; though some researchers see massive fraud on the part of Howard-Vyse. The whole assembly of these spaces is topped off with limestone beams, not unlike those we see inside the queen's chamber, and shown on Perring's section below. According to Perring the height from the king's chamber floor to the ceiling of Campells chamber is 69 feet 3 inches or 21.11m. (40 cubits?)



It seems a strange design; the term relieving chambers has largely stuck from the early days of exploration, but they don't seem to relieve anything; but merely raise the pent ceiling to a higher height. It has been suggested that it has been raised so as to avoid the masonry of the grand gallery, but I do question this, as they seem to have no concerns on its use in the queen's chamber, where the ends of the roofing beams are so close to the shafts and the ceiling of the passage. It seems an overly complex design, with vast quantities of heavy granite being required in its construction. Why not choose a simple design, such as we see in the Meidum

pyramid; here, we have the two lower chambers spanned across with flat limestone beams, whilst the upper chamber was corbelled. It was only discovered in modern times by Dormion and Verd'hurt that the lower chambers were protected by a corbelled ceiling also, above the flat roof; a void hidden from sight for thousands of years. A similar solution could have been used above the king's chamber flat roof, but instead we get this quite amazing structure.

It has not escaped the notice of some that the five spaces above the king's chamber may have been intended to be symbolic, and connected to the five equal courses which make up the walls of the king's chamber. The granite in this construction is not limited to the ceiling beams, but also to the side walls which support the beams; these walls on the north and south sides are not wholly of granite, for the supply of granite appears to run out, as the higher chambers tend to have their walls built of limestone. According to Petrie;

*“On the E. and W. are two immense limestone walls wholly outside of, and independent of, all the granite floors and supporting blocks. Between these great walls all the chambers stand, unbonded, and capable of yielding freely to settlement. This is exactly the construction of the Pyramid of Pepi at Sakkara, where the end walls E. and W. of the sepulchral chamber are wholly clear of the sides, and also clear of the sloping roof-beams, which are laid three layers thick; thus these end walls extend with smooth surfaces far beyond the chamber, and even beyond all the walls and roofing of it, into the general masonry of the Pyramid.”*<sup>132</sup>

Petrie would report cracked beams in the above construction, and signs of movement, for example; *“In the fourth chamber the supporting blocks along the N. And S. Sides are all of limestone, and are much cracked and flaked up by top pressure. The great end walls, between which all these chambers stand, have here sunk as much as 3 inches in relation to the floors and sides; as is shown by the ledges of plaster sticking to them, which have originally fitted into the edges of the ceiling.”*<sup>133</sup>

Petrie would also report many construction lines, in red and black, with the black lines being more refined than the broader red lines; the lines from his measures appear to conform to whole cubits. The pent limestone beams were numbered, and although most focus is on the Khufu hieroglyphs today, it would be nice to have more data on the construction lines and clear images of these spaces.

---

<sup>132</sup> Pyramids and Temples of Gizeh, 1<sup>st</sup> ed, page 91

<sup>133</sup> Ibid, page 93

## Concluding Remarks

The pyramid without doubt is a very frustrating structure to study; Gantenbrink on his now defunct website would state;

*“My engineer's curiosity was aroused because there seemed to be so many questions and so few answers. I just couldn't get over the fact that we can fly to the moon and explore the depths of the oceans, but we can't answer so many basic technical questions about the most exhaustively studied historical monument of all times”*

The above comment neatly sums up my views on the structure; certainly the pyramid has been exhaustively studied, but by no definition can it be said that it has been exhaustively explored. For truth be told, I don't know what I am looking at; how can we hope to understand something if we don't even know what we are looking at. Far too much of what we know is from dated reports, which often conflict; and why we have no shortage of opinions, detailed data on what we are supposed to be looking is rare. This lack of data is even more acute at the Dahshur giant's, where exploration is in its infancy. This is a major problem, for the Great Pyramid cannot be taken out of context, and any explanation for its design must also explain the others.

Sadly, the days when layman such as the Edgar's could explore the pyramid have long since gone, and to be fair to the Edgar's, whilst I do not agree with their pyramidology views, they do deserve a medal for the work that they have done. In many ways Egyptology is still stuck in 1928; here they would opinion about the shafts, but it took someone from outside to show some inquiry and initiative to get some rods and probe these shafts. Likewise, the masonry layout of the ascending passage, which the Edgar's worked so hard on. As I have stated in other guides, it seems that Egyptology has vacated architectural study; possibly they see no value in it, with more priority given to other areas. It's an area that few have taken to study in the history of Egyptology; but we live in an era where everything is so tightly controlled, that only Egyptologists have access, and we can only hope for data from them. However, I am not optimistic that any updated data will be forthcoming, and those who wish to study the structure will still have to rely on very dated and confusing reports.

So what can we say about the Great Pyramid, other than it exists. On the poor data which we hold, I am more inclined to see the structure as a well planned and unified scheme, straight from the drawing board, with no ad-hoc changes of

plan required to explain its layout. The only thing to me that seems out of place is the subterranean chamber, which could be an intrusive addition. I also suspect that a boat once resided in the grand gallery and that it can be related to the somewhat strange design of the structure. Can I prove it? Absolutely not; one needs data to test any theory, but as long as we view these giant structures through the lens of the 19<sup>th</sup> century, we will be forever stuck.

We are blessed to live in an advanced scientific age, and until we update the old reports with the equipment of our age, we are sadly destined to remain stuck.