



THE PYRAMIDS



By Peter Barrett (Canberra Skeptics)

Think of Egypt and you think of pyramids. These impressive objects have fascinated people for centuries; they were even tourist destinations for the ancient Greeks and Romans.

What amazes people today is their massive size combined with the precision of their construction. There are people today who believe that this size and precision is evidence that the ancient Egyptians couldn't have built the pyramids unaided, and that they instead were assisted by aliens or people from Atlantis.

So let's look at the construction of the pyramids.

Egypt of the Pharaohs became a united kingdom around 3000BC, with the appearance of the 1st dynasty of kings. Pyramid building was restricted to a period of little more than a century - around 2800BC - 2650BC, and so belongs to the earliest period of Egyptian history (for comparison, Tutankhamun lived more than 1000 years later). The pyramids developed from earlier buildings known today as mastabas (mastaba is the Arabic word for "step"). A mastaba was a large rectangular structure with steeply sloping sides, under which a Pharaoh would be buried. These were the first large stone buildings in Egypt.

The next stage of development came with a series of renovations to the mastaba of Zoser. It was originally a large rectangular building of one level, but was extended several times, both by increasing the length of the short sides to make it square, and by adding levels on top. When the renovations were complete, the result was the step pyramid of Zoser. The inspiration for this development was probably Egyptian knowledge of the ziggurats of Sumerian towns, which looked similar.

Next was the failed pyramid of Meidun, named for its location. This was the first building intended from the start to be a pyramid, with the burial chamber inside the pyramid, rather than underground. To put a room inside a pyramid required the development of a new masonry technique, called the corbel, a primitive form of arch. But while the corbel was a success, the outer layers of the pyramid collapsed because they weren't properly bound to the core. The Pharaoh at the time, Sneferu, ordered another pyramid built.

The result was the Bent pyramid. It's known by this name because although it's a pyramid in the proper sense, the angle of its sides decreases from 54 degrees to 43 degrees about half way up. This was because the weight of stone overlying the burial chamber threatened to collapse the chamber. However, the correction was too late, and once again, Sneferu had to order a new pyramid.

Thus was built the first pyramid in the sense that we think of them today. Due to the colour of its stones at sunset, it's called the Red pyramid. Taking advantage of what had been learned in building the last two pyramids, it set the standard for future pyramid construction. Finally, Sneferu had a burial chamber.

The pinnacle (so to speak) of pyramid construction was then reached with the Great Pyramid - the pyramid of Cheops - on the Giza plateau, just outside what's now Cairo. (Cheops was one of Sneferu's sons.) One more large pyramid was built, on the orders of Cheops's son. A few smaller pyramids were built after this, some of them with mud bricks, but the age of pyramid building was now effectively over.

So why did the Egyptians build pyramids? Or at least, why did the Pharaohs choose to be buried in pyramids, as opposed to something else? Egyptians revered the Sun god Ra, and the pyramids were simply tall buildings, getting the dead Pharaoh nearer the Sun. Inspired by Sumerian ziggurats, they used the one method they knew of building a tall building.

To build a pyramid requires a number of elements to be well organised, including a level starting surface, correct alignment, a large workforce, a good supply of stone, and a means of transporting the stone. All of these were within the abilities of the Egyptians to organise.

To level the ground where the pyramid will be built, dig a trench and fill it with water. Then chisel the surrounding rock to the level of the water. Incidentally, the prevailing wind will make the water gather slightly in one corner. The downwind corner of the Great Pyramid is a couple of centimetres higher than the other corners, presumably as a result of this effect.

To determine true north, all you need is an observation of the rising and setting points of a particular star. Bisect the angle and you have north.

The stone-haulers at the pyramid construction site weren't slaves. They came in two main categories: full-time professionals; and farmers unemployed during the annual Nile flood. They were employed in teams of eight, and were fed and housed on site. The latest evidence suggests that they were fed fish and prime beef, both expensive foods in Ancient Egypt, and that they received excellent medical treatment.

The Great Pyramid contains about 2,300,000 blocks of stone, weighing 2.5 tonnes on average. The stones were placed on sleds, and the sleds dragged along pathways. The pathways were covered with a local clay, and lubricated with water. In such a setting, a 2.5 tonne block of stone provides no great obstacle to a team of eight men - each man is pulling about 300 kilograms. These days, one person can easily pull a car, which weighs one tonne, though admittedly there's less friction involved.

It's reasonable to assume that a team of eight men could easily haul one block of stone into position per day. This means one team could place 365 blocks per year, or 7300 over a 20 year construction period. Divide 7300 into 2,300,000 and you get 315. In other words, 315 teams placing one stone per day for 20 years would be able to place 2,300,000 blocks. With eight men per team, theoretically only 2520 stone-haulers would be needed. However, as some stone-haulers were farmers, they were only available for a few months a year. As well, they worked only nine days in ten. It's also likely that there would've been holidays, supply shortages, industrial disputes (yes, even then!) and storms which would've prevented work. Even so, the most number of people required to haul stones would be well under 20,000. At this time, Egypt's population was about a million.

Ancient Egypt lacked iron tools, and this is sometimes thought to be a problem. However, the quarries used by the pyramid builders are well known and explored, and there are a number of partially extracted blocks left on site which show the techniques used to obtain the stone. Pictures of stone masons at work have also been found, so it's quite certain that the ancient Egyptians had the ability to quarry all the stone they needed for the pyramids, using copper axes and wooden wedges.

Much of the stone used in pyramids was quarried at the site of the pyramid, thus reducing the amount of transport required. But further stone was quarried elsewhere, and transported down the Nile. Once again, there are no problems with this procedure. Egyptian boats, known from both art and excavation, are easily large enough to have transported these blocks.

All of the above shows that the ancient Egyptians easily had the ability to build the pyramids. Of course, it's still possible the Egyptians got assistance from Atlantis or aliens. But if that's the case, then these helpers failed to teach the Egyptians all sorts of useful skills and technologies, such as use of the arch, cement and concrete, iron-working and the pulley, even though the ancient Romans knew about all of them. Is it believable that the Romans knew of them, but the Atlanteans or aliens didn't?

In conclusion, while the great pyramids are both enormous and yet incredibly precise, there is nothing to suggest that they're the product of anything but purely human ingenuity, and the ability to learn from failure.

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