THE CONSTRUCTION OF PYRAMIDS

Some of the remarks I have seen here regarding this subject range from the sensible to the ridiculous. So I post here a definitive estimate of how many men and how long it took, to build the Great Pyramid. My only regret is that a Danish engineer came to exactly the same conclusions back in the 1950's!

First, let me remark that plenty of sound waves were required to build the pyramid. I am sure Imhotep (the architect) and the general contractor --not to mention their attorneys-- did plenty of shouting. But there was no need to assume any more direct sound effect than this...

The GP has some 2.3 million blocks weighing an average of 2.5 tons. Its height is 480 feet. We therefore deduce a minimum amount of work (in the physics sense) of 1.4 trillion (10^{12}) ft-lb. A man-year of work is about 600 million ft-lb. Double the work needed to account for dragging, final shaping, etc. (The blocks were dragged up ramps on sledges lubricated with milk or vegetable oils. No rollers--the Egyptians had not discovered the wheel, and besides were timber-poor.) This means a crew of 500 for 10 years (double that if they only worked half-years). I assume a construction time of 10-20 years because kings didn't reign longer (with a few exceptions) in those days.

The work needed to transport the blocks to the site is small compared with that needed for assembly, since flotation was used throughout: down the Nile and along a narrow canal cut for that purpose to the base of the buliding site. The only machines required were levers and inclined planes. Pulleys and screws were unknown to the Egyptians of the OK.

Note that 2.3 million blocks in 10 years is about 1000/day during the building season. That's 100/hr, which means the quarrying crew was large also--perhaps 500 men. Finally, raftsmen were needed to transport the stones and load/unload them. Say 2 trips/day, meaning another 100 or so laborers.

The total workforce to build the GP in 10 years would then have been 2000, in round numbers, plus support personnel: overseers, clerks, paymasters, stock department, tool repair, etc. Say 3000 total. If the work were stretched out over 20 years, only half the force would be required. These numbers are by no means unreasonable for a kingdom with a population of 1 million or more. On the other hand, they are so small relative to the total population that the notion of pyramid building as a Works Progress Administration project to ensure full employment does not hold water. No one notices problems involving a mere 0.1% of the population.