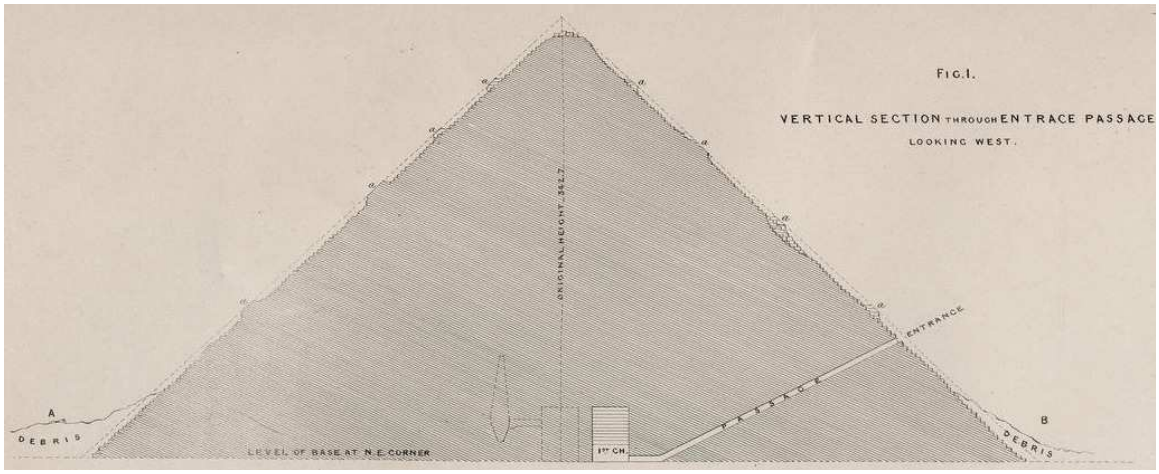
The Red Pyramid

A layman's guide

Keith Hamilton 27th September 2017



The drawing above by Perring from 1839 marks the start of serious exploration; published in *Pyramids of Gizeh, part III,* he provides a brief description and measurements along with some drawings. This information was only slightly added to by Petrie who provided some lower chamber dimensions in his book, *The Pyramids and Temples of Gizeh,* but was prevented from further exploration as, *"some animal has a lair in the inner chamber; I did not disturb it, being unarmed and miles from any help; and a pair of hyaenas with a family might have proved awkward acquaintances."* Petrie also provided some information on the angles of the pyramid core in *A Season in Egypt 1887*, unfortunately Petrie did not have the time to clear the base and provide a detailed survey.

The limited information that Perring and Petrie provide is barely enough to fill a page with text. The Italian architects Maragioglio and Rinaldi (M&R) who explored the pyramids in the 1960's published their exploration of the Red Pyramid in *L'Architettura Delle Piramidi Menfite parte III*. In this work they describe Perring's and Petrie's limited explorations as *"the only ones concerning this pyramid that have some scientific value: later descriptions and measurements generally repeat those of these two careful scholars."* This is probably due to the presence of a nearby military area; George hart in his *Pharaohs and Pyramids, A Guide Through Old Kingdom Egypt 1991,*

states, *"an important military base at Dahshur has for many years kept this site off limits to archaeologists and visitors. At present, tightly controlled excavations are being permitted in the vicinity of Dahshur"*. Today the Red pyramid is now open to tourists. However it appears that a thorough exploration of the Red pyramid is overdue as there is much disagreement between various authors as to its dimensions, Corinna Rossi in her book *Architecture and Mathematics in Ancient Egypt 2004,* states; *"Unfortunately, there is no agreement among scholars about the actual dimensions of this pyramid."*

It is not until about 1947 that Abdulsalam Hussein explored and cleared out the chambers, but his untimely death prevented any reports of his findings being published. The Red pyramid has been attributed to Sneferu, Mark lehner in his The *Complete Pyramids 1997, says;*

"In around his 30th year on the throne, Sneferu abandoned the Bent pyramid as his burial place, although, as at Meidum, he later completed it. Instead, he began work on the North, or Red, pyramid which was built at the gentler slope of 43° 22' from the beginning"

Rainer Stadelmann who worked at Dahshur for many years was of the opinion that Sneferu was buried in the Red pyramid. The pyramid itself appears to have been completed but the accompanying temples, causeway etc, the picture is less clear.

The Red pyramids name simply comes from the red hue that the pyramids core stones display, locals also call it the pyramid of bats; indeed some visitors have often commented on the pungent smell inside the chambers!

The Red pyramid is in terms of quality, a Giza class pyramid, Petrie says;
"The Great Pyramid of Dahshur is of fine work, about equal to that of the second pyramid of Gizeh". The quality of the stone work is excellent and the corbelled walls of the chambers give us a hint of how fine the grand gallery would have looked in the Great pyramid.

Once again I am indebted to ISIDA-PROJECT for their kind permission to use their images.

The Exterior

The pyramid still has a lot of debris at the base which makes measurement of the pyramid difficult. Perring gave the completed pyramid as base, 719 feet 5 inches (219.28m) and 342 feet 7 inches (104.42m) for height, and an angle of 43°36′11″. M&R in their work cite some examples of the disagreements among the authors as to the external dimensions of the pyramid; for example Reisner suggests a slightly rectangular base, with north and south sides about 218.50m, and east and west 221.50m.

Generally most articles suggest that the intended pyramid was to have a base of 420 cubits and a height of 200 cubits (to match the height of the bent pyramid) such a scheme would provide an angle of 43°36′ which matches Perring's value above. Such a scheme would provide a slope length of 290 cubits, which Varille noted, and suggested that the semi-meridian triangles of the pyramid are Diophantine, with sides 20, 21 and 29.

M&R also say in their work *"According to Lauer the theoretical angle of inclination of the faces should have been 43°20′. In the simple ratio*

14/15 and that of the edges in 2/3 (which are the same ratios of the upper part of the Double Sloping Pyramid).

Most articles also suggest that the lower chambers pavements are in alignment with the pyramid base, for example M&R say, *"It is very probable that this pyramid has no knoll of rock incorporated in its superstructure, as can be deduced from the appearance of the ground on which it rests. A confirmation of this can be found in the fact that the two inferior chambers are on the same level as the surrounding desert."*
It is clear from M&R's drawings that they have accepted and used Perring's results to have arrived at the above conclusion.

Rainer Stadelmann, writing in *The Treasures of the Pyramids, Zahi Hawass 2003,* says, *"The system of chambers is harmonious and congruent because they are laid out one behind the other. They are set only just below ground,…"* . The accompanying drawing to the text shows the lower chambers floors aligning with the pyramid base, as per Perring's drawing.

So it was a surprise to come across a survey by J.Dorner, *Neue Messungen an der Roten Pyramide, 1998.* (New measurements at the Red pyramid), in which he states the floors of the lower chambers to be 3.15m (6 cubits) above pyramid base! Dorner suggests a completed pyramid with a base of 219.08m and height of 109.54m (418 x 209 cubits) which provides an angle of 45 degrees. I have seen articles suggesting surviving casing stones displaying angles of about 44 degrees, and Petrie who could only measure the core masonry angle gives a mean of 44°36′±3′ says, *"Hence it is clearly not 45°; and the only likely rule for its construction seems to be a slope of 7 on a base of 5, as this would require an angle of 44°34'40", which is within the uncertainties of this pyramid."*

The above is just a sample of the confusion surrounding the external measurements of this pyramid; one can only hope that future exploration with more modern technology can finally clear up this ambiguity.

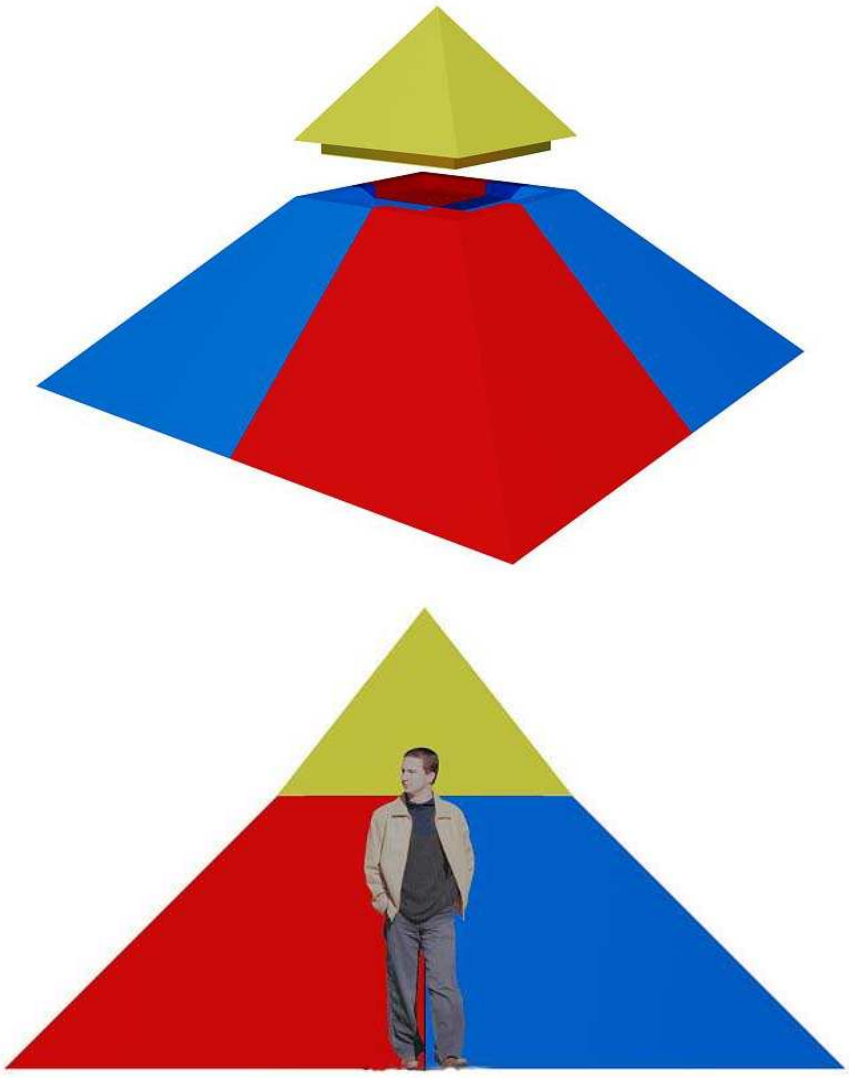
Trouble at the Top

Perring describes the top of the pyramid thus *"The top of the pyramid was built entirely with Arabian stone. The apex had been formed of one block, and the course below it of four others, 4 feet 9 inches thick; but in general the courses towards the top were about 2 feet, and those near the base about 3 feet, in thickness."* Unfortunately this is the only information provided by Perring about the top of the pyramid and no drawings are provided to help clarify what he describes; I do not know if the four stones he mentions still exist. Stadelmann writing in Hawass's book say the pyramid is now only about 92 metres high due to stone robbers; Perring in his day gave a present height of 326 feet, 6 inches (99.5m), so it's unlikely they have survived.

What is thought to be the Pyramidion of the Red pyramid was discovered in 1982 by the German Archaeological institute in Cairo. It was found amongst debris on the pyramids east side and was in many fragments. However confusion surrounds this Pyramidion as detailed by Robert Bauval in his paper, *The Pyramidion of Dashour, A confusing history of reporting and reconstructions, 14 May 2016.* After initial reconstruction the Pyramidion was declared to be 100cm high with a base of 157cm (3 cubits). These measurements do not conform to the casing angle of the pyramid but instead provide an angle of 51°52′12″, which is closer to casing angles displayed at Meidum and the Great pyramid for example. In Bauval's paper he gives examples of Stadelmann, also describing the Pyramidion as having an angle of 45 degrees as does Hawass; to add further confusion he cites Corinna Rossi in an article in JEA vol. 85 as giving the Pyramidion as 54°30′. Whatever the true angle is of the Pyramidion, I can only add that the currently reconstructed Pyramidion on display on the east side of the pyramid is certainly not 45 degrees.

It is hard to decipher the meaning in Perring's words; by *Apex* do we assume he means Pyramidion, supported by 4 underlying blocks, which were also part of the casing? Perring's measure for present height was 326 feet, 6 inches, and one would assume this was the height to the top of the mentioned 4 blocks (or the one block that he calls the apex). However he also gives a completed height of 342 feet, 7 inches; a difference of some 16 feet (4.9m), so it is unlikely that the four stones he mentions supported a 4.9m high Pyramidion. If we take the reconstructed Pyramidion as 1.0m high, we are still missing 3.9m of masonry. It is interesting to note the care in completing the top of the pyramid with the fine *Arabian stone* and not the

local stone that makes up the core. The four blocks Perring mentions are quite thick at 1.45m compared to the rest of the structure, where M&R say the courses are about 90cm thick at the base and 60cm near the summit; so it seems the thickest courses are at the top and it appears moving such large stones in the tight confines of the summit was not such an issue to the builders.



In the reconstruction above, I have used the reconstructed Pyramidion of 1.0m by 1.57m and set it into a socketed grouping of 4 support stones, 1.45m high. The steeper Pyramidion is not noticeably out of place compared to the main casing of the pyramid. It is possible that the Pyramidion was socketed into the underlying casing stones of an unknown height for extra security.

The Superstructure

The core masonry and casing of the Red pyramid is laid in horizontal courses. M&R state; *"The courses on the exterior are regularly horizontal and their height is rather constant, but variable from course to course. In line with the entrance, the height of the courses oscillates between 50 and 70cm. the whole masonry is very well made."* They also state;

The diggings recently executed in the NW, SW and SE corners seem to prove that the ground, at least along the sides of the base, was levelled, and on this levelling a layer of coarse limestone blocks was put, surrounded by one or two rows of fine limestone blocks. The pyramid was built on this platform: at least in one point one can see that the fine limestone blocks, which formed the perimeter of the foundation, go under the coarse limestone nucleus of the monument for a short way.

The good state of conservation of the nucleus does not permit any affirmation about its interior structure. So we do not know if it is in steps, or in layers, or more probably a homogeneous structure."

The limestone for the core is believed to come from a quarry some 500m west of the pyramid, Perring says; *"It is built with stone taken from the adjacent mountain, and principally from quarries to the westward and south-westward of the edifice, which, like that in the Mustabet el Faraoon, is of a reddish colour, calcareous, and interspersed with semi-petrified shells, chiefly those of oysters."*

Like at the neighbouring Bent pyramid 2km to the south, we do not know if the central core of the pyramid is founded on the bedrock. In the Red pyramids first chamber a portion of the paving and underlying core stones have been removed to a depth of 1.7m and no sign of bedrock visible. It would be useful to bore further into this excavation to determine where the bedrock begins; keeping in mind Dorner's view that the floor is some 3.15m above pyramid base, ideally a second survey should be carried out to determine the exact locations of these chambers.

Above, surviving casing stones and remains of pyramid temple, east side.

For comparison, the above image from the Bent's subsidiary pyramid, displays a similar line on its casing foundation platform.

Building Sequence

Before we explore the interior, it is maybe apt to explore the building sequence that Egyptology ascribes to this pyramid. In M&R's statement (*page 7*) they state that they do not know if the nucleus consisted of steps or if it was a homogeneous structure; however it seems Egyptology has decided that the structure is homogeneous. Why they have come to this decision is not so clear, but it appears to come about due to graffiti found inscribed upon fragments of limestone casing. For example Lehner in *The Complete Pyramids,* states;

"Many of these have graffiti inscribed on their rear faces by the work gangs. One from a corner bears the hieratic inscription mentioning 'bringing to earth year 15'. This refers to counting year 15, which, if biennial, is equivalent to the 30th year of Sneferu's reign. Some 30 courses higher Stadelmann was able to place a casing stone dated only four years later-this gives us a very clear picture of the length of time it took to build such pyramids."

Some 10 years after *The Complete Pyramids* was published, John Romer published his book *The Great Pyramid, Ancient Egypt Revisited.* In his book he goes into more detail on the building sequence of the Red pyramid using the graffiti found by Stadelmann, he states;

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

Romer further says, *"At the beginning of the work-and in the first two years no fewer than thirty-five courses of the Red Pyramid would have been laid-for a brief while, the workforce would have comprised around a tenth of the adult male population of the ancient Egyptian state."* He suggests a figure of more than 40,000 people.

This explosion of work, Romer describes as; *"The relative time frame established for all of Sneferu's building projects shows that the workload at the Red Pyramid represents an increase of almost 300 per cent from that of the second failed pyramid."* (By failed pyramid he means Bent Pyramid)

As a Layperson, I do find this build rate incredulous. The Red Pyramid is a huge pyramid, with care taken in its construction; its base area is second only to the Great Pyramid and by volume it is the 3rd largest pyramid in Egypt, about 2/3rd the volume of the Great Pyramid and 3/4th the volume of Khafre's Pyramid. According to Romer the graffiti tells us that the Red Pyramid was completed in just 10 years and seven months.

Given that we are told that half the pyramid was finished in three years, one wonders why it took over 10 years to complete. Romer states;

"Given that pyramids rise up to a sharp and single point, one would anticipate that, with a labour force of a single size working at a constant rate, the annual build rate would increase exponentially as the pyramid narrowed and approached its apex. At the same time, the dramatically decreasing area available to the workforce as the pyramid tapered into the sky would have increasingly denied them the physical access they required; at the ending of the work there would only have been room for very small numbers of workman."

The above statement is perfectly reasonable, but the problem I have is thus; what happened to the excess labour that could build half a pyramid in three years? Egyptology suggests that Sneferu built three large pyramids, with the Red being the last; I would assume that Sneferu was by this time advanced in age and eager to complete his final project, so why was this highly productive excess workforce not set to work constructing impressive stone enclosure walls, temples and causeways. These other constructions that make up the Pyramid complex are either missing or replaced with crude mud brick structures.

As a layperson I get the sense that Egyptology has painted itself into a corner when it comes to the three large pyramids of Sneferu; it has to juggle two problems, chronological evidence for years lived for Sneferu, and years required to build three large pyramids. I suspect these problems have led Egyptology to accept the graffiti as evidence that the Red pyramid is a homogeneous structure that took 10 years 7 months to build; and surely as a

sign of relief in order to address the chronological problems they also face, but is it the truth or convenient.

The build rate given for the Red pyramid I find hard to accept, so is there another explanation? I propose that the Red Pyramid is not a homogeneous structure, but that it may have a stepped core, and that the year 15 graffiti found on the casing cornerstone, is not the start of construction of the Red pyramid, but closer to the start of the casing phase that would cover the stepped core.

In my Meidum paper, I suggested that Huni may have built the Meidum pyramid and that Sneferu's involvement was only in converting Meidum into a true pyramid, phase E3. My reconstruction of the portcullis sealing of the vertical shaft in my Meidum paper suggested that it was used, and I feel it was unlikely to be used by Sneferu, given the choice of two great pyramids at Dahshur. I suggest that Sneferu's first Pyramid build was the Bent pyramid and that it was a success and not a failure (see my Bent pyramid papers). His next pyramid was the Red pyramid and possibly at the same time a workforce was dispatched to convert Meidum into a true pyramid, using the new method of laying the blocks horizontally.

In my previous paper, *The Bent Pyramid and the curious case of the 60 degree pyramid,* I suggest that the evidence that led to that assumption could also be used to suggest that a stepped core was built first instead, and that similar stepped cores may also exist in other Pyramids. In the Red pyramid we have graffiti from year 15 to the highest found year of 24; this has led some in Egyptology to conclude that Sneferu lived for 48 years, if these year dates are interpreted as biennial. These 48 years are probably a relief to some, in order to give time for Sneferu to build three large pyramids; however there is disagreement in Egyptology as to whether these year dates are biennial.

At the Meidum Pyramid, graffiti was found on the blocks that make up the E3 casing phase, though they do not bear Sneferu's name, they have been assigned to him due to their similarity with the graffiti found at Dahshur. Colin Reader has done an interesting paper on the Meidum Pyramid (*JARCE 51(2015)*, in this paper he reports on Dr. Ali el-khouli's clearance of the northwest corner of the Medium pyramid. In this operation, graffiti with year dates were found; the earliest was year 13, also found were years 15, 16, 17, 18 and a tentative 23rd occasion. It is interesting to note how this range of

dates appears to match the casing graffiti found at the Red pyramid, which ranges from year 15 to year 24. If the Red pyramid has a stepped core, it suggests that both casing phases over the stepped cores of Meidum and the Red pyramid occurred at similar times and that these years dates were annual and not biennial, for if they were biennial it would seem to be an excessive amount of time to case a stepped core. This does not mean that all Sneferu's year dates are annual, it's likely that in the early years of his reign that they were biennial.

Building a pyramid with a stepped core first and then casing afterwards is an entirely different model to Romer's explosive building sequence and the use of manpower and excesses of manpower as the apex was reached. But from Perring's observation of the 4 large *Arabian stones* near the summit and the reconstructed Pyramidion, it suggests that the casing phase was completed at the Red pyramid; likewise the near completed temple at Meidum, suggests that its casing phase was also completed. It may have been at this time of completion of the casings that Sneferu died, the work on the temple at Meidum came to a halt and the use of mudbrick to complete some of the Red pyramid complex, by his successor.

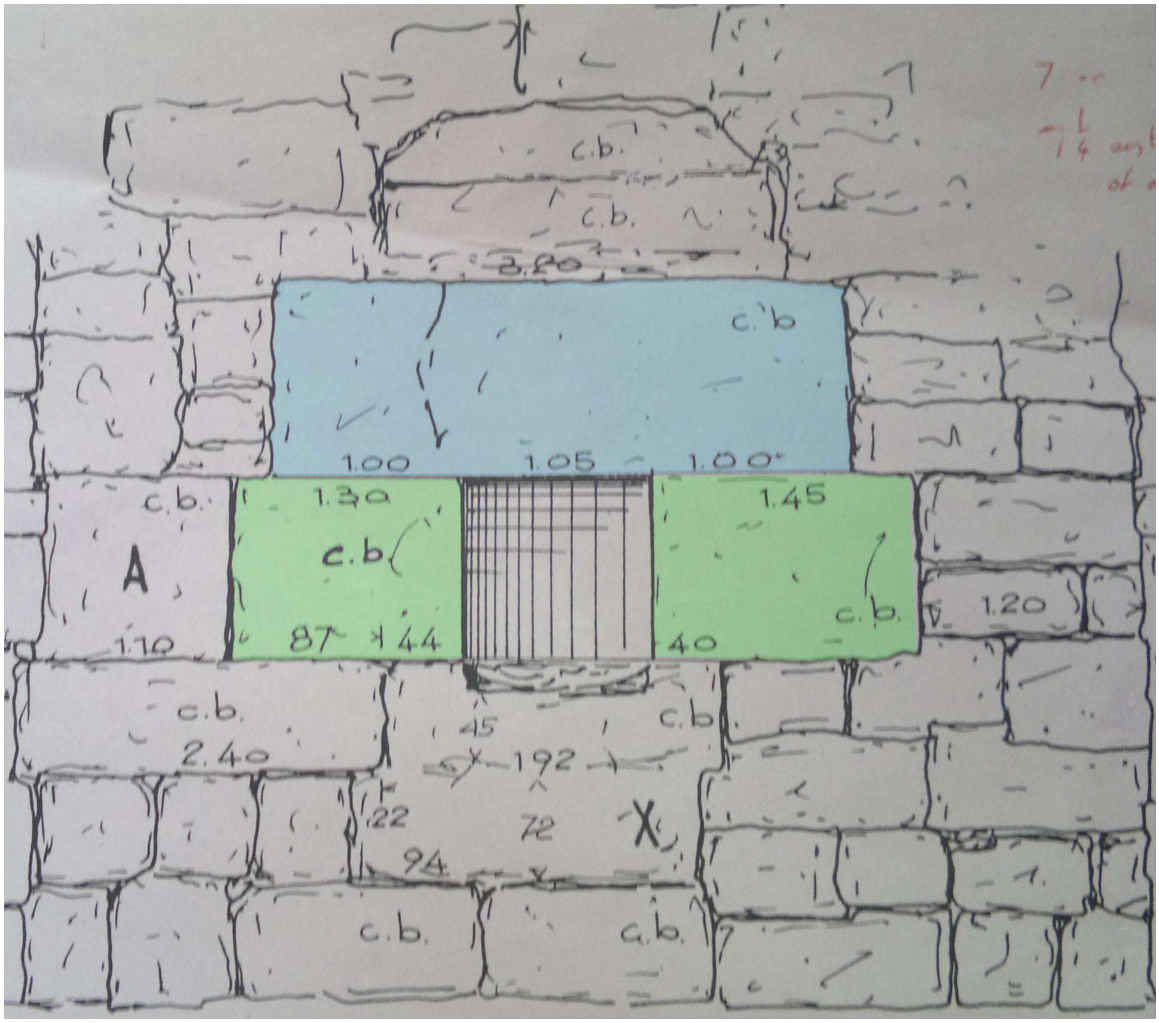
Assuming that Sneferu built all three pyramids was always going to put pressure on the chronology of Sneferu, to provide enough years to enable these projects. There is a difference of opinion in Egyptology when it comes to the reign of Sneferu, but I suspect those who advocate 30+ years are probably more correct than those who think 48 years. On balance and looking at the evidence available to me, I feel Sneferu's building programmes consisted of completion of the Bent pyramid complex, partial completion of the Red pyramid complex and partial completion of the Meidum pyramid complex, with the stepped phases of Meidum completed by his predecessor, possibly Huni.

The scenario above I feel is realistic and possible in a chronological time frame of 30+ years for Sneferu's reign. Ideally more clearance of these sites should provide more dating evidence that can hopefully resolve the chronological ambiguities that surrounds Sneferu's reign.

The Entrance

The entrance on the north face, Perring gives as being 94 feet (28.65m), perpendicularly higher than the base, and the passage axis is displaced 12 feet 6 inches (3.81m) east of the pyramid centre. The dimensions of the passage he gives as 3 feet 5 ½ inches wide, 3 feet 11 ½ inches in height, this converts to 1.05m by 1.21m or 2 cubits by 2 cubits, 2 palms.

Perring also says that the original length of the entrance passage was 205 feet 6 inches (62.64m) of which 4 feet 6 inches had been destroyed by removal of the casing. The inclination of the passage he gives as 27°56′.



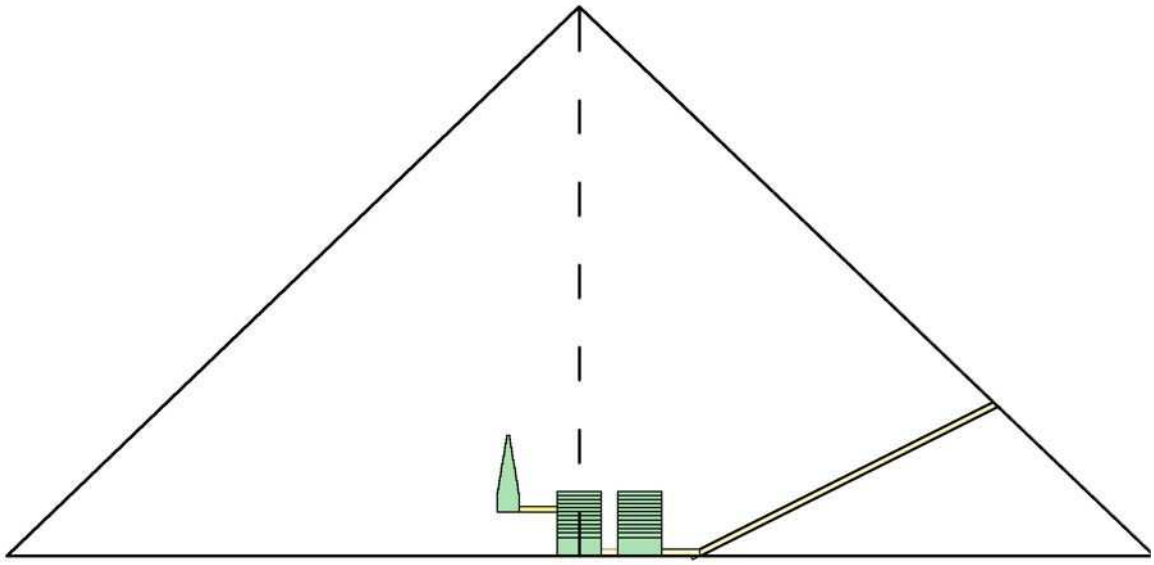
The Drawing above by M&R gives an indication of the masonry layout at the entrance. I have coloured the architrave as blue and passage walls green: M&R state;

"It results that in this point the structure of the corridor shows, besides a course of pavement, two blocks forming the sides and an architrave, also a course of white limestone as foundation of the pavement and two other blocks (of the same white limestone) above the architrave to protect it. The course under the pavement seems to be as inclined as the pavement itself, while the two blocks that relieve the architrave from its superincumbent weight, are less and less inclined until the superior side of the second block is nearly horizontal. To the east of the block forming the east side of the entrance one sees another block of white limestone which may be the first of a row parallel to the corridor but it could also be an isolated block."

M&R also state that the pavement is formed by two rows of slabs, which went under the corridor walls for a short distance. They appear to accept Perring's measures, but it's not clear to what extent they went to in confirming his measures; they did measure the conserved part of the ceiling in their time as 58.80m, what other checks is not known, but they do say; *"According to Perring the angle of inclination of the corridor is 27°56' and our measurements confirm this."*

However the survey by Dorner differs significantly, for example he gives the entrance as 30.92m above base and displaced eastwards by 4.09m, with the corridor end being some 2.93m above base; whereas Perring's drawings suggest that it is at base level. Dorner also believes that settlements in the passage have made the end of the corridor some 22cm lower that it should be. Though M&R confirm Perring's angle, Dorner provides an angle of 26°34′, practically a rise of one on a base of two. His height 109.54m (Perring 104.42m) and base 219.08m (south side) provide a perfect 45 degree angle.

Looking at Dorner's survey, I get the sense that he might be rounding things up to possibly fit a preconceived idea of how he sees the architect's original plans. The article along with a lot of papers on the Red pyramid are in German and the internet translations are not the best and often just add more confusion. Given the technology available today, with laser scanning technology etc, one can only hope that a concerted effort is made in the future to properly scan the inside and outside of these pyramids and provide an accurate database that researchers can confidently work with.



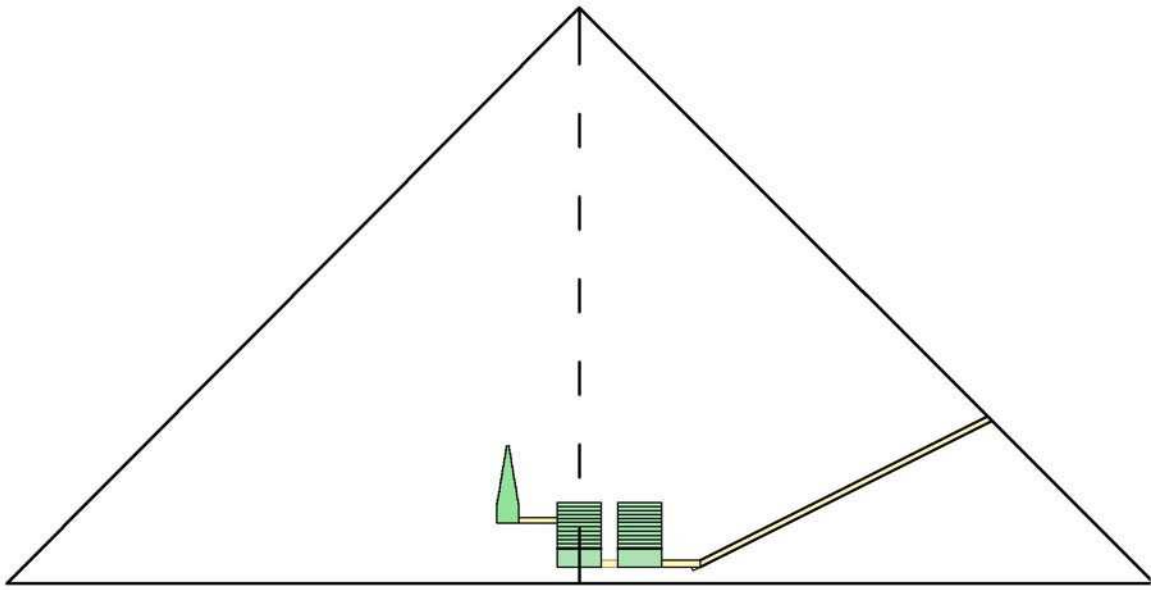
The image above is the one that most readers will recognize, with the lower chambers on a level with the pyramid base. This is how Perring and M&R see the pyramid.

It is often cited that this pyramid displays a base of 420 cubits and height of 200 cubits; such a scheme will give an angle of 43°36′, which is the angle that Perring gives. Perring gives 719ft 5in (219.28m) for the base.

To check I took a random selection of measures from M&R's TAV19 that details the internal chambers, as the fine work displayed here will probably give a good value for the cubit that they used. I obtained a value of 20.54 inches, Perring's 719ft 5in, is 8633 inches, which if divided by 420 cubits, will give a cubit of 20.55 inches. So the scheme is possible.

It may well be possible that the angle of the entrance passage was intended to have a rise of 1 on 2 base, this gives an angle of 26°34′, Perring gives 27°56′.

The entrance passage displacement east from pyramid centre differs between Perring and Dorner, being 3.81m (P) & 4.09m (D). I suspect what was possibly intended was 7.5 cubits as this is close to the mean of the two figures above and 1/56th of pyramid base (If base is 420 cubits); it would also place the middle chamber directly under the apex of the pyramid.
(20.54 inches times 7.5 will give 3.91m). M&R give a displacement east of 3.91m in TAV 19.



The image above is based on the reconstruction by Dorner.

Dorner suggests that the lower chambers floor was 3.15m (6cubits) above base, with the upper chamber floor being 11.53m (22 cubits) above base.

The pyramid height he gives as 109.54m (209 cubits).

Entrance height he gives as 30.92m (59 cubits) with the horizontal length of the passage being 55.55m (106 cubits).

These last two measures combined with the height of the lower chambers floor, provide a passage angle of one rise on two base.

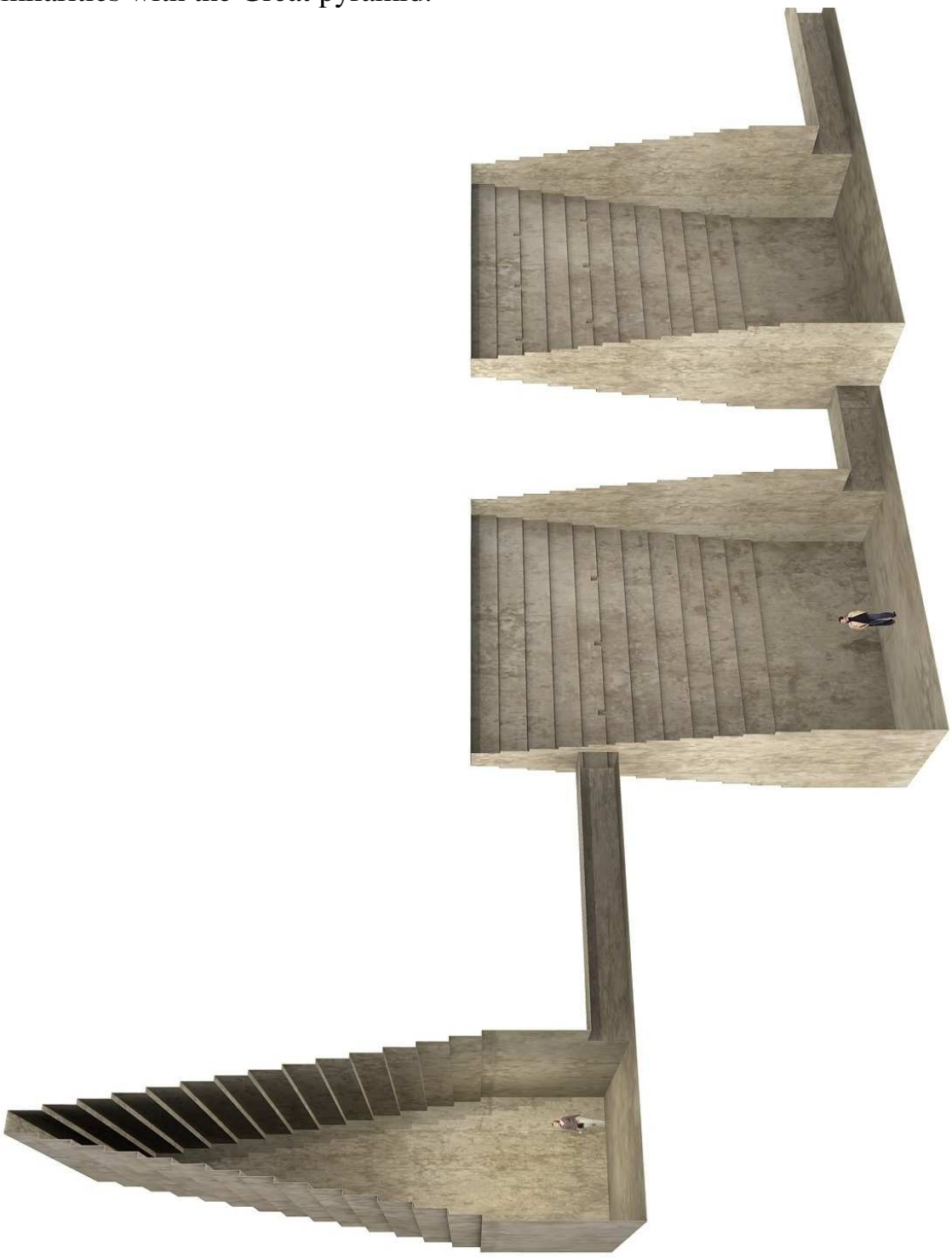
The reconstruction gives a pyramid angle of 45 degrees exactly and a base length of 418 cubits (219.08m).

This reconstruction provides a cubit of 52.41cm (20.63 inches) for the measures above. (Except for floor of 3.15m which gives 52.5cm)

Hopefully a more modern survey and clearance of debris from the site will provide a clearer picture. I can only add that the 20.63 inches that Dorner's scheme suggests, seems larger than the cubit displayed in the chambers.

In the above image I have attempted to reconstruct the internal chamber layout in cubits. The scheme is tentative as ideally more data is required.

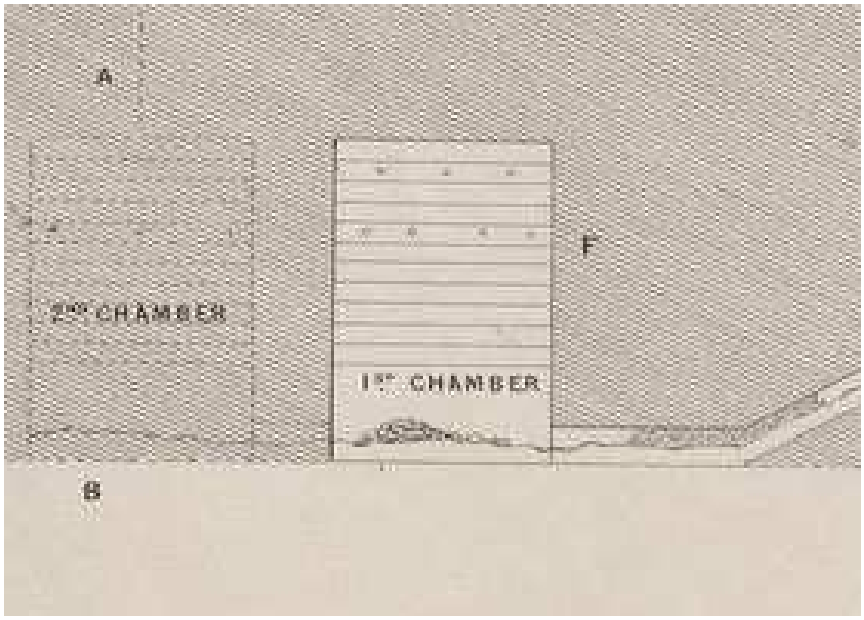
Those of you with a mathematical eye will recognize some patterns and similarities with the Great pyramid.



The image above will give the reader an idea of scale and layout of the chambers.

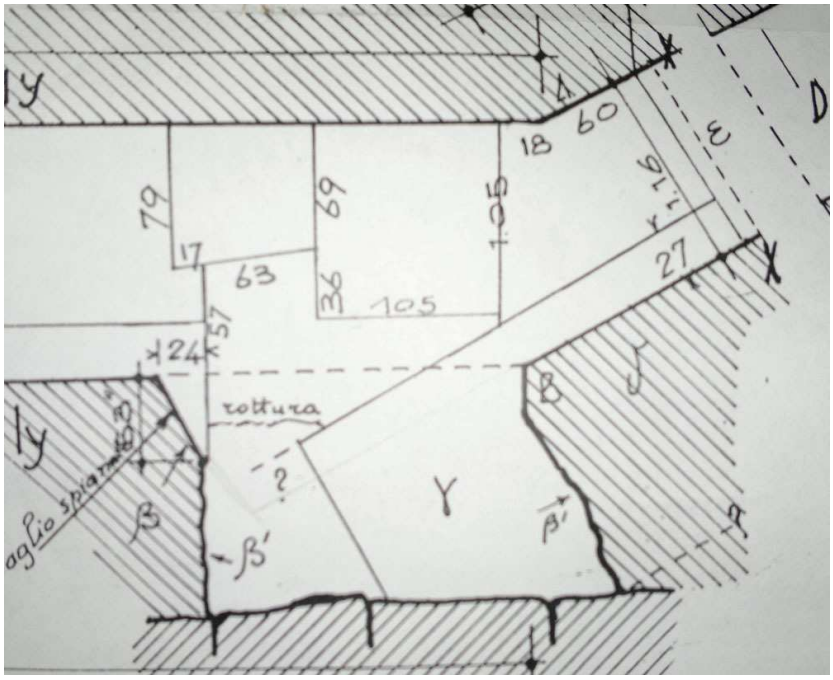
Returning now to the entrance passage, whose original length Perring gives as 62.63m, we see that the walls are made of single blocks and laid at right angles to the slope of the passage, with the passage paving running under the side walls and not inserted between the walls, like we see at the Bent pyramid. Near the end of the entrance passage to enable a strong bond between the masonry of the inclined and horizontal passages, M&R describe how some of the paving blocks have been cut in a U shape to form part of the walls.

At the end of the descending corridor, and along a portion of the horizontal passage, we have a large hole in the floor about 1.3m deep. M&R thought it may have been a trail digging by plunderers or a pit similar to those found in the Meidum and Bent pyramids. In my Medium paper, I suggested that the pit was maybe to protect the lower chambers from any meteoric water.

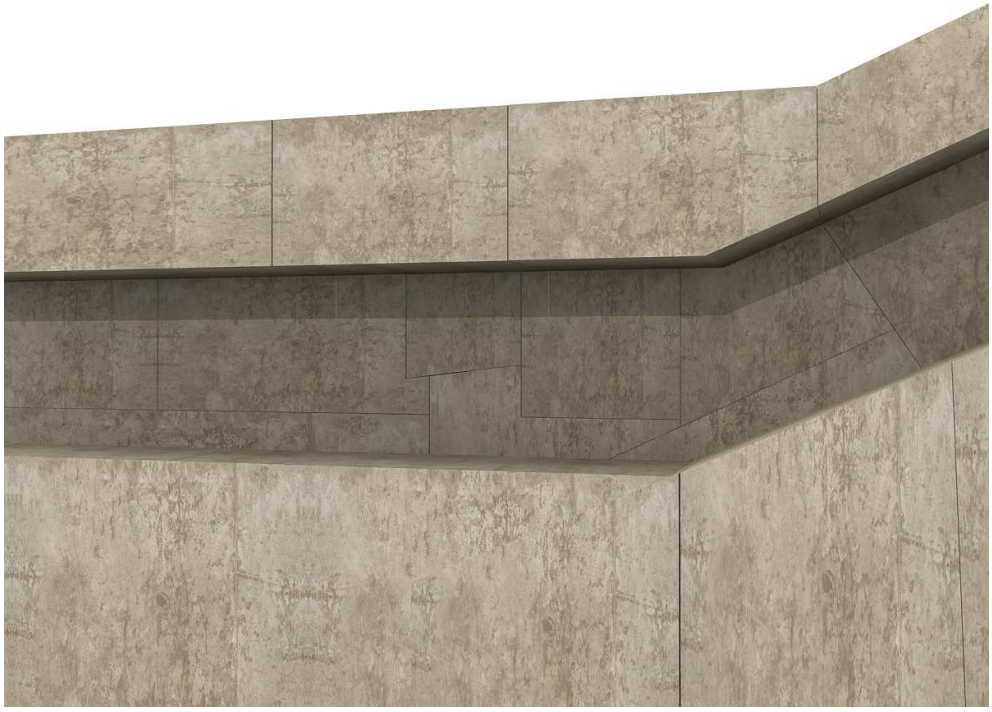


In the drawing above by Perring, the pit is not shown, which is understandable when one sees the level of debris present in his day.

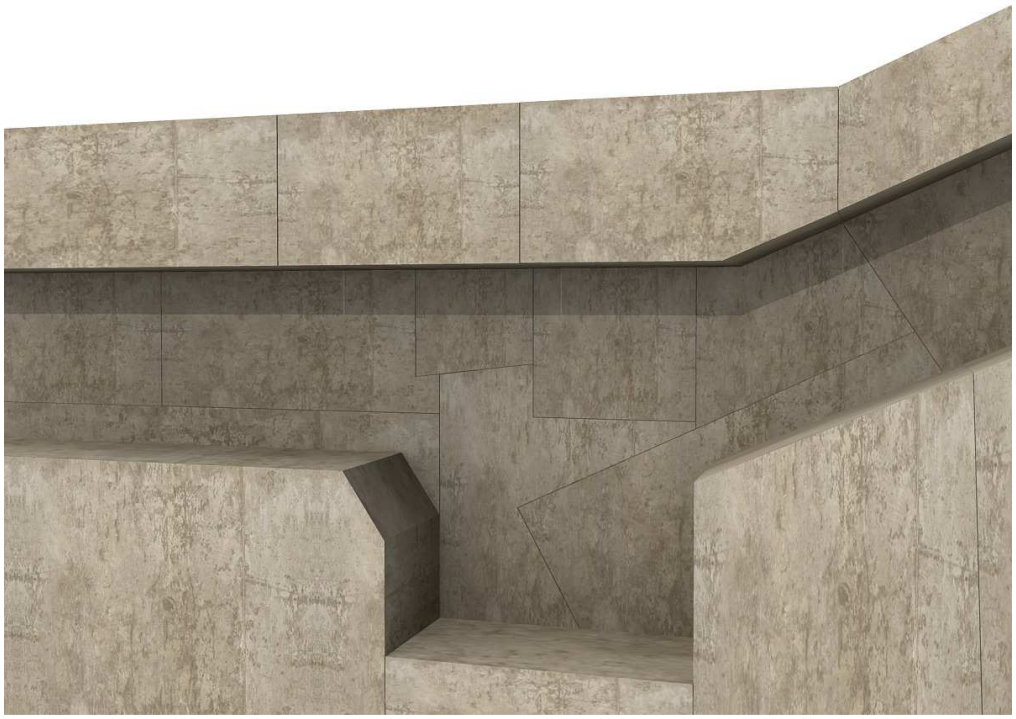
Views of entrance passage



In the drawing above by M&R, we see the pit and masonry layout of the west wall. The area is in need of further scrutiny, but I have made three reconstructions that may be possible. Option one below, we assume it is a robber's trial digging, and originally the passages simply meet.



Option 2, would help allow the passage of bulkier items pass the junction.



Option 3, a modification of option 2 above, but incorporating a pit to prevent meteoric water from reaching the lower chambers.

The horizontal corridor that leads to the first of the lower chambers, Perring gives as 24 feet 4 inches long (7.42m, which I assume is measured along the roof, due to debris visible in his drawings; as M&R give 7.43m along roof and 7.30m along floor). The corridor width Perring gives as 3 feet 5 ½ inches (1.05m) and height 4 feet 5 ½ inches (1.36m); M&R give 1.05m by 1.35m.

The paving fitted in the horizontal corridor is inserted between the walls, the thickness of the paving here is not clear, but paving that was visible to M&R in the lower chambers varied from 47cm to 55cm.

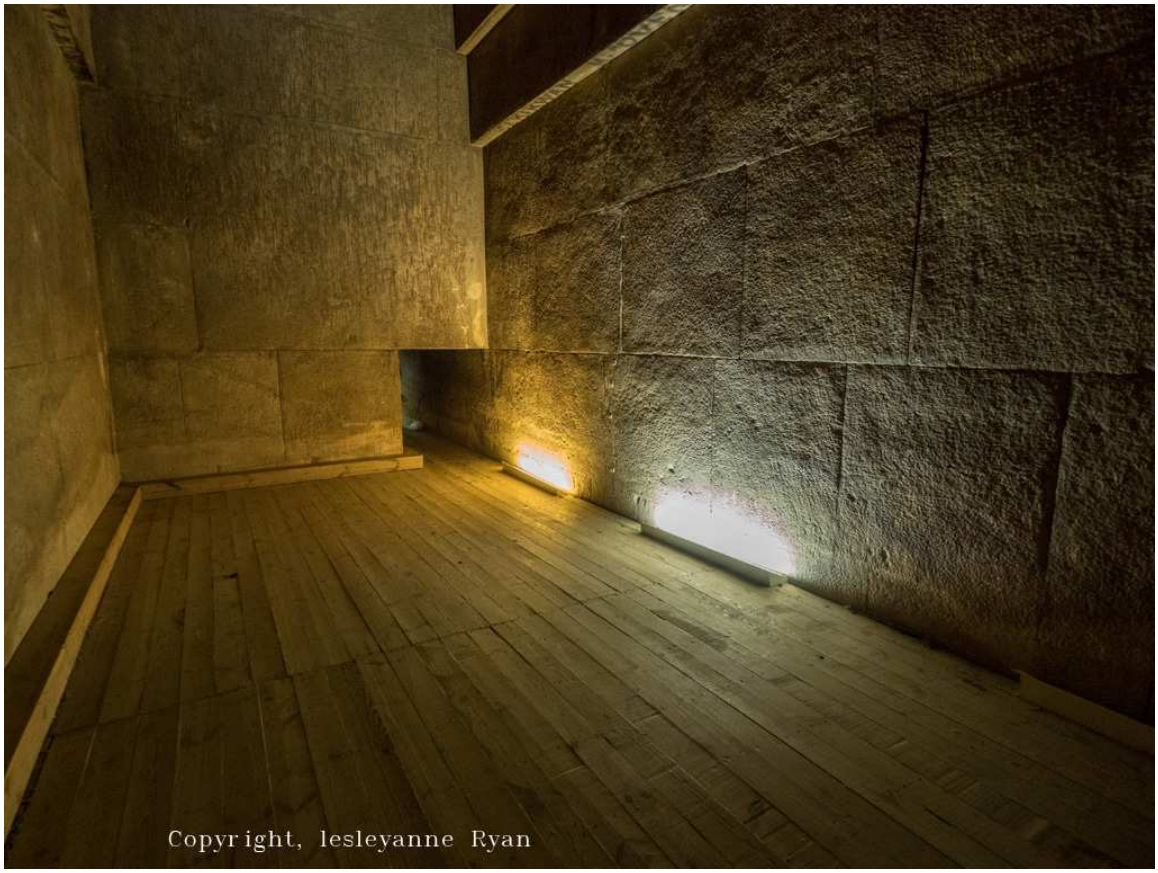
The southern end of the horizontal corridor enters the first of the lower chambers via its north east corner.

Lower Chambers

The lower chambers are in an excellent state of preservation with the corbels being particularly undamaged when compared to those in the Great pyramids grand gallery. The first chamber Perring gives as 27 feet 5 ½ inches, N-S and 11 feet 11 inches, E-W (8.37m by 3.63m), M&R's drawing gives 8.38m W, 8.36m E, 3.65m N, & 3.64m S. By comparison Petrie gives 8.38m W, 8.34m E, 3.65m N, & 3.63m S. (If we accept the chambers are 7 by 16 cubits which Petrie suggested and using Petrie's measures, we obtain a cubit of 20.55 inches. As the perimeter in inches by Petrie adds to 945.2, divided by 46 cubits, gives 20.55)

Perring states on the first chamber *"The floor is on a level with the base of the pyramid. The four lower courses of the walls, to the height of 11 feet 8 ½ inches* (3.57m)*, are perpendicular, but each of the eleven courses above them sets over nearly 6 inches, so that the ceiling is only 1 foot 2 inches in width* (35.6cm). *The two lower projecting courses are 3 feet* (91.4cm) *in thickness; the others rather more than 2 feet 6 inches; and the height of the chamber is about 40 feet 4 ½ inches."* (12.31m)

For comparison Petrie says, "*Height to first overlapping is 87.0 N; and 87.2 S; above the tops of the door-ways (whose floor is invisible owing to encumbrance); from the first to the second lap is 35.5, thence to third lap 32.0; width of first lap is 5.4 to 6.0. The whole height of 87 is filled by a single block over each door; these single blocks extend 115.2 on the north; and 113.6 on the S. wall, besides a part of each hidden in the side wall."*



I am very grateful to lesleyanne Ryan for some of the Red pyramid images.

In the image above looking north in the first chamber, we can see the monolithic stone above the entrance, that goes an unknown depth into the east wall. Today the original paving is covered by wooden flooring; an excellent early picture is in Romer's book, page 288, which shows upturned paving stones and an indication of the paving layout of the chamber floor.

M&R say of the paving blocks, *"In the chambers the blocks are shorter than half the width of the rooms. They were laid with the minor sides against the east and west walls: for every block laid against the east wall there is one, almost corresponding, against the west wall (eight blocks to each side). The slabs do not generally meet in the middle of the rooms, but are separated by small irregular spaces, filled up with little blocks cut to the right shape. The joints between the slabs themselves, and between the slabs and the side walls were very carefully worked. The slabs are of variable dimensions and some are so large that it would have been impossible to transport them along the descending corridor."*

M&R also observed that the lower wall course that was hidden by the thickness of the floor stones was also carefully dressed. The technique appears similar to what we see in the Kings chamber in the Great pyramid; where we see large slabs of granite span the floor, but this time the smaller pieces are not to be found in the middle, but rather against the north and south walls. In the Bent pyramids upper chamber, it appears to be more like the Red pyramid, in that the small oddly shaped keystone in its floor is surrounding by large blocks.

A large portion of the flooring and sub-pavement have been removed at the chambers north end. This shows that the sub-pavement went under the chambers side walls and was thicker than the floor slabs, being 65cm to 70cm thick; M&R go on to say that this sub-pavement was laid on another layer of yellow limestone blocks that were dressed only on their horizontal faces. How many layers under this is an unknown; I feel that it is probable that this masonry is founded on the bedrock, which could be some metres away yet and to this we must not forget Dorner's suggestion that the floors of the lower chambers are some 3.15m above the base. A core drilled down through this excavation would help in determining the location of the bedrock, and whether the pyramid core is founded on bedrock.

A strange statement appears in M&R's work, *"Perring's measurement of the height of the chamber is 12.31m, and he says that the corbelled vault begins at 2.21m from the inferior edge of the architrave in the passage, i.e. 3.57m from the pavement. However the measurements of the height taken by this English scholar were not precise due to the presence of a thick layer of rubble on the pavement."* However they do not clarify on what the possible true value should be; Perring only states the wall height to first overhang as 3.57m, he did not provide a measure from top of doorway to first overhang, though Petrie did, and obtained 2.21m. The only other measure Perring provides that may be related is the height of the horizontal corridor leading to the first chamber, which he gives as 1.36m, this added to Petrie's 2.21m seems to confirm a height of 3.57m. M&R's TAV 19, just adds to the confusion, they give horizontal corridor height by north entrance of first chamber as 1.35m, yet at the entrance to the second chamber they provide two values, 1.30m and 1.36m, with a question mark assigned to 1.36m.

In Dorner's survey, if the translation software is correct, he suggests that the floor sinks down into the first chamber about 11cm and rises again into the next room by 4.5cm. This I feel is unlikely to be settlement, given the great

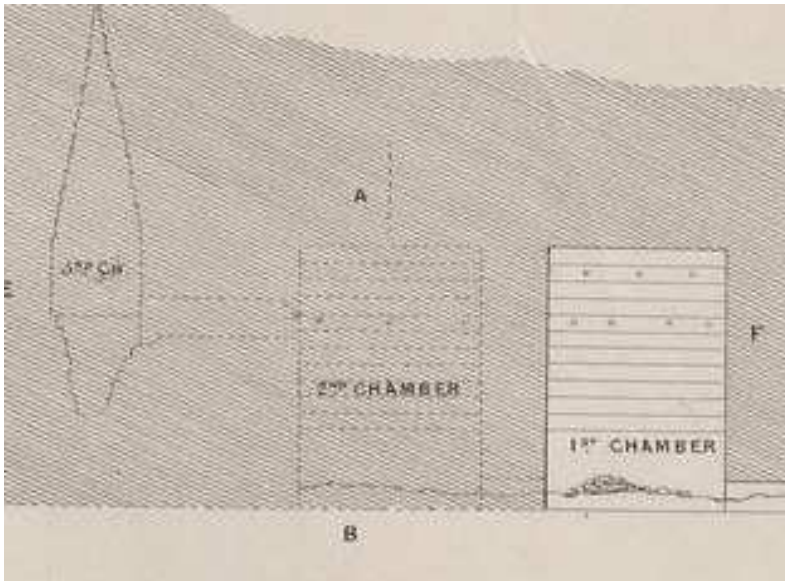
condition exhibited by the walls and corbelled ceilings, M&R state that the joints have not opened. In the photo I mentioned in Romer's book, we can see upturned paving blocks in the first chamber and in the second chamber Perring says *"The pavement of this second chamber has been removed, and the room is full of rubbish."* This rubbish may be part of the debris taken from the excavated floor of the upper chamber and threw down into the second chamber. In M&R's drawing the second chambers paving is largely intact, but it's reasonable to suppose that paving in the second chamber was also upturned, possibly by violators in the hope of some find. At some stage during the clearing of the chambers in modern times, these large paving stones have been reset into the floor, possibly on top of small debris and I feel that this is the likely cause for the measures given by Dorner and the strange statement by M&R.

The corbels appear to have an overhang of 2 palms and like at the subsidiary pyramid in the Bent pyramid complex, the north and south walls are not corbelled, whereas in the Bent pyramid all four sides where corbelled.

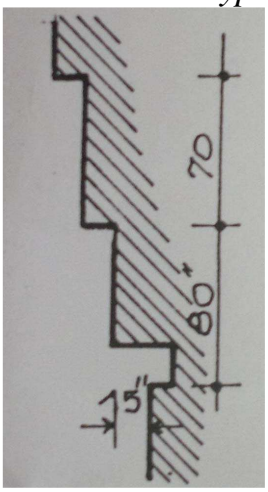
"If you look closely, you can watch the vertical line, running up the visible height of the wall. This line is not a junction of blocks, forming the wall masonry. This line is caused by 2 millimetres difference between left and right thickness of the already stacked blocks." From ISIDA-PROJECT

I have no measures on the location of this line, but from the images I have, it appears to run down the centre of the south wall of the first chamber.

Another unusual feature of the first chamber is the holes that Perring shows in his drawing below; here he shows 4 holes in corbel 7 and 3 in corbel 10, one can also make out 3 holes in corbel 7 in the second chamber.



M&R comment on the holes in the second chamber, "*Starting from the ceiling, under the fifth overhang, are seen three holes on the east and west walls. They are at the same height as the ancient pavement of the corridor giving access to the third chamber. The central holes are about in the middle of the walls. It is probable that a scaffolding leading to the upper corridor was fixed in these holes. It could be that other holes exist in the upper overhangs, but we could not ascertain this hypothesis.*"

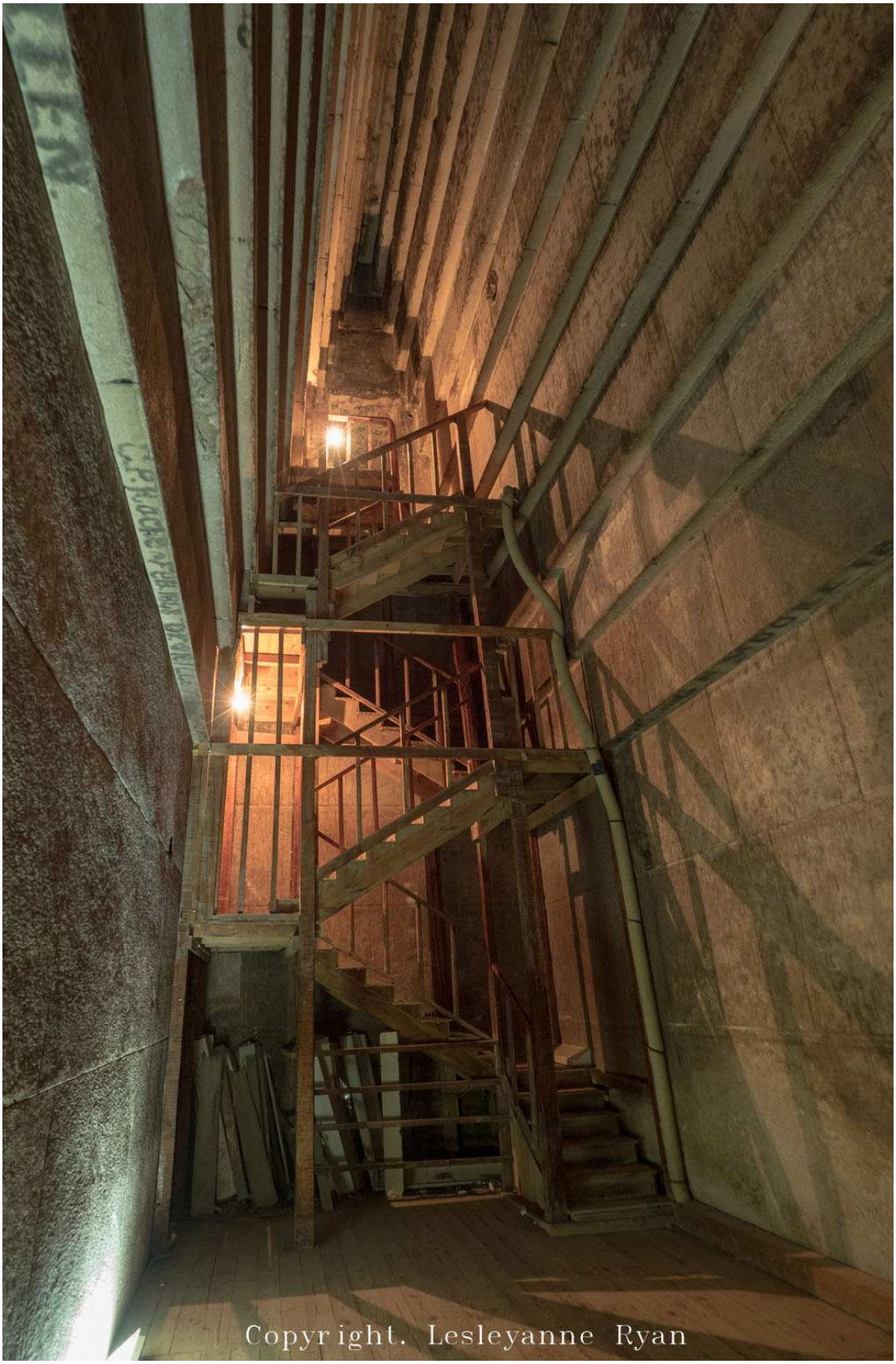


The section of one of the holes, above by M&R.

Unfortunately I have been unable to find any images of these holes, or their dimensions; they may be similar to holes observed in the corbelled ceiling of the lower chamber in the Bent pyramid. These holes noticed by Perring, need to be more closely examined, along with a search for possible other holes.

M&R mentioned the possibility of scaffolding leading up to the upper corridor, but then why have similar holes in the first chamber? Is there a corridor to be discovered leading from it? Another option might be a suspended wooden ceiling fitted to both chambers that would prevent prying eyes from looking upwards towards the corridor leading to the upper chamber. Though this corridor may have been blocked by a 2 x 2 cubit stone to blend in with the second chambers south wall, a neat feat in itself, given the height from the floor. But credit must be given to Perring for noticing these holes in the first place with only the help of a naked flame for illumination.

A view of lower chambers corbels



View of second chamber looking south.

The second chamber is reached by a corridor that leaves the south west corner of the first chamber, this corridor Perring gives as 10 feet 4 inches long (3.15m), M&R give west wall as 3.17m and east wall as 3.19m. The height and width, Perring gives the same as the first horizontal corridor. The monolithic stones over the entrances display cracks, as can be seen from the images. This corridor enters the north-east corner of the second chamber, which Perring describes as *"exactly similar, excepting that it is about 2 inches shorter from north to south."* M&R give 8.34m W, 8.345m E.

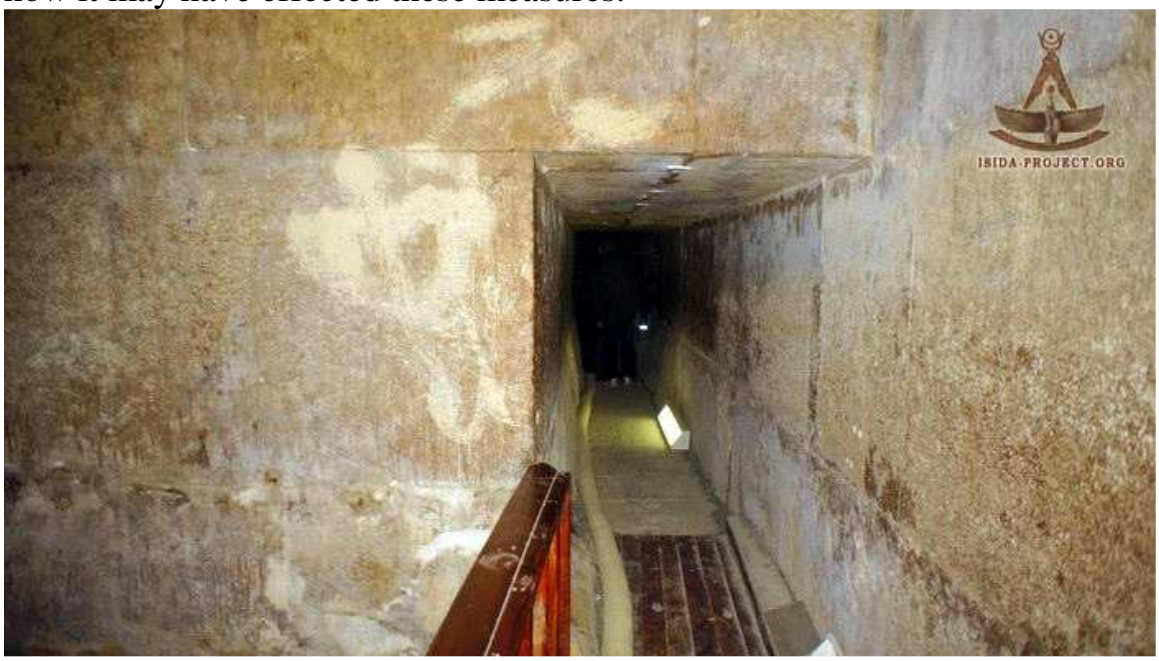
Views of second chamber

View of entrance to second chamber & monolithic block

Today, steps are placed against the south wall of the second chamber to provide access to the horizontal corridor that leads to the third chamber. Perring states;

"At the end of it, and at the height of 25 feet 3 ½ inches (7.71m) *from the original floor, a passage 3 feet 5 ½ inches in width, runs southward for 23 feet 11inches* (7.29m), *to a third chamber, the floor of which had been taken up to the depth of 14 feet. The floor of the above-mentioned passage (which was originally 3 feet 5 ½ inches high) had also been taken up, in order, probably, to facilitate the removal of the large blocks from the inner chamber."*

M&R's drawing suggests that the original floor of the upper corridor is 8.60m from the lower chamber floor and its roof 9.64m, with the cutting below the original corridor starting at 7.80m, some 9cm higher than Perring's measure, but we have to keep in mind the uneven floor slabs and how it may have effected these measures.



In the view above, looking from inside the upper chamber, we can see the corridor leading out to the corbelled ceiling of the second lower chamber. Originally the corridor was 2 by 2 cubits square; however the floor of it has been excavated to a depth of about 83cm. The length of this corridor M&R give as 7.37m (Perring gives 7.29m). M&R report two holes in the corridor walls, by the entrance from the second chamber, one curved through the stone, similar to what we see in the Bent's subsidiary pyramid.

The Upper Chamber

Perring states; *"The third chamber is 27 feet 3 ½ inches* (8.32m) *long from east to west, and 13 feet 7 ½ inches* (4.15m) *wide from north to south. The sides are perpendicular for 12 feet 1 inch* (3.68m)*, after which fourteen courses project inwards, as in the other apartment; and the total height from the original floor to the ceiling, is 48 feet 1inch* (14.66m).

M&R's drawing gives length 8.35m, width 4.18m, to first corbel 3.69m and total height 14.67m.

In the Meidum and Bent pyramids the chambers follow a north-south orientation, but here in the upper chamber it follows an east-west orientation. The chamber itself is the same length as the lower chambers; however it has been widened by 1 cubit, necessitating 14 corbels, compared to the lower chambers 11.

A massive excavation has taken place in the floor of this chamber and Perring reported a depth of some 14 feet (4.27m); M&R's drawing shows the excavation to be 4.46m from the original floor, which has all disappeared. The missing material, from a rough calculation using M&R's drawings suggests that some 98 cubic metres of stone has been removed, some 255 tonnes or 280 US tons.

M&R's drawing suggest a pavement around 63cm thick and a sub-pavement of 43cm thickness, M&R say,

"the pavement itself was inserted after the building of the walls: we can make the same observation about the corridor. As usual, in this crypt the subpavement was laid with the joints well worked, but the blocks of the masonry underneath are only coarsely squared. From a breach in the north wall of the crypt it is possible to see that the subpavement, and the courses under it, go under the side walls. By studying this breach we were able to ascertain that the monument was built in horizontal courses varying in thickness from one another. Sometimes a course (whose thickness was constant for all its extension) in certain points is formed by two super-imposed blocks.)

The two courses under the sub-pavement are 1.30 and 1.25m (M&R)

The excavation in the upper chamber

The corbelled ceiling of the upper chamber: M&R report that no holes are visible on these corbels.

Excavation, showing breach in north wall

View inside north wall breach

View of 43cm sub-pavement, followed by two courses of 1.30m & 1.25m

M&R suggested *"Perhaps, here, the architects did not use a sarcophagus but built a loculus in the pavement and covered it with a stone slab. The plunderers, in searching all around, probably thought that treasures were hidden under the loculus and for this reason they destroyed the pavement and made a deep excavation in the masonry underneath."*

In Khafre's pyramid we have a sunken sarcophagus surrounded by granite blocks and let us not forget the strange oval sarcophagus at Zawyet El Aryan. That said, the destruction seems excessive and similar destruction is not to be seen in other contemporary pyramids, were the violators appear to be content in only upturning paving blocks in their searches. In my Bent

pyramid paper part 1, I suggested that the damage to the upper chamber ceiling may have been caused by violators quarrying stone to make the rubble ramp next to the massif, to enable them to remove a valuable item. It is possible that something similar may have happened here; only this time the floor of the upper chamber became the quarry for the violators. The removal of the floor in the corridor leading to the upper chamber, suggests that something valuable in the chamber was larger than the original 1.05m square corridor or removal of the floor simply aided removal and lowering of a ramp. Was a masonry ramp required from the corridor entrance to the floor of the second chamber, to secure the removal of a heavy object?

A substantial masonry ramp would be required to lower a heavy object from the mouth of the excavated corridor some 7.8m above the second chamber floor. Whatever the object was, it had to be less than the height of the descending passage in order for it to complete its journey out of the pyramid. For example it's possible that half the volume of the second chamber that includes up to the first corbel, was full of this masonry ramp, which would accommodate 54 cubic metres, if we assume the ramp spanned the width of the chamber, to ensure its stability. We still have to add more masonry to cover the remaining 4.23m to the corridor floor, and obviously the cubic amount decreases as the ramp rises, but my rough calculations suggest that the excavated material from the upper chamber could make this ramp.

What became of this possible ramp is unknown, Perring simply states *"The pavement of this second chamber has been removed, and the room is full of rubbish."* M&R's drawing suggest the paving is complete in this room, apart from a small portion directly under the corridor entrance: was Perring confusing blocks of masonry threw down from the chamber above perhaps?

Could a ramp have been removed during possible Saite era restorations? M&R say;

"In the rubble coming from the funerary apartments and thrown along the north face of the pyramid, we found a bronze coin from the Ptolemaic period. This is further proof, if there had been any need, of the fact that in this period the pyramid was open, accessible and probably used for intrusive burials."

According To M&R *"During an excavation of the interior of the pyramid made in 1950, very ancient human remains, and bones of numerous kinds of animals were found."* These human remains were examined by Batrawi and

his findings published in ASAE volume 51. I have not been able to read this article, but from other sources, it appears that the remains belonged to a single male who died past middle age and that there were signs of mummification; M&R say of Batrawi *"He has no difficulty in saying that this skeleton could be Sneferu's"*

I have been unable to find out if any more modern scientific techniques have been carried out on these remains, certainly I would suspect that back in the 1950's the science and knowledge were not available to definitively conclude that these are the remains of Sneferu. My understanding is that these remains still exist, but have never been radiocarbon dated. I feel sure that if they have been subjected to modern scientific scrutiny and dating and found to fit the chronology of Sneferu, it would be well reported in the literature; but I can find nothing. This has not stopped some in Egyptology using these remains to suggest that Sneferu was buried in the Red pyramid; indeed, in some cases there appears to be no ambiguity on the matter. For example Zahi Hawass confidently states in his book *"Valley of the Golden Mummies"2000*

"Remains of Sneferu, the first pharaoh of the fourth dynasty, were discovered with resin inside the empty skull, which tells us that by this time Egyptians had begun to solve the problem of deterioration by applying resin to preserve the inner cavities from which the brain and other internal organs –the first parts of the body to deteriorate-had been removed."

As a layperson I don't know if Hawass has access to unpublished information that allows him to make the assertion above; however it is now some 17 years since his book was published and I still cannot find any scientific confirmation that these remains belong to Sneferu. Whatever the truth behind these remains, be they intrusive or not, it does seem inexplicable that more modern scrutiny has not been carried out; even if they turn out to be intrusive it would be nice to know what date this activity took place.

Modern Scrutiny has been done on some assumed old kingdom remains; for example an article in *Anthropologie XXXIX/1, page*. 15-23, 2001, *'Identification of Royal Skeletal Remains from Egyptian Pyramids',* the authors conclude; *"Our results show that not all assumed royal remains from the Old Kingdom pyramids are genuine. Of the four identifications two*

cases were positively proven (Neferefra, Djedkare Isesi), while two others had to be refused (Djoser, Mycerinus).”

Returning now to the upper chamber, an interesting feature can be seen in the preceding picture, which shows the corridor to the upper chamber, viewed from inside said chamber.

Here, we do not see the use of large monolithic stones spanning the roof of the corridor, but rather stones that join in the middle of the corridor. I have no measures of the stone above the entrance that is visible top left. But from other images it appears that the greater bulk of it, 2/3rds, is supported by the chamber wall, with the remaining third, creating half of the corridor roof. It is possible that the opposing stone that disappears into the east wall is a similar size, along with the other stones that make up the corridor roof; from the images I have, the only stone that spans the corridor roof completely, is the first stone that is also part of the corbelled ceiling of the second chamber. The white strips visible on the joints are tell tales to monitor the joint.

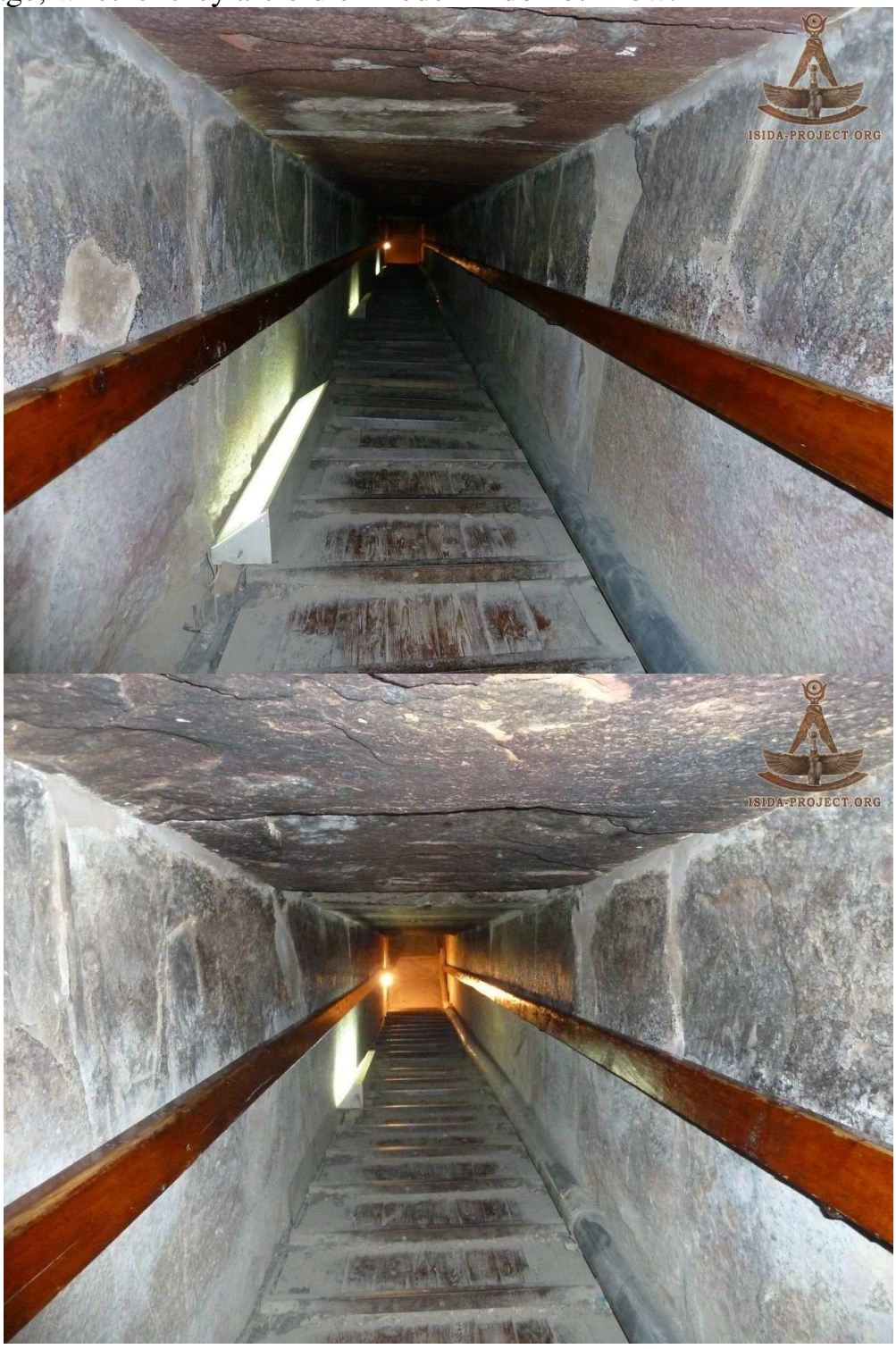
The only stone that appears to span the corridor roof is the first stone

In the image above, notice how one of the course stones appears to turn a corner, this technique can also be seen at other sites, like in the valley temple next to the Sphinx at Giza.

A common feature is the dark running stains visible on the walls, which display a noticeable gap beneath the corbels and the horizontal masonry joints; I suspect this is caused by bats urinating on the walls.

Repairs

There appear to be evidence of repairs, mostly in the descending entrance passage, whether they are old or modern I do not know.



Pyramid Closure

The method of closure of the Red pyramid is not known, M&R say;

"We wish to point out that portcullises and traces of blocking of the corridors do not exist in the funerary apartments of this pyramid"

In their observations they further say;

"The absence of portcullises is not a surprise: the same absence is noted, as we have seen, in the Meydum Pyramid and in the inferior apartment of South Dahshur. Besides, no one could have suspected the existence of the crypt (owing to its position) and the horizontal corridor which was probably blocked and concealed, if they had not been informed of their exact location."

In my Meidum paper, I suggest that there is evidence that the vertical shaft contained a portcullis. The inferior apartment of the Bent pyramid (M&R mean lower chamber) had the benefit of a high entrance from the antechamber, and possibly the north passage extension, plugged. In the Red pyramid we may have something similar; the high entrance to the upper chamber and the possibility that part of the inclined pyramid entrance being plugged.

In the Bent pyramid there appears to be no attempt at concealing the external entrances, by making them blend in with the surrounding masonry; both west and north entrances are easily discernible. Only at Meidum do we see a deliberate attempt to conceal the entrance on the final casing phase; given the graffiti dates, it appears that the casing of Meidum and the Red pyramid may have been done concurrently. I feel therefore, that the Red Pyramid entrance was probably done likewise, though we will never know, as a significant portion of the entrance is lost to us.

Regardless of what security measures were put in place, huge construction projects like these would always have many prying eyes from unsavoury characters, biding their time and awaiting their opportunity to plunder; though there may be a deep shaft (as found in the Bent pyramid) yet to be discovered, a possible location may be in the short corridor that connects both lower chambers.

Pyramid Complex Constructions

During M&R's investigations, they mention that the enclosure wall for the pyramid had not yet been found; neither does Perring report the existence of one. For many years now, the German Archaeological Institute has excavated at Dahshur, unfortunately, access and translation of their articles has been an issue, therefore I can only give a brief description of constructions surrounding the pyramid.

The enclosure wall was eventually found and appears to be a brick construction with parts covered in limestone cladding. The south and north wall is about 15 to 16m from the pyramid, west wall slightly further away at 19m, while the east wall is some 26m away. Inside the north east corner of the wall, a mud brick structure has been found. Scant remains of a pyramid temple have also been found on the east side, consisting of mud brick and limestone elements; apparently north of this temple, tree pits were found.

It appears that there is no evidence of a causeway, or preparation of one. The existence of a valley temple is not known, though some suspicion is attached to a structure 100m by 65m, mentioned by Grinsell: M&R searched for these ruins without success; my understanding is that these remains are now in an agricultural area and that the high water table makes the site inaccessible. The complex is also devoid of any subsidiary pyramid; it appears we only have the pyramid, remnants of a pyramid temple and enclosure wall, with a mud brick building in its north-east corner.

Stadlemann apparently interprets the mud brick enclosure wall as evidence of haste to complete the complex. It may be possible that Sneferu died and his successor completed this wall and curtailed any further work at Meidum; we do not know if a causeway, subsidiary pyramid or valley temple was envisioned by Sneferu for the Red pyramid, he might have been content with the Bent pyramids valley temple etc, and saw no need to duplicate these items.

Concluding Remarks

The Red pyramid like the Bent Pyramid is in much need of a thorough forensic investigation, it appears a mess, and do we have any confidence for example on the chambers location within the structure. Unfortunately Egypt is cursed with too much archaeology, with more examples being unearthed every day, resources are stretched, so it may be sometime before the pyramids are revisited again with modern technology and proper recording of the structures done. It would be nice to see something along the lines of the restoration work carried out in the Great Pyramids Grand Gallery, were Hawass states (In updates to Petries, Pyramids and temples of Gizeh 1990);

"Registering all the blocks in the grand gallery and recording by drawing and photographs, the actual condition off each block before restoration."

This is the sort of information I should like to get my hands on, as much useful information can be gleamed from it; ideally a thorough mapping of the masonry inside the pyramids should be done. Such a process would give us much needed information on the myriad holes found in the Bent pyramid for instance and even those present in the Red Pyramid, where we do not have any detailed information as to their size and location that might help in deciphering their function. Careful mapping of the insides can help reveal anomalies, had this been done in the Meidum pyramid for instance, the anomaly that helped Dormion discover the relieving spaces would have been picked up much sooner.

We now come to the difficult bit, and that is trying to make sense of Sneferu's building activities. The reader must remember that I am just an amateur layman with limited resources, delving into a subject, were there is still much disagreement among Egyptologists. One area of contention is the chronology of Sneferu; having read too many papers on it, to give me a headache; we clearly have a wide difference of opinion of years reigned for Sneferu. Stadlemann suggests 48 years, assuming a biennial count; others counter with evidence that the count was not always biennial and suggest a reign closer to 30 years. I understand Stadlemann's position of 48 years as he needs time to build three large pyramids; however, based on the evidence available to me, I find myself more convinced by the argument of those who suggest a reign closer to 30 years. So it is from this time frame that I feel compelled to work to; this means something has to give, for I fail to see how three large pyramids could be built in so short a time frame.

The pyramid that I believe has to give way is the Meidum pyramid; this is based on research done for my Meidum guide, in that guide I gave a reconstruction of the features found in the vertical shaft, that suggested that a portcullis was used. I don't believe Sneferu was buried in the Meidum pyramid, but the remnants found in the pyramid suggest that it was sealed for someone, be it Huni or some other predecessor. What evidence we have suggests that Sneferu may have been involved in casing the Meidum pyramid only.

I suggest therefore that Sneferu's first pyramid building project was the Bent pyramid; this I suggest was first built in steps (see my, *curious case of the 60 degree pyramid* paper). This project when you compare it to the Meidum pyramid is a huge leap, be it in size and complexity and would require a large workforce; maybe some of this work force was Libyan captives, used to quarry the vast amounts of stone from the quarries. A sizeable workforce would also have to be present in the Tura quarries to provide the fine white limestone.

It may be possible that when the step phase of the Bent Pyramid was completed, Sneferu may have found himself in a position of excess labour, even taking into account other constructions required in the pyramid complex. Did he then decide to build another pyramid, a short distance to the north, one that would compliment the other; the Red pyramid is a similar height, but with a larger base, if it was hollow, you could pick it up and neatly cover the Bent pyramid. We could be looking at an overlap in the construction of the two pyramids; as the casing phase was begun on the Bent pyramid, the core of the Red could have been started.

It has been suggested that failings in the Bent pyramid was the motive behind the construction of the Red pyramid; the evidence for these failings is not as clear cut as some authors would make out and I have discussed these in my Bent pyramid papers. In the Red pyramid we see further development and increase in masonry quality, that old proverb, 'necessity is the mother of invention', springs to mind: in the many years that it took to build these structures, continual improvements in techniques is to be expected. The quality of the Bent pyramids subsidiary pyramid is such that one would have expected it next to the Red pyramid and not the Bent pyramid, the impression I get, is that it was built closer to the time frame of the Red pyramid chambers.

Possibly as the casing phase of the Bent pyramid came to a close, the stepped core of the Red may have neared completion; it may be near this time that some excess work force was dispatched to Meidum to turn the Meidum pyramid into a true pyramid, maybe to honour a predecessor that Sneferu held in high regard.

The casing of the Red and Meidum pyramids seem to be in similar time frames and appear to have been completed, though the use of mud brick at the Red and unfinished temple at Meidum could suggest the death of Sneferu: did Khufu curtail any further works at Medium and hastily build a mud brick enclosure wall at the Red?

As a lay person, I feel the above building sequence best fits the evidence and do-able in a time frame closer to 30 years and explains the implausible build rate that Romer suggests. I have shown in previous papers the evidence for steps inside pyramids and the possible motive for doing it this way, indeed the Great pyramid may have a stepped core; the micro-gravimetric scan of the Great Pyramid done in the 1980's has been used by some as proof of a internal spiral ramp, though it could equally be interpreted as a stepped core.

The design and function of the chambers in these three pyramids will probably never be known, but I shall hazard a guess. In the Meidum pyramid we have two small antechambers, of the same size, leading to a large upper chamber. Where these two small antechambers built to house items that represented the two kingdoms of Egypt, i.e. upper and lower, with the king holding the double crown, laid to rest in the upper chamber?

Was an extension of this symbolised in the Bent pyramid, where two distinct passage and chamber systems and double slope of the pyramid a deliberate representation of the two kingdoms of Egypt, an idea first proposed by Varille?

Having completed the complicated Bent chambers, did Sneferu revert back to the simpler design of Meidum for the Red pyramid, in homage to a predecessor he held in high regard; high enough indeed to transform Meidum into a smooth pyramid?

This concludes my guide to the Red pyramid, certainly, much still remains to be discovered about these pyramids, one gets the sense that we have barely scratched the surface when it comes to exploring them. I can only

hope that future generations can revisit these structures and give them the thorough examination that is long overdue, and hopefully answer the many perplexing questions that they currently pose.