CHAPTER 9

Egyptian Technology

Over the years, many theories have been advanced to try to explain the methods of construction which were used to build the pyramids and also to explain the numerous artifacts which have either been found in the pyramids or associated with them. In general, the basis for each of the many theories has been the assumption that thousands of years ago when the pyramids were built, civilization must still have been in its infancy. Therefore, it was further assumed that the ancient Egyptians were also primitive. Their ancient science and the associated technology derived from that science were assumed not to have advanced very far, certainly not as far as our modern technology has. However, none of those theories has been successful in explaining the many observations that have been made. It would seem to be more productive to utilize hints from the numerous artifacts indicating that the ancients were not primitive.

The idea that ancient man was primitive has been firmly entrenched in traditional teachings. Thus, that which is considered to be general "knowledge" of the Great Pyramid has been greatly influenced by these traditional teachings. From there, it carried over into the media and news items concerning the pyramids. However, extensive data have now been collected and it shows that the ancients were

actually not primitive. Such data is either not generally known or has been passed over or ignored because of the mindset that the ancients were primitive. An example of data which has been either passed over or ignored relates to the kind of tools which were used to cut the rocks used in building the pyramids. It has been assumed that copper was the only metal available at the time. Therefore, as the reasoning goes, tools must have been made of copper. However, this assumption may be entirely wrong.

Copper Tools?

In the case of the Giza pyramids, as we have already mentioned, much of the stone used was limestone. Limestone is a relatively soft rock as compared to hard rock like granite or diorite. The question is could limestone conceivably have been cut using "primitive" tools made of copper as has been suggested?

There are several problems with the idea that copper tools were used. Copper is a soft metal, much too soft even for cutting limestone. While copper is a soft metal, it is true that it can be work-hardened somewhat by hammering or by alloying with a substance like beryllium. However, work-hardened copper or copper hardened by alloying is fairly brittle and can break easily. It would not make a practical cutting tool. Furthermore, very few copper tools have actually been found.[1]

But there is an additional problem with the idea that only copper tools were used. In addition to limestone, many of the blocks that were included in the pyramids were of

1 Dunn, p. 70

granite. The method of using a hammer combined with a copper chisel is totally incapable of cutting a hard rock like granite.

The main reason copper has been suggested as the metal for making the tools was that traditional Egyptologists have assumed that copper was the only metal available at that time. That assumption, however, is no longer valid. It has no basis in reality. The reality is that the pyramid builders were iron makers as well, although this fact it is not widely known. In the British Museum is a piece of wrought iron that was discovered in 1837 in one of the joints of the limestone masonry. Modern metallurgical analysis has shown that it was ancient iron.[2] It was incorporated into the pyramid when it was built.

> That sheet iron was employed we know, from the fragment found by Howard Vyse in the masonry of the south air channel; and though some doubt has been thrown on the piece, merely from its rarity, yet the vouchers for it are very precise; and it has a cast of a nummulite on the rust of it, proving it to have been buried for ages beside a block of nummulitic limestone, and therefore to be certainly ancient. No reasonable doubt can therefore exist about its being really a genuine piece used by the Pyramid masons;…[3]

Thus, copper was in actual fact, not the only metal available for making tools. It causes one to wonder what other items may have been missed and not given proper consideration.

A further objection to the idea that a hammer plus copper chisels were used to form the pyramid blocks is the

---

2 Dunn, Appendix B, pp. 263-265

3 Sir W. M. Flinders Petrie, *The Pyramids and Temples of Gizeh*, NEW YORK: SCRIBNER & WELFORD, 1883, pp. 212-213

precision with which the blocks were cut and placed into position. In fact, in the case of the Giza pyramids, each pyramid in its entirety is a marvel of precision and accuracy. As mentioned previously, this point was confirmed in the late 1880s and following, when Sir William Flinders Petrie carried out a series of careful and precise measurements on the pyramids. He systematically and painstakingly recorded his measurements, and that data is still available today.

The data gathered by Petrie is another example of information that has been either passed over or ignored. Those measurements have been available for 120 years or more. Petrie's measurements have been checked by more recent investigators and shown to be accurate. Furthermore, additional discoveries and careful measurements are being made all the time. Enough data has now been collected that it can no longer be ignored by anyone seeking to provide a realistic explanation for the construction of the pyramids. The body of information shows definitely that the ancients used what we would consider as advanced techniques and tools.

It now appears that the pyramid builders were not primitive in construction methods either. A thorough study of the measurements that have been made on the Giza pyramids has shown that they used machine-age precision throughout.[4] The precision was for the entire structure. It was not limited to only individual stones. Also, in Chapter 7, evidence was presented which showed that the ancients had optical technology. They were not primitive in that regard. Thus, in order to provide a realistic interpretation of this continuing data, we need to open our minds to the possibility that the ancients were in fact not primitive in their building

4 Hancock, p. 278

methods either.

Machine-Age Tools?

If the Giza Pyramids were built with machine-age precision throughout, then two questions naturally come to mind, "Could machine-age tools have been employed?" and if so, "What were the kinds of tools used?"

Traditionally, interpreters of data and the artifacts from ancient Egypt have lacked technological perspective. That has put them, therefore, at a definite disadvantage in coming up with an explanation for these artifacts. Fortunately, that situation is beginning to change. It started to change with the very careful measurements and the detailed studies made by Flinders Petrie.

For example, Petrie noticed what appeared to be saw marks on stones that had been cut. Not only were there saw marks on some softer limestone objects, but also on the extremely hard diorite, granite, and basalt materials used in construction. He particularly noted saw marks on the granite coffer in The King's Chamber of the Great Pyramid.[5]

Modern observers have also made the same observation about saw marks. Steven Miller is one of them. He has an interest in the technological capability of ancient Egypt, and he also understands modern machine technology. Accompanied by his wife Cassie, Mr. Miller in 2005 conducted a research visit to Egypt. His objective was to study the technology that may have been used in constructing the pyramids. Mr. Miller also studied artifacts related to the

5 Sir W. M. Flinders Petrie, *The Pyramids and Temples of Gizeh*, NEW YORK: SCRIBNER & WELFORD, 1883, p. 84

pyramids and which were housed in the Cairo museum. On several objects he noted tool marks which indicated definite evidence that rocks had been cut by sawing.[6] In order to understand how saw marks might be recognized, let us consider some details about rock saws.

Rock saws are not constructed in the fashion of most saws. We tend to think of a saw as a flat piece of metal having either a circular or rectangular shape. On the edge of the blade are the saw's teeth which chip away material from the object which is being sawn. But saws with metal blades and teeth are not capable of cutting rock, especially hard rock. Rock is an abrasive and quickly either dulls the metal teeth or grinds them away. Another approach must be used to saw rock.

The saw modern rock cutters generally use is a wire in the form of a continuous loop. The wire is held between two wheels, one of which is powered to serve as driver. It is not the wire that does the actual cutting. Instead the cutting agent is a powdered abrasive made from a very hard material such as silicon carbide. Silicon carbide has a hardness index close to diamond and is hard enough to cut through hard rock. The wire simply firmly holds the silicon carbide powder as the wire moves through the material being cut. This type of saw leaves recognizable parallel cut marks on rocks as it cuts through. In modern quarry mills even hard rocks like granite are cut rapidly using this method.

Could the ancient Egyptians have used a type of wire saw? Did they have metals which could be used to fabricate a wire saw? It is now well established and well documented that the pyramid builders were makers of iron. This leaves open the possibility that other ferrous metals also existed in

6 Steve Miller, private communication, 2005

"pre-history" and could have been used to form wires for wire saws.

Other modern researchers familiar with current technology and who also have extensive experience and involvement with it are re-analyzing existing data as well as doing research to discover new data.[7] One example is Christopher Dunn, a man with more than 35 years of personal experience in modern machining methods and technology. He has had a special interest in doing research on the Giza pyramids. From his knowledge of modern machine technology and also after studying items like the coffers in the pyramids which show evidence of saw marks, Dunn makes the following observations:

> While no one can say with certainty how the granite coffers were cut, the saw marks in the granite have certain characteristics which suggest that they were not the result of hand sawing. …My experience (machinist), plus my observations of others using power saws, makes it inconceivable to me that manpower drove the saw that cut the granite coffers.[8]

A further argument against handsaws being the tools that were used for rock sawing is the physical requirements. There is insufficient pressure available from hand-sawing as well as insufficient speed to cut through rocks using handsaws. Also, the cut lines on pyramid rocks are perfectly parallel, and that would be extremely difficult to maintain using a handsaw.

Modern rock saws are not hand-powered. The driving wheels are machine powered. Cuts made by them leave marks that are even and uniform as expected from machine driven

7 Dunn, p. 54; Hancock, pp. 290-291

8 Dunn, p. 77

equipment. Cuts made on rocks used in the pyramids have the same type of pattern. This indicates that they also were probably made by a type of power driven machinery. After carefully studying the saw marks on pyramid rocks, Dunn again concludes with the following statement:

> This evidence points to the distinct probability that the pyramid builders possessed motorized machinery when they cut the granite found inside the Great Pyramid and the Second Pyramid.[9]

Lathe Tool-Marks

When Flinders Petrie made his measurements in the 1880s, the modern machine age was still in its infancy. Yet, Petrie recognized what appeared to be modern machine-type tool marks on objects which he studied.[10] For example, he noticed what appear to be lathe marks on sarcophagi lids. Anyone acquainted with modern technology can readily recognize lathe tool marks on an item. Petrie noted such evidence and clearly explained that a lathe tool was involved. That evidence has not disappeared. Evidence of tool marks made by a lathe on sarcophagi lids housed in the Cairo Museum can still be observed by visitors to the museum today.[11]

Numerous other examples of objects which appear to have been made on a lathe have also been found. An example is many diorite bowls (Figure 6a & 6b). As mentioned

9 Dunn, p. 79

10 Sir W. M. Flinders Petrie, *The Pyramids and Temples of Gizeh*, NEW YORK: SCRIBNER & WELFORD, 1883, p. 176

11 Steve Miller, private communication, 2005

Figure 6a.
One of numerous diorite bowls, some of which show clear evidence of having been carved on a lathe.

Figure 6b. Diorite bowl in hands to show perspective.

previously, diorite is a very hard rock. Yet, the bowls are perfectly round as would be the case if manufactured on a lathe. Could these bowls have been made using manual methods? It is true that intricately shaped objects can be made by using hand methods instead of machinery. An object could simply be rubbed with an abrasive such as sand or a harder abrasive material imbedded in wood or bone and used to apply the abrasive. Manual methods, however, cannot produce the perfectly regular tool marks found on some bowls. Although, on many bowls tool marks have been polished out, some bowls still retain lathe tool marks. In the case of one bowl, Petrie observed two different radii for the tool marks. This indicated to him that the bowl had been turned in a lathe, and then removed before completion. It was then re-centered for completion, and the re-centering was not quite exact, hence the two different radii. Hand methods simply do not produce that type of pattern.

In addition to bowls, numerous granite vases have been found. These objects show clear evidence of having been made by machine methods instead of by hand. Many are polished both inside and outside, and so, any tool marks would have been polished out of them. In some cases, however, unfinished vases are found, and they show clear evidence of tool marks. Photographs of such a vase are found in Figure 7. Notice the clear spiral tool marks in the vase in Figure 7c.

The vase is of such a size as to easily fit into a man's hand. On the inside is clear evidence of tool marks, made either on a lathe, or by tubular sawing. The tool made clear, evenly spaced spiral grooves on the inside of the vase. By manual methods such as rubbing with an abrasive powder, it would be nearly an impossibility to produce such a vase with these

Figure 7a.
Granite vase

Figure 7b.
Granite vase showing
size perspective

Figure 7c.
Granite vase showing
spiral grooves inside,
indicating tubular drilling.

Courtesy of Dennis Swift

tool marks. The rubbing would polish out any tool marks.

Intricately Contoured Vases

The vases just described are not the only examples of hollowed-out objects made in ancient Egypt. Many hollowed-out objects, even more intricately carved than the ones just mentioned, have been found. They are made out of a variety of very hard materials, including diorite, basalt, quartz crystal, and metamorphic schist rock. Thousands of these vessels have been found beneath the Step Pyramid of Zoser at Saqqara, which dates back to the early dynastic period. The workmanship on these vessels is superb. It is so excellent that one author comments that they must have been made by an almost unimaginable tool.

> Why unimaginable? Because many of the vessels were tall vases with long, thin, elegant necks and widely flared interiors, often incorporating fully hollowed-out shoulders. No instrument yet invented was capable of carving vases into shapes like these, because such an instrument would have had to have been narrow enough to have passed through the necks and strong enough (and of the right shape) to have scoured out the shoulders and the rounded interiors. And how could sufficient upward and outward pressure have been generated and applied within the vases to achieve these effects?"[12]

Graham Hancock has studied many of these objects and other similar enigmatically shaped objects. He reports that many vessels are tall and exquisitely carved. Such vessels have been unearthed at various places and present an enigma as to how they were made. As Hancock states, "There

12 Hancock, p. 333

were monolithic urns with delicate ornamental handles left attached to their exteriors by the carvers."[13] Many of these objects can be viewed in the Cairo Museum. In addition to the variety of shapes, some of them were constructed with what seems like extreme finesse. Hancock lists some examples of items which he noted and he comments about them as follows:

> There were also open bowls, and almost microscopic vials, and occasional strange wheel-shaped objects cut out from metamorphic schist and with inwardly curled edges planed down so fine that they were almost translucent. In all cases what was really perplexing was the precision with which the interiors and exteriors of these vessels had been made to correspond — curve matching curve — over absolutely smooth, polished surfaces with no tool marks visible.
>
> There was no technology known to have been available to the Ancient Egyptians capable of achieving such results. Nor, for that matter, would any stone-carver today be able to match them, even if he were working with the best tungsten-carbide tools. The implication, therefore, is that an unknown or secret technology had been put to use in Ancient Egypt.[14]

It is one thing to speculate about the possibility of the ancients having possessed high technical capability, but these finely crafted artifacts constitute irrefutable hard evidence. It may be difficult enough to polish the outside of an intricately shaped object, but the larger question is how was the ***inside*** polished? The evidence seems irrefutable that high technology was involved.

---

13 Hancock, p. 333

14 Hancock, pp. 333-334

Tubular Drilling

In addition to lathe tools, tubular drilling appeared to be the tooling method used on numerous objects that Petrie studied. His explanation for the tubular drilling tool was that a rock saw blade was formed into a circle. He also assumed that the blade was made out of bronze with some hard jewel-like substance in the bronze to serve as teeth for the saw. Diamond is a very hard material and can be used for cutting hard rock like diorite or granite. Granite contains a large proportion of quartz crystals and quartz is very hard. A very hard material like diamond is required to cut quartz. However, no diamonds have been found associated with the archaeological remains of the pyramids. Diamond is also a rare jewel and may not have been available to the pyramid builders or not available in sufficient quantity.

A more likely explanation according to Petrie is that a powdered abrasive such as silicon carbide was used in combination with a circular bronze saw blade. Petrie also offers his suggestion of evidence to support the idea of bronze as a tool for tubular drilling. He mentions that he had seen green colorations on the rock that was cut. Bronze is an alloy of copper and tin or some other alloying agent. Copper particles or particles of alloys of copper turn green when weathered. That is why Petrie used the green coloration as evidence that bronze tools were being used.

Petrie's observations as to how the drilling tools were being employed astounded him. He tried very hard to find an explanation. The thing that astounded him most was the apparent rapid drilling rates of the tubular drills. As a drill enters a piece of work, it travels downward into the work and so leaves spiral marks as it turns and progresses downward.

From a study of the spirals, it is possible to discern the rate at which the material enters the work. Petrie describes his surprise in the following words:

> The great pressure needed to force the drills and saws so rapidly through the hard stones is very surprising; probably a load of at least a ton or two was placed on the 4 inch drills cutting in granite. On the granite core, No.7, the spiral of the cut sinks .1 inch in the circumference of 6 inches, or 1 in 60, a rate of ploughing out of the quartz and feldspar which is astonishing. Yet these grooves cannot be due to the mere scratching produced in withdrawing the drill as has been suggested, since there would be about 1/10 inch thick of dust between the drill and the core at that part; thus there could be scarcely any pressure applied sideways, and the point of contact of the drill and granite could not travel around the granite however the drill might be turned about. Hence these rapid spiral grooves cannot be ascribed to anything but the descent of the drill into the granite under enormous pressure; unless, indeed, we suppose a separate rymering tool to have been employed alternately with the drill for enlarging the groove, for which there is no adequate evidence.[15]

It is easy to understand why Petrie was surprised by the rate at which the tubular drill penetrated hard rock. Modern diamond drills working in granite have a feed rate of about 0.0002 inch per revolution, while the Egyptian tube drills penetrated 0.1 inch per revolution. Since 0.1 divided by 0.0002 equals 500, this shows that the Egyptian drills penetrated 500 times as fast per revolution as modern drills. The spiral grooves in the Egyptian artifacts are continuous and symmetrical, giving nearly positive proof that machine power was used.

There are additional features to the holes cut by the

15 Sir W. M. Flinders Petrie, *The Pyramids and Temples of Gizeh*, NEW YORK: SCRIBNER & WELFORD, 1883, p. 177

Egyptian tubular drills and the cores which came out from them. There was a taper on both the hole made by the drill, and the core which came from inside the tubular drill.

In addition, the drill cut faster through harder materials in the granite. It cut faster through quartz than through the softer materials like feldspar. These and other characteristics pose a problem for any explanation of how the holes were cut. Even the usual modern rock drills do not cut through harder materials faster than through softer materials. Several modern theories have been put forward to explain the information observed on the artifacts. None of them is without problems. It is possible to explain the facts of both the rapid cutting rate, and also the fact that the tubular drills cut through the harder materials in granite at a faster rate than they did the softer materials. However, that explanation involves technologies which have only been discovered and applied in recent times.

Ultrasonic drilling has been discovered and can explain why a feed-rate through harder materials is more rapid than through softer materials. An abrasive material can be used to accelerate the action. An object vibrating at 19 - 25 thousand vibrations per second generates ultrasonic sound. It is termed ultrasonic because it is above the frequency range to which the human ear can respond. A tool vibrating in the ultrasonic range can vibrate in harmony with the natural frequency of a hard material, causing the hard material to vibrate. As ultrasonic energy is applied, the hard material being cut vibrates at greater and greater amplitude until it shatters. It is much like pushing a child in a swing. Every push makes the swing move at a greater and greater amplitude. That is the same principle for ultrasonic drilling which is applied in modern technology to precision machining of ultra-hard

and brittle materials.

Ultrasonic machining is a modern technology, and it may be difficult for the modern mind to think that ancient Egyptians used such a technique. Yet, it fits the physical evidence found for tubular drilling. As Dunn comments:

> Egyptian artifacts representing tubular drilling are clearly the most astounding and conclusive evidence yet presented to indicate the extent to which machining knowledge and technology were practiced in prehistory.[16]

Machine-Quality Contours

During his research trip to Egypt in 2005, Mr. Miller noted an artifact lying out in the open amidst a variety of other rock rubble. It was a smoothly contoured piece of the very hard rock diorite. The object is shown in Figure 8.

Figure 8. One of several large blocks made of hard rock. The shape and uniform contour indicate that it was made by machine and not by hand methods. *Photo courtesy of Steve Miller*

16 Dunn, p. 83

The interestingly shaped object is located at a site not often thought to be of interest to tourists. It is off from the beaten trail as it were. In addition, there are many other rocks of various shapes and sizes lying around with the appearance of just being rubble, so the object could easily be overlooked. To the trained eye, however, it is apparent that this particular object was machine made. Hand working can be used for simple shapes such as a flat surface or non-complex rounded surface. However, the smooth contour of this complex surface would be nearly impossible to produce by hand. Other similar objects have been noted.[17]

We know that modern machine methods (technology) can sculpt out objects with complex shapes and contours such as those just mentioned. But to make these shapes, modern contouring machines utilize three axes of movement. That is, they use x-, y-, z- axes. If the Egyptians used machines utilizing three axes of movement, the question naturally comes, "What guided those tools?"

Precision Flatness

Before we leave the topic of high precision on objects made in ancient Egypt, let us consider one more bit of evidence. Dunn mentions artifacts found at Saqqara, the site of the Step Pyramid and Zoser's Tomb. In tunnels under the pyramid, he mentions 21 huge granite and basalt boxes, each weighing about 65 tons. The boxes had been placed in crypts that were cut out of the limestone bedrock and placed at various locations along the tunnels. The granite boxes were approximately 13 feet long, 7.5 feet wide, and 11 feet high

17 Petrie, p. 99

(4 meters long, 2.3 meters wide, and 3.4 meters high). Dunn checked the outsides and insides of the boxes for flatness using a flatness gauge. He placed his flatness gauge at various locations against the sides of the boxes, and then shined light from his flashlight on the gauges. The light from a flashlight would not show through under the flatness gauge. The sides of the boxes were shown by this method to be perfectly flat. The task of manufacturing granite boxes to such precision is a challenge even for modern technology.

There is yet one other item of information that needs to be explained concerning the granite boxes. At the entrance to the tunnel was an unfinished box. It appears that the boxes were first crudely cut out and then machined to perfection ***inside*** the tunnels. Why would that be done? To obtain the precision that was observed required a constant temperature, constant humidity atmosphere. If the boxes were finished outside, then the heat of the sun, or ambient conditions, would change the dimensions to what they would be once they were moved into the cave-like atmosphere inside. To retain the observed finished precision, they had to be finished inside. Otherwise temperature changes would ruin the precision once moved inside. Dunn checked with modern precision granite cutters and none can do that type of work from a single piece of rock.

There is yet a further puzzling question. How were the completed, finely-finished boxes moved, especially the ones toward the far inner end of the tunnel?[18] There was not room for hundreds of slaves using ropes to pull them into position. Further, there appear to be no scratch marks on the boxes. They were not dragged into position. In the next chapter a speculative answer will be suggested.

18 Petrie, p. 78

Where are the Tools?

If the ancient Egyptians used tools, skeptics will ask, "Where are the tools? Why do we not find them?" The truth is, at least so far, no tools have been found. Petrie also thought about this problem and put forth an explanation. He states the following:

> That no remains of these saws or tubular drills have yet been found is to be expected, since we have not yet found even waste specimens of work to a tenth of the amount that a single tool would produce; and the tools, instead of being thrown away like the waste, would be most carefully guarded. Again, even of common masons' chisels, there are probably not a dozen known; and yet they would be far commoner than jeweled tools, and also more likely to be lost, or to be buried with the workman. The great saws and drills of the Pyramid workers would be royal property, and it would, perhaps, cost a man his life if he lost one; while the bronze would be re-melted, and the jewels reset, when the tools became worn, so that no worn out tools would be thrown away.[19]

It certainly would be a great aid to our efforts to explain and understand ancient Egyptian technology, and that of other ancient cultures as well, if some tools could be found. The fact is, however, that as far as we know, no tools have yet been found. Further research is continuing all of the time and who knows what may yet be found? If the pyramid builders were in fact not primitive in their technology, then one may well wonder if their advanced technology may have been applied to the logistics of actual construction methods as well. That topic will be considered next.

19 Petrie, p. 78