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BOB LOWDERMILK'S THEORY OF PYRAMID CONSTRUCTION IN ANCIENT EGYPT

An Overview

By Judy Greenfield

ESS Member Develops Theory Based on Description by the Great Historian, Herodotus. Watch for his article in *KMT*, January, 1992!

ABOUT BOB LOWDERMILK: Bob, president of Tectonic Construction, has been involved in the movement of millions of cubic yards of rock through the construction of highways in the Western states. As a student of history and a highway contractor, he has been concentrating on pyramid construct for the past seven years. He is a member of the American Center for Research in Egypt as well as of the Pyramid Study Group of the ESS.

A penchant for Egyptology, a background in construction and a clue from Herodotus led Bob Lowdermilk to an alternative theory of pyramid construction. The following overview of Bob's theory evolved from his lecture, *Hieroglyphic Hypotheses of Pyramid Building Techniques*, (presented to the ESS on February 19, 1991), dialogue with Bob himself, and perusal of drafts for his upcoming *KMT* article.

One of the widely-held, but insufficient, theories of pyramid construction involves an earthen ramp constructed to haul stone blocks to the desired height of the structure. An uncontained earthen ramp, with a 10% grade, would have required the movement of 96 million cubic yards of earth to build a 3.3 million cubic yard pyramid 479 feet high - an unreasonable ratio of earth to pyramid. Another theory entails a mudbrick ramp which wrapped around the exterior of the pyramid. "Basic physics tells us that in order to pull and move a heavy block and sledge on flat ground, it would take approximately twice as much weight in men dragging it as the weight of the block and the sledge. A 5500 pound block would require approximately forty 135-pound men to drag it. Physics also says that it would require even more men to move it up a ramp. It should also be noted that sledges can only be pulled in straight lines." Therefore, it would have proved very awkward for the large number of laborers needed to haul each block up the hypothetical ramp to negotiate the ramp's sharp corners. Besides the significant construction and maintenance problems of such a ramp, the wrap-around structure would have significantly obscured the sides of the pyramid, increasing the difficulty of accurately measuring the pyramidal angles.

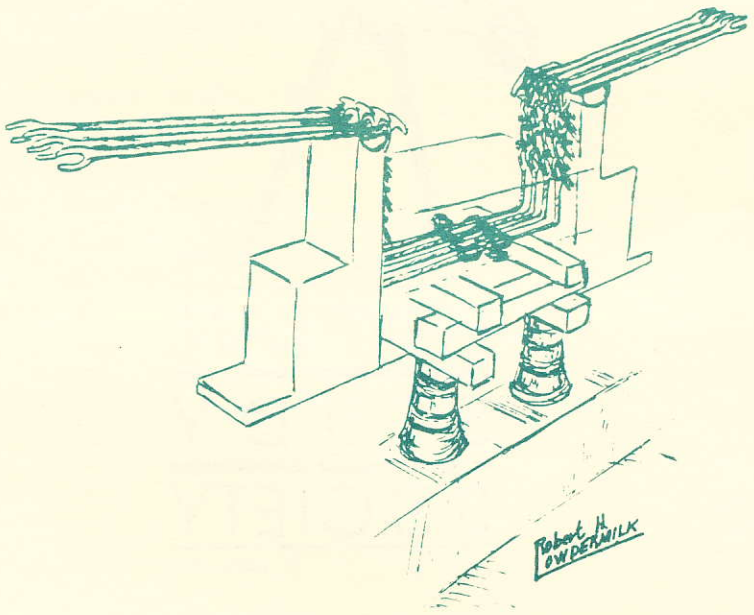


Figure 1: Total Block Lifting Machine

Since none of the current theories on pyramid construction seemed to adequately explain how the monuments were built, Bob arrived at an imaginative theory of his own. His theory was triggered by Herodotus' description of how the Great Pyramid was built. About 500 BC, 2000 years after it was built, the Greek historian, Herodotus, visited the Giza plateau and recorded the explanations given to him of the pyramid's construction. The pyramid had been built:

"in tiers...stepwise...They raised the...stones to their places by means of machines formed of short beams of wood. The first machine raised them from the ground to the top of the first step. On this was another machine, which...conveyed it to the second step, whence a third machine advanced it still higher."

Using Herodotus' description, and having in mind the type of machine necessary to lift a massive stone block weighing an average of 5500 pounds, Bob next turned to the hieroglyphs.

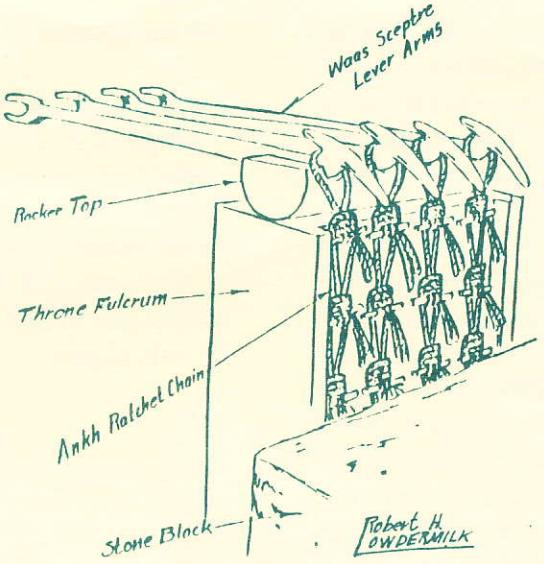


Figure 2: Portion of block lifting machine.

Although no block-lifting machine has yet been recovered from the archeological record, the individual components are all there - preserved in the hieroglyphic "alphabet" *(see Fig. 3)*. The block-lifting machine, according to Bob's vision, consisted of seven components, each of which has a hieroglyphic equivalent. Bob believes that instead of recording and depicting the entire machine in texts, reliefs, amulets and statues, the Old Kingdom Egyptians transcribed the individual components of the machine into the hieroglyphic record.

Bob built a lifesize, working model of the lifting machine, and from this, extrapolated how blocks could have been lifted in ancient Egypt. The principle of lifting machines was not unknown to the ancient Egyptians, who used shadufs to lift their water. Shadufs, which utilize a lever arm, are known to have existed within 700 years of the Great Pyramid's construction and are still in use today by the *fellahin*. Bob describes his machine as a ratchet lever system in which lever arms are used to lift the stone block through a series of lifts that are approximately 2 3/4 inches per lift and a ratchet system that is used to maintain the block's elevation after each of these incremental lifts.

"A modern ratchet is a mechanism like a wheel or a bar with teeth or periodic notches that come against a catch, called a pawl, which permits motion in one direction only. In antiquity, a ratchet system could have been created using a chain of interlinked rope loops connected in a manner similar in concept to an interlinked chain of rubber bands. In a lever-ratchet system, a lever delivers power to a ratchet that allows the motion of that power to be directed in only one direction. A good example that works on this principle is a car jack."

Two wooden components, resembling the "throne of Isis" would have been placed at each end of the stone block, with their backs to one another *(see Fig.1)*. The operator could have stood on the seat of an adjacent "throne" to lift the blocks. The tops of the "throne" pair serve as fulcrums for "rocker tops" (essentially half cylinder roller bearings made of wood, the hieroglyph model *(see Fig. 3)* translating into "mountainous land," "foreign country", "East", "Syria.") Perhaps "Syria", a mountainous foreign land east of Egypt, was the source of large logs from which the semi-cylindrical rocker tops were made. The rocker tops reinforced the lever arms, which increased the working lifespan of the arms and created a better bearing surface on the fulcrum. Leverage was achieved with several lever arms in the shape of "waas scepters" *(see Fig. 4)*. The translation of the waas scepter: "to decay" (referring to the tendency of the lever arms to wear out?) and "fine gold" (perhaps alluding to the commodity for which they were at one time bartered) seems appropriate.

Four cradling ropes, with loops at each end, were placed beneath the stone block. The translation of the hieroglyphic models for these cradling ropes, "fetterer", "lift", "raise," and "support" do, indeed, describe the function of these slings. To prevent the four cradling ropes from shifting beneath the stone, the ropes were stabilized with a rope lattice, which means "hobble", "guard" or "protect." The cradling ropes were attached to a ratchet chain of connecting "ankhs", each consisting of a looped rope and wooden crosspiece. Ancient Egyptian ankh hieroglyphic signs symbolize "life", "tie," "strap". *(See Fig. 3)*

When a stone block was lifted with this lever-

ratchet device, some of Herodotus' "short beams of wood", now called cribbing, were placed beneath the lifted block to maintain the elevation that was gained with each lift. With each new lift, two additional "short beams of wood" were placed at a 90 degree angle to those below. And because the stone blocks overhung the step on which they sat, strong posts (possibly of bundled papyrus stems) were placed under the overhanging portion of the stone and its supporting cribbing. Viewed together, the "short beams of wood", cribbing, along with their stabilizing and supporting strong posts resemble the hieroglyph, "djed-pillar". This hieroglyph, meaning "be stable" and "enduring," aptly describes the cribbing system's function.

Once the elevation gain was achieved and the stone secured with cribbing, the lever arm was moved to catch the next lower link in the ankh chain in order to lift the block another "notch." The shape of the waas scepter head enabled easy detachment from an ankh loop by simply rotating the lever arm 180 degrees. After movement to and insertion into the next lower ankh in the chain, another 180 degree turn reattached the lever to the chain and made the system ready for another lift. This ingeniously designed lever arm head, shaped somewhat like a crested bird's head (and sometimes found with eyes drawn or carved at its midpoint), provides some of the strongest evidence for the authenticity of the lifting machine. The ease with which it performs this attachment and detachment function speaks to the simplicity and elegance of the waas scepter's design.

Each machine could have been crewed by seven machine operators: four to operate the waas scepter lever arms, two to assist the lever operators by positioning themselves at either end of the stone block and moving the waas scepters to new ankhs in the chain, and one to place the cribbing beneath the stone block after each elevation gain.

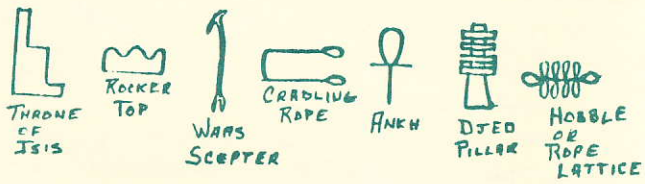


Figure 3: Hieroglyphs representing components of block lifting machine.

Imagine the sides of the unfinished pyramid lined with these lifting machines, "with approximately each seventh machine crewed by men working in a logical repetitive block lifting sequence." The machines would have been arranged in a series of parallel, ascending rows, with the machines' fulcrums on each narrow step. As in the old-fashioned "fire-brigade" system, the stones were lifted up the sides from the base level to the upper reaches of the pyramid to construct each successive horizontal layer. "The start of construction of each successive layer was begun by raising the capstone so that the first blocks in that layer could be placed under it. This was done with each layer. And with the capstone sitting at the exact center of the pyramid, it was, layer by layer, elevated up to the center line to the very top

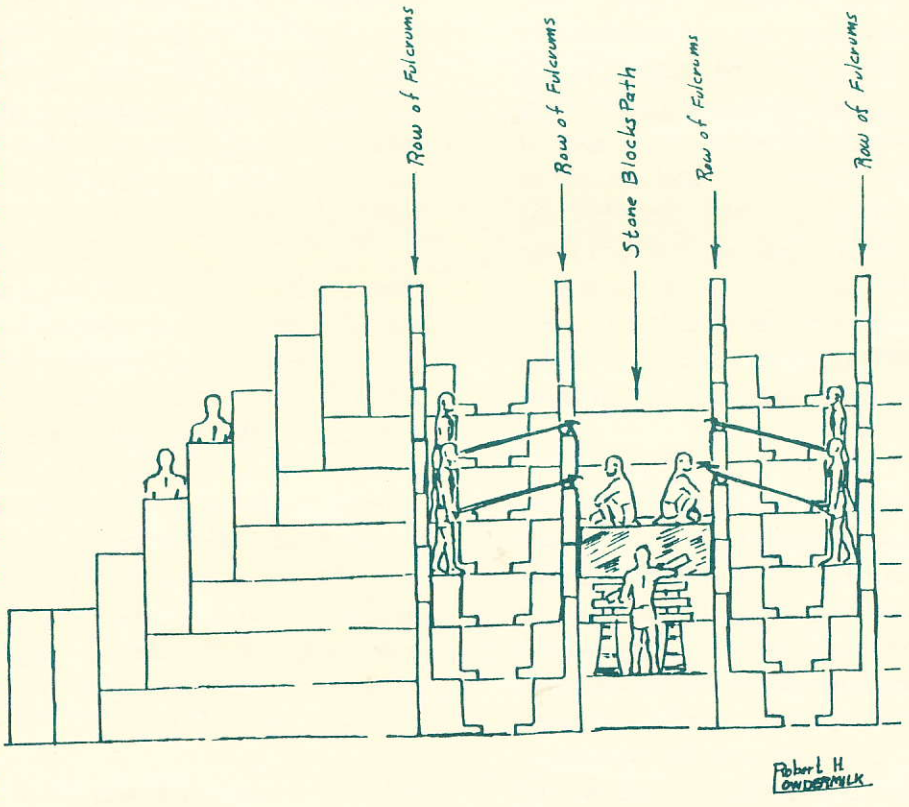


Figure 4: Pyramid construction in progress using block lifting machines.

of the pyramid. These lifts were also made using lever ratchet machines. Once in place at the top of the pyramid, the overhang of the sides of the capstone then acted to "key in" the facing stones that were then placed in a similar overhanging and keying fashion, row by row, from the top of the pyramid, down its sides to its base. These facing stones were also transported to their placement level up the already in place rows of block lifting machines that had remained on the pyramid faces in preparation for this use." This construction sequence concurs with Herodotus' description that the top of the pyramid was completed first, then the sides, and finally the bottom.

The ratchet-lifting machine could have provided a 20:1 mechanical advantage. It could lift 5500 pounds with a force of 275 pounds, distributed over eight lever arms. Each arm could lift 665 pounds with a mere 34 pounds of applied force. This is not just idle speculation on Bob's part; he and a crew assembled a successful block-lifting lever ratchet machine which coincided with his vision and lifted a 3160 pound concrete block. Bob believes "this machine is capable of lifting much heavier weights."

Bob Lowdermilk's theory holds much promise and, perhaps, answers the question which has baffled Egyptologists for ages: How WERE the Giza pyramids built? The implications for such a machine are great and may force us to re-think our ideas about ancient Egyptian technology. In Bob's words:

"Machines of this type may have revolutionized the Ancient Egyptians' technological capabilities. This may be the first evidence that lever-ratchet mechanical advantage tools were used over 4500 years ago. Much additional work must be done and more concrete evidence must be found before the theory can be proven. But as of now, it is at least the newest theory of how the pyramids were built and it may be right.

PRE-DYNASTIC EGYPT WHERE IT ALL BEGAN

by Doris Forrester

ABOUT THE AUTHOR: Doris, who has a passion for archeology, works in a laboratory which analyses the pollen record from ancient civilizations. Besides her love for Egypt, her interests also focus on Roman-Britain and Bronze Age Aegean societies. She enjoys studying fossils and paleontology and belongs to the Western Interior Paleontological Society. Other DMNH activities include volunteering in the Zoological Department.

The image of ancient Egypt shimmers in the mind like a desert mirage, tantalizing yet elusive. Cultured, venerable, rich and mysterious, Egypt's history spans not centuries but millennia. For the sake of convenience, Egypt's long history has traditionally been divided into three major periods and four minor periods, as follows:

Pre-Dynastic Period	5000-3100 BC
Archaic Period	3100-2700 BC
Old Kingdom	2700-2230 BC
First Intermediate Period	2230-2130 BC
Middle Kingdom	2130-1750 BC
Second Intermediate Period	1750-1550 BC
New Kingdom	1550-1080 BC

All dates are approximate, as authorities differ on specifics; this article shall take a brief look at the Pre-Dynastic Period.

The First Farmers. What do we know about the origins of this great land? Egypt has long been known as a land of contrasts: Nile and desert, black earth (Kemet) and red earth (Deshret), river delta and river cataracts, Lower Egypt and Upper Egypt. People have lived in the Nile Valley since before the dawn of recorded history. In the course of time, several small, isolated cultures grew up in various locations along the Nile. Eventually, neolithic peoples began to take advantage of the fertile Nile floodplain to cultivate crops (c. 5000 BC). The basis for Egyptian culture begins with them. The duality of their physical existence, the balance between opposites that creates a complete and harmonious world, shaped Egyptian thought from earliest times, and expresses itself in their developing culture. Three important successive cultural traditions emerge strongly in the

Pre-Dynastic Period. They are easy to remember if you use this simple acronym: The Pre-Dynastic B A G.

Upper Egypt	Lower Egypt	Date, BC
Badarian	Merimden/Faiyum A	5000-4000
Amratian (Naquada I)	Omari A	4000-3500
Gerzean (Naquada II)	Omari B	3500-3100

Each culture is named after the find-spot where it was identified but each covered a diffuse area of greater or lesser extent. The cultures of Lower Egypt are not as well-known as those of Upper Egypt because the annual flooding of the Nile over the centuries has buried their remains in deep layers of silt. Some now lie below the water table, making excavation extremely difficult. This article will focus on the cultures of Upper Egypt.

The Badarian Culture. The Badarian culture developed in central Egypt, approximately half-way between Memphis and Thebes. As yet, no trace has been found of Badarian cultural antecedents, and it is not known whether the Badarian culture was an indigenous development or the result of new peoples coming into the area.

Its characteristic pottery type is a black-topped, plum-red ware with a finely rippled texture covering the body of the vessel. Clay boat models show one means of transport, and suggest that the Badarians may have supplemented the produce of their fields by fishing. Wheat and barley were grown, but no evidence has yet been found of irrigation in this period. Dwellings were of mud-plastered reed. Finds of simple oval and rectangular slate cosmetic palettes with traces of red ocher and green malachite show that the Badarians were already practicing the art of eye-painting; besides its cosmetic function, eye-painting served to protect the eyes from strong sunlight. Already, linen for clothing was produced from cultivated flax; tanned leather was also worn. Woven mats and quality basketry were common. Crude basalt vases make their first appearance. Tools were of flint and wood. A rich diversity of materials provided beads for necklaces and belts: shell, ivory, carnelian, glazed steatite, jasper and occasionally copper. The dead wore their finery in the grave and were also provisioned with ivory combs and spoons; sometimes animal amulets and terracotta human figurines were also included.

It is not known what form their afterlife belief may have taken. Although they are not as pronounced as in later cultures, differences in wealth and status already show in Badarian tombs, and it seems that the nefarious practice of tomb-robbing may have begun during this period.

The Amratian Culture. Amratian culture grew directly from Badarian culture, as shown by the stratigraphic continuity at Hemamieh and Hierakonpolis. It retained many Badarian traits, but a variety of adaptations and new features reflect either indigenous development or influence by other cultures.

Besides the black-topped plum-red ware, a burnished red pottery appears with white cross-lined decorations including geometric designs and pictures of plants, animals and sometimes boats. Slate pigment palettes become lozenge-shaped. The first "powerfacts" - physical symbols of authority - make their appearance in the form of disk-shaped mace-heads made of hard porphyry polished to a sheen. Both these and improved basalt vases show an increasing mastery of stone-working techniques.

Dwellings range from circular huts in small farming hamlets to rectangular wattle-and-daub or mud-brick houses in villages. Larger settlements included differentiated areas for living, crafts, and refuse disposal.

Amratian tombs are larger and more richly-endowed than their predecessors, and for the first time, important people had their own section in the cemetery. At Hierakonpolis, kilns for producing mortuary pottery were found adjacent to the cemetery, demonstrating the growing links between the growth of power elites and the manufacture of prestige items for the mortuary cult. Finds, including slate palettes, stone vases, 20-30 pottery vessels of both wares, flint lance-heads and arrows, amulets and pendants, beads, ivory combs, and occasionally mace-heads, suggest that a somewhat standard mortuary kit developed. Cult activities for the

worship of local deities during the Amratian period are still poorly understood.

The Gerzean Culture. Gerzean culture, located just south of Memphis, developed from its native roots and became quite widespread, penetrating north into the delta and south clear to Nubia.

Two new pottery types are representative of this period. The first, Palestinian wavy-handled jars and local Gerzean copies, show that an active trading network existed. The second, buff ware with red painted designs, shows the intellectual dynamism of the period. Motifs point to early Dynastic designs and include plants, animals, spirals, people and deities, and many-oared boats carrying shrines and standards. The standards are a good indicator of the emergence of distinct territorial units and probably anticipate the sacred or deity standards of the Nomes (provinces) of Dynastic Egypt. Although the full pantheon of Egyptian deities is not yet recognizable, it is certain that each locality had its own patron deity or ascendant gods. Several of the distinctive zoomorphic deities evidently enjoyed a long history; for instance, Horus identified with the city of Hierakonpolis - "City of the Hawk" (Nekhen) - and Seth identified with Naquada (Nubt - gold). There is speculation that rivalry between these two centers gave rise to the legends of the struggle between Horus and Seth, from which Horus, of course, emerged victorious. Gerzean artisans were full masters of their medium and produced an amazing array of beautiful, high-quality stonework. Pear-shaped mace-heads polished to a mirror finish, flawlessly cut vases, bowls and basins of serpentine, marble porphyry, breccia, alabaster, schist and diorite are just a few of the masterpieces of this period. Incomparable ripple-flaked flint knives are also characteristic of the Gerzean culture. Slate palettes came in a variety of pleasing animal shapes. Cast copper tools and weapons, gold and silver jewelry, and jewelry of imported lapis lazuli and turquoise were produced in quantity. Trade-goods, art motifs and ideas crossed between the Gerzean delta settlements and the cultures of the Near East. In this bustling society, stratification based on wealth and status became more marked and is again reflected in tomb-furnishings as elites stand out ever more clearly.

The large rectangular mud-brick tombs found at Naquada and Hierakonpolis believably suggest local kings. Foundations for larger proto-monumental structures have been unearthed. The oldest known Egyptian temple has been excavated at Hierakonpolis. The mud-plastered fence, later replaced by a brick wall, enclosed an oval courtyard 46 ft by 108 ft. Imposing wooden columns, nearly 50 ft high judging by the post-holes, stood at the entrance to the temple. The temple itself was large enough to be subdivided into several chambers. Nearby is a compound composed of numerous rooms around a central courtyard, believed to be a 'palace' or some other elite structure. There is also "the Painted Tomb", a ruler's tomb with depictions of kings, priests and warriors and containing a large quantity of imported goods.

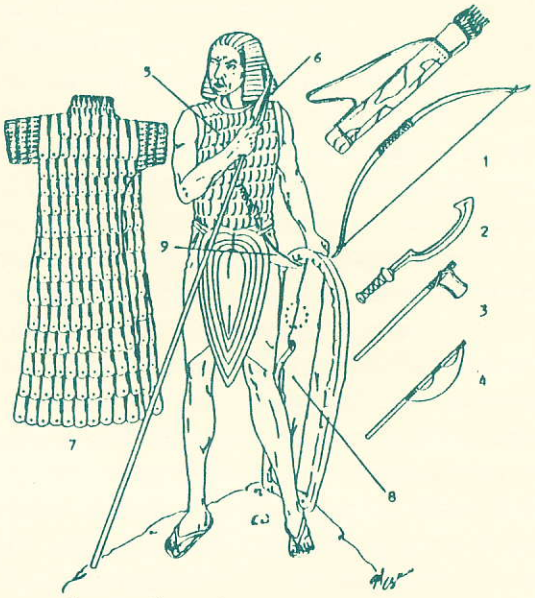
During the late Gerzean period, accounts of the increasing friction between regional rulers is related by pictorial narratives on large ceremonial mace-heads and votive palettes. The famous King Scorpion Mace-head shows the king, wearing the White Crown of Upper Egypt, victorious over his enemies and also overseeing important irrigation works in his territory. Interpretations of the proto-hieroglyph beside the king identify him as Scorpion. These and other early hieroglyphs are the subject of much study and debate. Although their meaning defies interpretation in many cases, they are undoubtedly the direct precursors of the developed hieroglyph of Dynastic times. The Battlefield Palette is another important document of this period. It shows a lion-king ravaging his vanquished enemies as personified captive nomes are led away. Another, the Bull Palette, portrays a confederacy of nomes victorious over their foe. On some palettes the figures are scattered and in no apparent order, while on others they appear in well-defined registers. In both cases, however, the important figures are shown much larger than their enemies or subjects. Altogether, the mace-heads and palettes tell a story of the consolidation of power.

The Narmer Palette gives a vivid account of the climax of the Pre-Dynastic Period. This large votive palette depicts, on one side, the conqueror

Narmer (Menes), wearing the White Crown of Upper Egypt and striking the defeated enemy at his feet. The god, Horus, offers the king the captive delta-land on which he stands, illustrating the close connection between the concept of kingship and the Horus cult. The king becomes Horus incarnate as indicated by his first title, The Horus Name or Throne Name, encased in a *serekh* or Palace Facade, representing authority. On the other side of the palette, Narmer, now wearing the Red Crown of Lower Egypt, surveys the battlefield accompanied by standard bearers, who are known as the Followers of Horus. In the next register, two lionesses with long intertwined necks, under the charge of keepers, are an enigma but may possibly represent the union of Upper and Lower Egypt. In the lowest register, the king, as a bull, destroys a fortified city. It is not known whether the "unification" was motivated strictly by political power or to gain dominance over lucrative trading cities in the delta. However, the fact remains that the new king of the Two Lands now had both in his possession. To consolidate his power and strengthen his position, Narmer established a new capital at Memphis known as White Walls, midway between the apex of the delta and southern Egypt, under the patronage of the god Ptah. As Ptah, in the original act of creation, had caused the primeval mound to rise from the waters of chaos, so King Narmer, in a similar act, now caused a new land to be formed. In a culture so dependant upon symbols, Narmer, with great acumen, applied to himself the symbols of both lands and unified them in his own person. The Lord of Tawy (the Two Lands) wore both the White Crown of Upper Egypt and the Red Crown of Lower Egypt combined as the Double Crown or *Pschent*. He was protected from any sort of evil by the Two Ladies who rode on the front of his crown: Nekhbet, the vulture goddess of Upper Egypt, and Wadjet (Edjo), the cobra goddess of Lower Egypt. By means of these and other paired symbols of the Two Lands, the duality that described Egyptian thought became focused in the King. With the physical and cultural richness of the Pre-Dynastic cultures united under one hand, Egypt stood poised on the threshold of a new era of greatness whose achievements would define her through the ages.

THE MIGHTY FLAIL
THE EGYPTIAN ARMY IN THE NEW KINGDOM
by Jordan A. Wright

ABOUT THE AUTHOR: Jordan Wright is a recent graduate of the University of Colorado with a B.A. He researched this article in The Metropolitan Museum of Art and The British Museum.



The Egyptian Soldier and His Weapons

1. Composite Bow
2. Khopesh
3. New Kingdom Axe
4. Middle Kingdom Axe
5. Padded Leather Armor
6. Spear
7. Scale Mail
8. Shield
9. Khopesh Knife

Illustration provided by Martin Caglao

Some scholars assert that geography was the prime factor in the longevity of Egyptian civilization. Protected by vast deserts and seas, the two kingdoms were virtually impregnable against invaders; Egyptians owed their centuries of peace and prosperity to their natural defenses and not their military.

This assertion is only partly correct. The Arabian Desert and the Mediterranean Sea may have been adequate barriers during the Old and Middle Kingdoms, but they could not stop wave after wave of invaders during the New Kingdom. From the 17th century BC onward, the Pharaohs had to contend with an array of enemies including the Hyksos, Mitanni, Hittites, Libyans, Kushites, and Sea Peoples. Some of these

adversaries sought to challenge Egypt's great authority in the ancient world at large while others tried - sometimes successfully - to invade the kingdom itself. Natural boundaries could no longer ensure the safety of the Black Land, and the people and rulers of Egypt responded by building one of the most impressive military forces of the age. The armies fielded by Tuthmosis III and Ramses II were well-equipped, highly-organized and technologically advanced. This new army drew some of its strength from foreign inventions but many of its institutions were entirely Egyptian. In this article, I shall consider the New Kingdom military in detail and discuss how it protected the Egyptian legacy.

Equipment. The New Kingdom army benefitted from an array of new equipment, much of which was copied from foreign adversaries. Before the 17th century BC, Egyptian soldiers had relied primarily on bronze spears and hide-covered wooden shields. Their bows (sometimes called 'self bows') were relatively crude, short-range weapons made either of wood or of two antelope horns joined by a central wooden piece.

Composite Bow. After the well-equipped and technologically advanced Hyksos (a Semitic people) conquered Lower Egypt, the Egyptians quickly adopted the Hyksos composite bow. This new weapon was made from laminated strips of various materials, making it tough and pliable. It had a stronger 'pull' than its predecessor, giving it superior range and power,[1] and in skilled hands it could kill an adversary at a range of over 200 yards.[2] New Kingdom archers used the composite bow to devastating effect; in their battle with the Sea Peoples, Egyptian arrows virtually annihilated the invading force.

Khopesh. The Hyksos introduced other weapons into the Egyptian arsenal. The bronze 'sickle sword', for example, was a scythe-like weapon which vaguely resembled the later Arabian scimitar. Some were little bigger than a butcher knife, but others had far longer blades. The Egyptians called the new weapon *khopesh* after their term for the foreleg of an animal, and it soon became a standard sidearm.

Armor Metal. Armor was also introduced by the Hyksos invaders. Previously, Egyptian soldiers had only their shields for protection, although occasionally an officer did wear a padded leather jerkin. In the New Kingdom, the use of leather armor became far more widespread, while Pharaohs and their officers clad themselves in Semitic-style scale mail. Examples of scale mail have been found in the tombs of Amenhotep III and Ramses III and are a testament to Egyptian craftsmanship. The bronze plates were sewn onto a coat of leather or thickly-padded fabric which covered the body from throat to knee. The plates were fitted together with great precision and hooked onto a central spine which gave greater strength without increasing the armor's bulk.[3] While many Pharaohs are depicted bare-chested in battle, it seems unlikely that any of them left home without their armor.

Chariot. For much of their history, Egyptians had shunned the use of mounted troops and relied entirely on infantry. But when they were confronted (and often outflanked) by the nimble Hyksos chariots, the Egyptians were quick to correct their mistake. The New Kingdom chariot was a small, lightweight vehicle, carrying a driver and one soldier - usually an archer. The axle was placed at the very rear of the body for optimum speed and maneuverability. In addition, the axle was long - 1.53 meters, almost 5 feet - giving the vehicle a broad base which helped prevent it rolling over during fast, tight turns.[4] Egypt never adopted the larger, heavier chariot designs of the Hittites and never used more than two horses per chariot; the Egyptians seem to have preferred quick, agile units which could pour arrows into the enemy ranks and avoid becoming embroiled in hand-to-hand fighting. This tactic proved effective on many occasions, especially at Ramses II's Battle of Kadesh, when the fleeing Hittite chariots were overtaken and annihilated by their faster Egyptian counterparts.

Battle Axe. Not all of the new equipment was of foreign origin. After encountering the heavily-armored Hyksos, the Egyptians introduced armor-piercing weapons into their arsenal. One of these was the battle axe. Egyptian soldiers had been using axes for

centuries, but they were wide-bladed weapons designed to slash an unprotected opponent. The new axe looked something like a large tomahawk with a much narrower cutting edge. This configuration concentrated the force of the swing into a smaller area, allowing the axe to punch through armor. New Kingdom troops are often shown carrying this weapon, and a fine example bearing the name of Tuthmosis III is now in the British Museum.[5]

Fortresses. When one considers the Egyptians' architectural genius, it comes as little surprise that they needed no foreign inspiration in the building of fortifications. They had built many fortifications along the Nile and in Nubia during the Middle Kingdom; by the New Kingdom, they were masters of the art. These ancient 'castles' compare quite favorably with their medieval counterparts and were just as effective. In describing the Middle Kingdom fort at Buhen, one Egyptologist writes: *"Egyptian soldiers manning the outer defenses stood behind a mudbrick breastwork with towers at intervals... there were two rows of triple loopholes, so designed that each archer had his choice of six slits pointing in six different directions, and could thus command a complete field of fire... In the unlikely event of these outer defenses being overrun, the attackers were still faced with a high bastioned wall... from which soldiers manning the inner battlements could rain down missiles. The only entrances to the town were by a watergate on the quayside... and by a narrow gateway flanked by towers on the landward side, approached by a drawbridge over the moat, which could be drawn on rollers into the town in time of danger."*[6] Such planning and sophistication indicates a great understanding of siege warfare, and these forts no doubt played a key role in Egypt's defenses.

Organization. Another purely Egyptian facet of the New Kingdom army was its organization. Since the beginning of the Middle Kingdom, each province (or *nome*) had to provide a quota of recruits to enter permanent military service under the Pharaoh. These professional soldiers were so completely isolated from the rest of society that they became known as 'those who live in the army'. When these men left home, they were often mourned, as if they would never be seen again.[7] Additionally, mercenaries were recruited from Nubia and Libya, but their numbers were not great during the New Kingdom. Troops were organized into decimal-based units of 10, 40, 200 and 500, and an army normally consisted of 5,000 men. In the early part of the New Kingdom, chariots were attached to infantry units, but later they were organized into large independent formations. Troops marched in tight, disciplined formations resembling the later Greek phalanx; precise formations depended on weapon type. The movements of these units may have been directed by large, martial-sounding horns such as those found in the tomb of Tutankhamen. Armies bore the standards of various gods, including Amon, Ra, Ptah, and Sutekh. They were usually commanded by the Pharaoh's sons, or by appointed generals if the Pharaoh had no sons who were able to command. The officer class consisted of haut, mer, aten, and menh, which roughly corresponded to the modern general, lieutenant-colonel, captain and lieutenant.[8] Army officers were treated with great respect in the New Kingdom, and possessed a social status equal to that of the priesthood. No doubt many talented young noblemen sought a career in the army and the accompanying prestige.

By the time the Hyksos were expelled from Egypt, the New Kingdom had a well-trained and formidable military force with sophisticated organization and advanced weaponry.

Notes

1 Baines & Malek, p. 203.
2 Bickerman & Smith, p. 61.
3 Wise, p. 20.
4 Wise, p. 31.
5 Wise, p. 13.
6 Drower, pp. 27-28.
7 Wise, p. 15.
8 Wise, p. 16.

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HOUSE OF SCROLLS

BOOK REVIEWS

KMT: A Modern Journal of Ancient Egypt

KMT 

COMPILED FROM REVIEWS BY:
Joanne Covas-Munro, Irene F. Moose, Barb Fenton, and Dennis McDonald.

E.S.S. members and other Egyptophiles are in for a delightful experience when they open a magazine called *KMT* (pronounced kemet, but written in ancient Egyptian fashion with no vowels). Named after the Egyptian word for their 'black land', *KMT* has been in publication for almost two years under the editorial command of Dennis Forbes. He is not a professional Egyptologist, but confesses to "a forty-year fascination with the Two Lands." The magazine caters to the non-professional community, providing a publication devoted to Egyptology which remains scholarly without being stuffy. Each issue of *KMT* offers a wide range of subjects. For example, the winter 1990-91 issue had an institutional report on the work of the Boston Museum of Fine Arts at Giza, a synopsis of painter Winifred Brunton's portraits of ancient Egypt's royalty, and a profile of Kaemwaset, the son of Ramses II and a high priest of Ptah. There was also a lively article on how to plan your first trip to Egypt, and Egyptologist Don Ryan - one of our potential speakers for 1992 - offered some useful pointers on how to get started in the study of ancient Egypt. Subjects in the previous issue ranged from efforts to conserve Egypt's heritage to a business-oriented article on buying and selling antiquarian books. The Summer 1991 issue had a special in-depth focus on Akhenaten. *KMT* also features a book review department. Fall 1991 reviews included *Mummy Stories* edited by Martin H. Greenberg, *Awakening Osiris: A New Translation of the Egyptian Book of the Dead* by Normandi Ellis, and the ever-popular Amelia Peabody's latest adventures in *The Last Camel Died at Noon* by Elizabeth Peters. The wonderfully-named *Nile Currents* department highlights current news from excavations, conservation efforts and museum openings. Another regular feature is *The Editor's Report*, which in Fall 1991 focused on Forbes' activities at the Sixth International Congress of Egyptology held in Turin, Italy, in September. Forbes told The Ostracon about many exciting articles planned for future issues. An in-depth study of Amenhotep III is planned to coincide with the exhibit, ***Egypt's Dazzling Sun: Amenhotep III and his World***, which opens in July, 1992, at the Cleveland Museum of Art. Also coming in Winter 1992 is our very own Bob Lowdermilk, with a fascinating article on his theories of pyramid construction.

Whether you're interested in interviews with Egyptologists, reports on current conservation efforts and profiles of ancient Egyptian personalities, or whether you just like looking at superb photographs of things Egyptian, you're sure to find something to like about *KMT*. *KMT* is published quarterly at $8.00/issue ($32/yr), and considering the diverse topics and in-depth research and reporting, this is really quite reasonable. Back issues can be ordered for $9.50 each; issues available are Spring 1990, Summer 1990, Fall 1990, Winter 1990-91, Spring 1991, Summer 1991 and Fall 1991. For subscriptions and back issues, send a check or money order with your name and mailing address to: ***KMT, 1531 Golden Gate Ave.,San Francisco, CA 94115.***

A TALE OF TWO MUMMIES

Notes on the October 15th meeting
by Graeme Davis

Dr. Robert Pickering is a man who needs no introduction to ESS members, and his work on CT-scanning mummies has had us enthralled for the last few months. At October's meeting, though, we met the medical specialists who have given their time and expertise to this project, and heard from them about the latest work.

Dr. Ed Hendricks kicked off the proceedings with a brief explanation of what a CT scanner is, how it works and how it produces better results than conventional 'flat' radiology. The CT scanner uses X-rays, but instead of taking one view and producing a two-dimensional image, the X-ray source moves around the subject, taking a number of 'slices' which can then be assembled by computer into a three-dimensional image. This means that true spatial relationships can be seen (is the scarab on the chest or inside the body cavity?), and that objects opaque to X-rays - metal pectoral ornaments, for instance - do not obscure the view of what is behind them. The result is an unparalleled look inside the human body (or other object - CT scanners have been used to examine dinosaur fossils) without the need for an intrusive procedure such as exploratory surgery or unwrapping. This is an especially significant step forward in the study of mummies. In order to obtain this level of detail, it was previously necessary to unwrap the mummy and effectively render it useless to future researchers. With the CT scan, the mummy remains intact and undisturbed, so that future researchers - perhaps with more sophisticated techniques which can retrieve even more knowledge - can examine it. The mummies enjoyed first-class treatment at University Hospital, including an ambulance ride each way, a fast check-in and no need to worry about consent forms and insurance coverage. Antiquity does indeed have its privileges. They were scanned from head to toe in a mixture of 10mm and 2mm slices: 10mm to give an overall idea of what was going on inside each mummy and 2mm to give high resolution for the really interesting bits. The cost of doing this for a living patient is about equivalent to the price of a small house, so once again we thank University Hospital and the specialists who gave their time and resources to the project.

For the medical details we heard from Dr David Rubenstein, a neural radiologist, on the brain and nervous systems of both mummies, and from Dr. Jan Durham on the rest of the remains. The slides they showed were outstanding in their clarity, and it was even possible to make out the individual layers of wrapping on each mummy.

The main interest of the lecture came from the comparison between the two mummies. Both were adult females. One was 'Mos', whom Dr. Pickering described in the last Ostracon, and both were from the 19th or 20th Dynasty. However, there were striking differences in the treatment they had received. It seems that there is more than one way to wrap a mummy, and it is almost irresistible to think of these two specimens as a five-star package and an economy job.

Mummy 1, Mos, has the five-star treatment. We saw from the CT scans that the brain had been removed through a hole in the right side of the nose, and the body cavity was cleaned out with similar thoroughness. Packing - apparently linen - was used to maintain the body's shape, and the inner wrappings were separated from the outer wrappings by a layer of pitch. Another layer of pitch was applied to the upper surface of the outer wrappings. The eyes were removed and replaced with false eyes made of resin and other materials. The neck was packed with resin to keep its shape. The organs were separately treated and then replaced in the body cavity in a number of bundles - the precise number cannot be discerned at this time, but there seem to be four or five. The incision in the flank through which they were probably removed is now covered with a patch, apparently of metal foil; another piece of foil sits on the chest and would have almost totally obscured conventional X-rays of this area . This mummy seems to have been a healthy woman in her late 20s or 30s, around five feet tall. The only dental feature is one decayed tooth, although dental wear is consistent with a diet of stone-ground grain. The name 'Mos' - a forerunner of 'Moses' which was a

common name in biblical times - comes from the coffin, which almost certainly does not belong with the mummy. It was a common practice among the shadier modern dealers in antiquities to put a mummy and a coffin together regardless of whether or not they belonged. However, Dr. Pickering believed that this exchange happened in antiquity, perhaps as a result of ancient looting. The coffin itself is poorly built, and not consistent with the high standard of mummification.

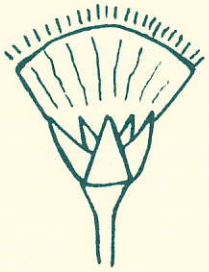
Mummy 2, on the other hand, had been treated with far less thoroughness. The brain - or rather the shrivelled remnants thereof - could clearly be seen laying at the back of the skull. There were no bundles in the body cavity - just something which may be the remains of the heart, and a possible fragment of the liver. No incision was seen through which the organs might have been removed. Without packing, the neck and body were losing their shape, and the mummy was visibly collapsing inward. There seemed to be no inner wrappings to indicate that the arms and legs were wrapped separately; the arms were just laid against the body and the whole thing was wrapped in one piece. The eyes seemed to have received little or no treatment. There were also several postmortem fractures and other disruptions to the skeleton - noticeably in the spine where several vertebrae were dramatically displaced. Of three missing teeth, two were probably lost postmortem and one was found inside the body. It was thought that there may have been a significant interval between death and the start of the mummification process, resulting in the start of decomposition. This would explain both the physical state of the remains, and, perhaps, the apparently hurried treatment they received. This mummy was slightly older than Mummy 1, in her 30s or 40s. Again, height was around five feet. There was no unusual pathology which could indicate a cause of death, and although three teeth were missing, only one seemed to have been lost in life.

Both mummies had some jewelry in the wrappings, but again Mummy 1 was better off. Mummy 2 had no jewelry or amulets (a string of beads around the neck was not original to the mummy and was a later inclusion), while Mummy 1 had a scarab laying on her chest and other, less clear, pieces of jewelry inside the body cavity with the organ bundles. Unfortunately, the resolution of the scans was not sufficient to identify these pieces and see whether they were traditional burial-amulets as described by Budge and others. But there was a ghost of an impression on one of the pieces of foil in which it was very tempting to see the shape of the Eye of Horus.

One interesting similarity is that, in both mummies, the small bones of the right middle ear are missing or displaced, although there is no sign of interference in that area. Dr. Rubenstein attributed this to coincidence, rather than the result of any part of the mummification process. In both mummies, the corresponding bones of the left ear were perfectly intact.

No cause of death could be found in either case - in Dr. Pickering's words, both were "healthy but dead". This is not remarkable, though, since the soft tissues of the body are not available for inspection. In Mummy 2, the tissues are nearly all missing and what remains is much decayed; in Mummy 1, it is not possible to see inside the abdominal bundles, and in any case, indications of death may have been masked by the process of mummification.

Dr. Pickering left us with the tantalizing prospect of a future exhibit using information recovered from these and other specimens, and an appeal for volunteers to try counting and measuring the layers of wrapping in each mummy, to test Classical sources on the amount of cloth used. All in all, this project is giving us some remarkable new insights into the process of mummification which does not seem to be as uniform and unvarying as earlier sources would have us believe.



1992 TENTATIVE SCHEDULE OF SPEAKERS & PROGRAMS

The E.S.S. is proud to announce a varied and fascinating program of speakers and events for 1992. As well as E.S.S. members presenting their own research and thoughts, we can look forward to an array of distinguished speakers bringing us the latest research, new slants on various Egyptian topics, and critical re-evaluations of past work. We think this season really has something for everyone. This PRELIMINARY list was put together mainly for planning and publicity. Although the whole schedule is still tentative, events marked by a '(T)' indicate the lectures still to be negotiated and details finalized. Watch *The Scribe's Palette* for final details as soon as we get them.

January: *The Complete Valley of the Kings* -- **Speaker: Dennis McDonald**, E.S.S., A.R.C.E., S.S.E.A.
A visual introduction to the entire valley, designed to acquaint past and future tourists with many of the historical sites which are never included on tours of the Valley. This program will show all the tombs in the Valley, including the interiors of many. It is also intended to serve as a curtain-raiser to our March speaker (see below) and his work in the Valley.

February: *The Aswan Dam and its Effects on Egypt* -- **Speaker: Prof. Joseph Szyliowicz**, University of Denver.
The construction of the Aswan Dam made international headlines, but public attention focused mainly upon the plight of ancient sites in the area to be flooded. This program will show the dam's effects on modern Egypt, both good and bad.

March (T): *Three Years' Work in the Valley of the Kings* -- **Speaker: Dr. Don Ryan**, Pacific Lutheran University
For three seasons, Dr. Don Ryan has been working on five uninscribed lesser tombs in the eastern wadi. One of these tombs, KV-60, was re-located and excavated; this received extensive coverage in the premier issue of *KMT* (Spring 1990), and the female mummy found in this tomb is thought by many to be that of the female Pharaoh Hatshepsut. Dr. Ryan will take us into these tombs and tell of his discoveries: PENDING APPROVAL FOR EXPENSES.

April: *Changes in Egypt in Modern Times* -- **Speaker: Bonnie O'Leary**, E.S.S.
It has been said that modern tourists are causing more damage to Egypt's ancient treasures than centuries of invaders. This program will show graphic evidence of the deterioration of Egypt's most famous monuments over the last thirty years. The speaker is a seasoned world traveler, who will compare slides taken thirty years apart.

May: *A Nubian Village in Modern Times* -- **Speaker: Dr. Anne Jennings**, DMNH Comm. Outreach Coord., Cultural Anthropologist
Dr. Jennings will be discussing her experiences with the delightful people from Nubia where she did her field work.

June: *Cleopatra* -- **Speaker: Dr. J. Donald Hughes**, University of Denver, E.S.S.
While not especially beautiful, Cleopatra had a wonderful voice and seductiveness, was intensely alive, tireless, and fearless; even her wretched coin portraits have preserved the eager vitality of her face. She was highly educated, interested in literature, conversant in many languages, a skilled organizer and woman of business. Brought up in a corrupt court, she knew no conventions and few scruples; the moral code had little meaning to her. SHE WAS HER OWN LAW.

July (T): *Subject to be announced* -- **Speaker: T.G.H. James**, former Keeper of the British Museum and renowned author on Egypt.
A famous author, and probably the foremost living Egyptologist, T.G.H. James will be in the IMAX theater with a presentation that is sure to fascinate. To be presented in conjuction with the DMNH.

August: *Influence of the British Occupation in Egypt* -- **Speaker: Dr. Charles Geddes**, University of Denver
The British were one of several powers to have a presence in Egypt at various periods of its history. This program will detail the effects of the British occupation on Egypt over the last few centuries.

September: *Subject to be announced* -- **Speaker: Evan Mitchell**, E.S.S.

October: To be announced

November: Annual Election & Business Meeting to be followed by a shortened program: *The Tomb and Treasures of Tutankhamen* -- **Speaker: Dennis McDonald**, E.S.S., A.R.C.E., S.S.E.A.
This program will be given at an East Coast university this spring. On this 70th anniversary of the discovery of Tutankhamen's tomb, you will be taken through the discovery and clearance of tomb KV-62 by the use of old photographs and diagrams. You will see many of the problems encountered by Howard Carter in his ten years' work, and many of the tomb's famous treasures - both in situ as Carter saw them and as they are today.

December (T): *HOW ABOUT an Annual Christmas Potluck Get-Together??*

ANCIENT EGYPTIAN JEWELRY

By Judy Greenfield

ABOUT THE AUTHOR: Judy Greenfield graduated Phi Beta Kappa from Vassar and received her diploma in Archeological Conservation from the University of Durham in England. Her curiosity in Egyptology peaked in 1981 when she was a student archeologist in Egypt. Judy is currently an objects conservator at the Rocky Mountain Conservation Center.

Apotheosis and resurrection are the leitmotifs of ancient Egyptian jewelry, according to Bob Bianchi, curator of Egyptology at the Brooklyn Museum, who hosted a lecture, *"Ancient Egyptian Jewelry: Form and Function."* Bob Bianchi's presentation in March was sponsored by the American Institute of Archeology, in conjunction with the University of Colorado at Boulder.

Ancient Egyptian jewelers had access to a fairly wide array of materials. The Eastern desert supplied them with semi-precious stones such as agate, feldspar, jasper, onyx, and turquoise as well as gold. Later, gold came from Nubia. Indeed, the hieroglyph, "Nebu", means both "gold" and "Nubia." Gold, considered "the flesh of the gods," was obtained either through trade, as tribute, or by colonizing Nubian gold mines. Electrum, a natural alloy of gold and silver, was also exploited for jewelry-making. Though the ancient Egyptians were familiar with silver, it could not be easily mined and was not used until the late New Kingdom, when it was imported from the Near East.

The bead, according to Mr. Bianchi, was "the midwife at the birth of Egyptian jewelry" because its mass-production caused an explosion in jewelry-making. Beads were crafted from semi-precious stones, but more ubiquitously from faience. The technology of crafting faience was imported from Mesopotamia. Faience consists of silica, calcite, colorants, and alkalis which could be hand-modelled or cast in molds and then fired at 800 degrees centigrade for several hours to produce the characteristic turquoise-colored material. Later, the Egyptians produced red, white, and yellow faience. To create a faience bead, a flax or papyrus fiber was introduced into the raw faience paste; when it was fired, the fiber burned out, leaving a hole for threading.

Men and women wore very similar jewelry, including earrings, in Ancient Egypt.

Western, Greek-influenced jewelry differs markedly from that of the ancient Egyptians, focusing on the precious metals, usually gold. Although the brooch, earring, bracelet, necklace, or ring usually has a focal point (e.g. a solitaire diamond), the stone serves to accent, not detract from, the precious metal setting. Forms are free-flowing and three dimensional.

By contrast, ancient Egyptian jewelry focuses on a single axial or heraldic motif consisting of a harmonious arrangement of colorful elements. The Egyptian jewelers (or their patrons) preferred solid color elements in their jewelry, framed within registers and architectural motifs or confined in cells (as in cloisonne) to produce a mosaic effect. The whole was balanced and symmetrical. This architectonic approach to jewelry permeates ancient Egyptian temple and furniture design as well.

Jewelers, woodworkers, and temple architects all followed the same artistic conventions for a thousand years, proof of the uniformity and conservatism of Egyptian society. Certain motifs, along with a prescribed palette of colors, persisted in Egyptian jewelry through the centuries.

Color is fraught with meaning. It is the primary and chosen means by which people identify objects, according to psychologists. Egyptians had only five words to describe color: black, white, red (also yellow and orange), green (blue or green), and multi-colored. Gold is associated with the afterlife because it resists corrosion, like the incorruptible body of the embalmed deceased. This concept carried into Byzantine times when gold was equated with Paradise. Black refers to death. Green ("wadj") alludes to rejuvenation and resurrection. The sun, depicted as a red disk, manifests divinity.

The iconography of apotheosis, immortality, and resurrection in ancient Egyptian jewelry includes

animals, the sun and moon, the gods and goddesses, and topographical features. The ancient Egyptian, watching the scarab push its ball of dung, imagined it pushed the sun along its daily path as well, and thus, this lowly insect took its place in Egyptian mythology. It was considered the sacred agent of rebirth. Therefore, it is not surprising that most scarabs in jewelry are green or blue, the resurrection colors. A flowery motif symbolizing the primordial swamp, from which creation arose, also appears in both Egyptian mythology and jewelry design. The crescent moon and sun disk, depicted in Egyptian jewelry, represent night and day, another metaphor for re-birth and resurrection. Jewelry was more to its owner than simple adornment; it was a subliminal statement that the wearer followed the prevailing belief in the afterlife.

During the question and answer session, Mr. Bianchi cautioned us to understand the jewelry in the context of Egyptian culture. And, furthermore, to realize that jewelry, fraught with symbolism, may have been a luxury item of the rich and may not reflect the cosmology of the general population.

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