XIV
The Service Shaft

Returning to the Quadrivium, described earlier, we may deal with another part of the pyramid also subjected to numerous conflicting theories. That is the Service Shaft: a tunnel that follows a tortuous path downward until it joins the Descending Corridor on the west side, just few meters before the horizontal passage leading to the Subterranean Chamber.

It starts with the trapezoidal niche carved in the west platform between the first and the second pits (the ones without niches).

This cavity was not made during construction; instead it, even carved with extreme care, has been excavated *a posteriori,* as well as the rest of the shaft (photo **G01**).

This supports the theory of many successive architects being involved in the construction, as well as that one of various changes in strategy during construction.

Just nonsensical. The shaft had certainly been foreseen in the original project, but it was constructed in due course.

If the service shaft has been planned since the beginning, the obvious solution would be to build it along while the surrounding structure rises, but Hemiunu has good reasons not to do so.

I will show you the reasons elsewhere. It is essential that the shaft starts exactly at the position I told you, but difficult then to be sure that it would end exactly where it was established and, furthermore, there might have the settling phenomena...

So though it would be perceived as a blunder, it is much simpler, more reasonable, and safer to dig the shaft when the pyramid is almost finished.

Over the years, the structure would get stabilized and digging the shaft could proceed without any surprises. Certainly working hard on 24-hour shifts, a good team of stonemasons could advance in the limestone at least one meter per day. The well is about 50 meters long. That means increasing the work of a few unfortunate workmen by a couple of months. Nothing compared to be sure to do it without any problem.

Clearly this way is the safest and easiest to achieve although in our time it would be very expensive and almost immoral.

I my opinion it is not easy to describe the shape of this niche at the Quadrivium. Still, I shall make an attempt to do so, while I build a wooden model of it to shoot photos of it.

However, since the model-making process is moving slowly, I begin the description here to keep the job going forward.
This niche is located at the west side of the Quadrivium, dug into the platform and going a further 15cm (two palms) deeper into the sidewall. Its floor, however, is 67.5cm (1c + 2p) lower than the corridor floor.
From here, the bottom of the niche moves westward 1c (52.5cm) horizontally then, still westward, it slopes downward for a stretch 88cm long (the floor here is very rough now) until it reaches the mouth of a square vertical shaft of 68cm sides (1c + 2p) and 10c deep.
At first I did not care of the sloping part, assuming it was attributable to Caviglia during the extraction of the four granite blocks from the shaft.
Only recently (I added this part in August 2008) having no other issue to devote myself to, I became intrigued with this cavity; perhaps I still discovered something.
Perring, who was the first to come here in modern times, says that at the inlet of the vertical shaft two lateral niches were excavated, in its south and north walls. I suppose these two cavities were intended to accommodate men standing on the sides to steer into correct position the granite blocks to plug the shaft (at the inside works completion).
I also contemplated the plausible measurements for these blocks, coming to the conclusion that they should be 2c (105cm) high each. With five such blocks, the vertical section of the shaft, 10 cubits deep, would be "filled up."
The North-South side should reasonably have had a length equal to 2p + 1c (67.5cm) to allow the blocks passing through the cavity (which is 68cm wide). Only the third measurement was puzzling me.
To seal the shaft completely, it is logical to expect the third dimension equal to 67.5cm as well. But the niche entrance in the Grand Gallery could not allow it to pass through, nor it would be possible to pass any ropes on the sides of the block itself. One of these blocks was found within the "grotto" (this is a natural cavity at a lower level) and, although mutilated, shows two holes through a 50.8cm side.
I doubt about this measurement (maybe a mistake in conversion from inches to cm): 1c should be the right one. Such a block would weigh about a ton and the two small lateral cavities, carved in the shaft walls, could not accommodate all the men necessary to hang the block.
The mystery is explained by the two holes drilled in the block: from within the two niches at the entrance of the vertical shaft only a few people would work. They would have the sole task of guiding the blocks properly, with the help of poles and

cables, while to hold them as dropping, would be carried out by a large number of workers at the Quadrivium using ropes passing through the two holes. My wooden model is already well under way and I checked my hypothesis (photo sequence... **G02-G08**).

I want to notice that, standing in front of it, the niche enters 67.5cm westward, going 15cm into the sidewall after having crossed the whole platform. The extra 15cm are essential to the rotation letting the blocks in.

Furthermore such a kind of block can pass through, having the ropes inserted, only if the end of the niche floor westward has the right slope. So it is reasonable to assume that this gradient was planned from the beginning but subjected to further damages in later periods.

Yet another detail: the two ropes to slip the block must be prevented from being damaged by the block itself. Having the two holes placed at 15cm (2p) from the block corners, it was essential to provide at the 88cm sloping path two floor grooves, each 1p wide, to save the ropes.

Shortly: what it looks like a demolition work could have only slightly altered the existing shape.

Caviglia, who worked in the Service Shaft to free it from the top, wrote in his own report he had to work hard since the passage was blocked by four large granite blocks, stuck inside the shaft, above the "grotto" level I will describe shortly.

It was necessary to break them by mallet and chisel to remove them, so it is clear no one had ever been able to go up from the bottom of the shaft.

This detail is crucial because it attests that until the time of Al Mamun the pyramid was unmarred.

At the final closing, Hemiunu did drop the five granite blocks from the top to plug, up to the point where the conduit slope changes, the ten cubits long vertical shaft. These provided a good hitch against anyone wanting to enter from the Descending Corridor.

Since a block was found broken into the "grotto", removed by breaking a shaft wall, this likely scenario struck me: Al Mamun initially penetrated the Descending Corridor (with other problems which I will discuss elsewhere) and discovered the gooseneck rising upward, but he was stopped by the five block barrier.

Of course he attempted to remove them from below, risking the lives of his workers. The bottom block was induced to fall down by a dangerous widening of the shaft (Caviglia describes this part roughly damaged to doubt about its original shape), just to be followed by the next four, definitely sealing the shaft. Not even

after having moved the first block within the "grotto," it was possible to enter this way. So Al Mamun chooses a second option: he dug a tunnel below the cap-block at the intersection between the Ascending and the Descending Corridor, to get inside the Great Pyramid.
Caviglia, probably unaware that it would lead him into the Descending Corridor, after the Service Shaft had been freed and entering the last section (the gooseneck found abandoned, digging tools along and the usual baskets used for the soil transport).
In my opinion, before to insert the five granite blocks, the shaft was partially filled by using the material from its excavation (...the "goose-neck" was full of debris....). This material probably never left the pyramid and was "parked" above the wooden loft installed at mid-height inside the Grand Gallery.
This was a suitable warehouse to hold the necessary tools for the workers, but not only. Forced to bear more weight, like the debris (perhaps not expected in normal conditions), lastly it had to be reinforced, by a wall coarse chiseling, to allow the insertion of more robust wedges.
This modification in emergency conditions is visible in the lower and upper part of the Grand Gallery.
About the upper "chiseling" I have also another explanation, which I'll speak elsewhere.
February 2015: Really, this book will never end.
I'm waiting for a friend of mine ends the English translation of this text, but in the meantime, perhaps I got further information about the size of the broken granite block still inside the "grotto".
I found a drawing (**N63**) made, I think, by Edgar, where the grotto and the broken block have been represented on a horizontal and a vertical plane.
The measures are not assessed, but it seems made with care, perhaps it is scale drawing.
Starting from this assumption, however this may not be correct, the side corresponding to 67.5cm is just smaller than the well width, equal to 68cm, and this is a good start.
Using this side as a basis for the proportions, I would get to the short side of a 52.5cm (1c) value, exactly as I said earlier.
The long side, however, is mutilated along the axis of the two holes, but working with patience, imagining to add two granite palms over the holes, would get a total of 131cm. which correspond exactly to two cubits and a half.

I find this measure reasonable, even if it forces me to partially revise my assumptions about Al Mamun: such a long block could still pass through the entrance at the Quadrivium and it would be even more appropriate.
Four blocks like this would be enough to completely fill the ten cubits long vertical section.
In this case we must believe that Al Mamun began to remove the debris into the shaft from its bottom, never imagining finding higher up the four granite blocks.
Maybe he tried to bring down the lower one, widening the well, but the block must have shown an insurmountable obstacle, forcing him to abandon the enterprise, maybe after having moved it into the "grotto".
Or perhaps it was Caviglia to park into the "grotto" the broken block being impossible to lift it up by ropes.
Back to the Shaft: under the 10 cubits vertical section, a carved slope path begins: overlaying a ruler over the slope floor, as I did, it is possible to see it points exactly (despite the various changes of slope) to the actual shaft exit.
How was it possible to do such a precise task I cannot imagine: maybe a plumb line and a compass? (The path lies exactly on the north-south axis and Phoenicians were on good terms with the Egyptians...).
I will not hazard dangerous solutions; the current complications will be enough.
Everything was going perfectly, the shaft going down safely, when suddenly... trouble!
The excavation carried out so far had been through the "erected" part of the pyramid, but upon reaching the bedrock on which it rests (part that should not create any problems at all), a layer of sediment pebbles due to a stream running through the site thousands of years ago, was found into the rock.
It was not possible then to continue with the initial slope: too dangerous.
The excavation went on down vertically, hoping the anomaly would be short.
So it was luckily: after just over two meters, the bedrock was back. But it was necessary to ensure the vertical part by building a girdle wall, same internal size of the shaft to allow the work to continue.
This is the part called "the grotto"—to be visited only using proper safeguards, since the broken shaft wall to free the block.
After this short vertical section, the excavation downward resumes, but now with a changed slope: it no longer points to the same emerging point; instead with its shallower slope, it points to the end of the Corridor.

This seems to contradict my first statement speaking about it emerging in the exact spot where it is just from the beginning of the excavation.
However, I think Hemiunu still wanted to prevent curious climbers in the shaft, for which he had in mind, at least for the final stretch, a slope to discourage anyone. If he had taken the excavation still focusing on the same target, the new corridor stretch would have had a "sweeter" slope than the original.
To avoid any risk a new, lighter slope is adopted, just because the architect want to achieve the final stretch with a much, much steeper slope, almost a "fall" towards the bottom exit: no one could climb up without an Herculean effort...
I can also imagine that the last part of the excavation was led by the sound of a bat from the bottom of the Descending Corridor.
The joining of the two paths was carried out with a "goose-neck" excavation in order to connect them properly.
Hemiunu want to close the whole shaft in due course and to conceal its lower exit with a suitable rectangular stone, like the wall blocks of the Descending Corridor.
I have already showed pictures (photo **E04** and **E05**) from which it is possible to deduce the shape of the bottom exit. But then things took an unexpected turn from what the architect wished...
I believe it was unlikely that this steep passage was planned for men and things, the conditions being so uncomfortable. In my opinion the purpose of this tunnel was to provide air to the people working inside the pyramid.
This idea is not very original; I think I have read it somewhere, even if cast only as a hypothesis and nothing more.
When I described the technique for raising the blocks in the Grand Gallery, I had estimated at least 170 working men plus thirty for peripheral activities (wetting the ropes, moving the pulleys, relieving the injured, looking after the lamps etc.). Two hundred men, almost all under stress.
Under these conditions, a worker may consume more than 100 liters of air per minute and, since the theoretical air available is 1200 m3, it's easy to understand the extent of the problem...
Certainly Hemiunu was aware about this. However, he had no reason to worry: the problem will be solved later by digging the service shaft.
Since I could not find evidence in favor of my hypothesis, from this point on I will be forced to be creative. I shall pretend I lead the work. I will then operate the device in my own way, hoping that Hemiunu may have had a similar idea.

Of course I'm worried: despite the Shaft, the natural air circulation will be fairly small as said by Caviglia who worked inside with just a dozen men.
Due to the particular layout of the corridors and the thermal laws, the fresh air tends to linger at the bottom, so any air replacement is hindered.
My idea is the entire Descending Corridor acts like a giant cylinder in which a piston sliding downward will compress the air through the Shaft, pushing it up to the Quadrivium (having of course installed a frame at the bottom end of the Descending Corridor).
Simple and brilliant! I wonder if...
To work properly the piston must be formed by a wooden sled and a vertical frame with one or more one-way valves, which must be closed when the slide descends and open during the upward run (maybe made by leather installed on a wooden frame and steered by hand). Obviously the device must seal the most of the whole section of the corridor. Since it will be tiring to handle, workers must be placed on both sides of the frame.
For towing upward there is no problem: the space for men (although many) is plentiful, for sure.
When pulling downward a space for at least a dozen men is necessary between the two frames. For this reason, in my opinion, the shaft entrance is a little more distant (about 7m) from the bottom end of the corridor.
At the Shaft exit in the Quadrivium, also the Horizontal Corridor to the Queen's Chamber and the down corridor have to be plugged with a fake wall.
In this way the fresh air flow will move upwards, toward the King's Chamber and its two external vents. They will work like two "chimneys" justifying, even if in an unexpected way, their being called "ventilation ducts"...
It is evident the block itself, during the trip within the Ascending Corridor, is enough to ensure a proper sealing.
Working in this way, at each downward stroke of the piston, a volume of at least 70 - 80m3 of fresh air will force the warm air into the King's Chamber, discharging the modest overpressure through the ducts.
The bending slightly upward flame of the lamps would, probably, have reassured the men at work.
An estimated time required for each complete piston stroke of 5 minutes seems reasonable to me (or even less....) Then a flow of fresh air equal to about 950 m3/hour can be counted on: this is a suitable amount of fresh air and also allows rest breaks for everyone.

As I said, this is a figment of my imagination, but it works very well, according to all the features of the structure.