

# THE OSTRACON

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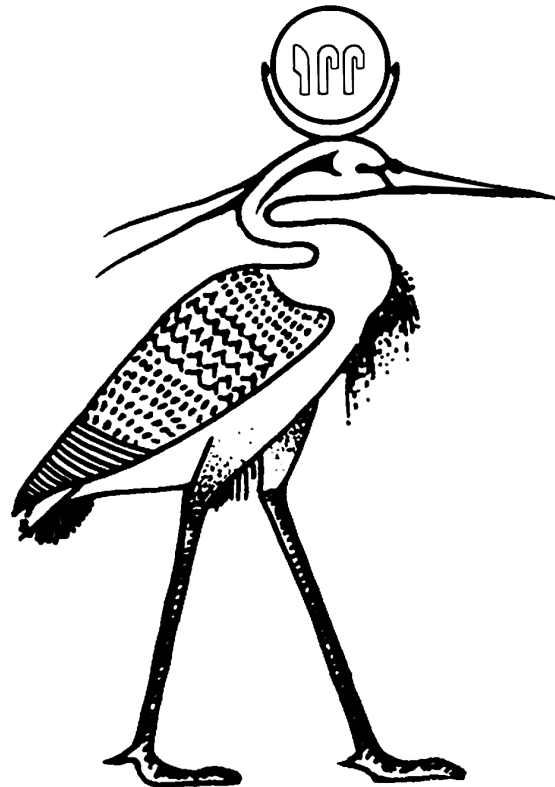
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# Origins of Pyramid GI-d, Southeast of the Great Pyramid

Charles Rigano

**T**he Giza Plateau may be the most excavated ancient site in the world. For 200 years archaeologists have been clearing the monuments and moving sand and debris from this enormous area covering nearly a square mile. Yet modern excavators can still make significant finds beneath the sands. A subsidiary pyramid which I call “GI-d” is one such recent find (Brock 1993:10-11, Note 1).

All pyramids do not fit our standard notion of what pyramids should look like. After thousands of years of vandalism and stone robbery, today some are little more than holes in the ground. That is much the case here. What remained of GI-d was covered by rubble and went unnoticed by George Reisner when he excavated the eastern and western cemeteries and subsidiary pyramids around the Great Pyramid from 1902 to 1939. Some years ago an asphalt road was built from the northeast corner of Khufu’s Great Pyramid, over the top of what remained of the mortuary temple basalt courtyard and the debris covering GI-d, and connected to a road that went down to the Sphinx. In the winter of 1992-1993, this road along the east side of the Great Pyramid was removed and the surface cleared to bedrock revealing GI-d. This pyramid was totally ruined with only a few core and casing blocks remaining

in situ along the east and south sides. The substructure was cut into the bedrock and open to the sky. Parts of the pyramidion were found, rebuilt, and placed on display at the site (Hawass 1996:379-398).

The substructure was simple, composed of a descending passage which enters a 9-foot deep rectangular chamber with slightly inward sloping walls. There is no evidence that the chamber was lined with blocks but significant amounts of pink plaster remain on the walls. The descending passage enters the chamber 18 inches above the floor. In the chamber floor, just below the passage, there is a shallow hole that may have held an angled stone which continued the ramp down to the chamber floor.

Egyptologists seemed to immediately accept GI-d as the fourth of Khufu’s subsidiary pyramids which served as his ritual pyramid and was possibly used during Khufu’s Heb Sed festival. I had visited the ruin and climbed down into its chamber several times and this seemed to me at first to be a logical conclusion.

However, seeing the site in an aerial photograph and being better able to evaluate its location relative to other ancient structures made me rethink this ascription. This tiny pyramid differs considerably from Khufu’s three subsidiary pyramids – GI-a, b, and c – and is located in a



**(Left) GI-d, looking down into the chamber with the descending passage entering from the left. The blocks along the passage are reconstructions. (Right) The chamber interior with the inward sloping walls cut into the bedrock.**

spot that indicates all surrounding monuments were built first. This led me to theorize that GI-d was not contemporary with Khufu, but was constructed during a later period. The data supporting my theory follows.

The differences between GI-d and Khufu's three subsidiary pyramids are significant. The chart below compares their dimensions. GI-d was less than half the height, less than half the base length and only about 10% the volume of each of the other three pyramids.

The substructure of GI-a, b, and c are almost identical and appear to have been built one after the other to the

Except for a short distance at the top of the first descending passage, the rest is cut wholly within the bedrock as compared to the T-shaped pit, open-to-the-sky construction of GI-d.

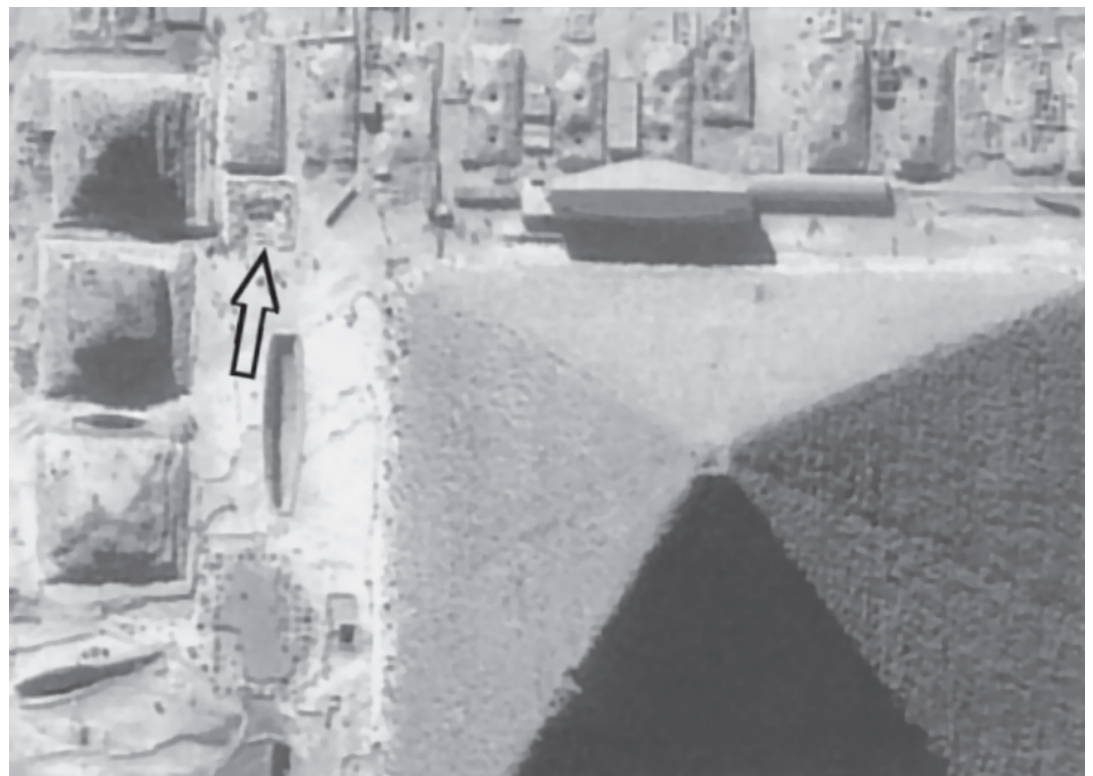
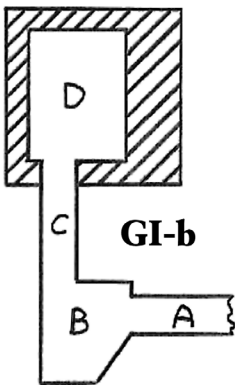
While its size and internal arrangement clearly set GI-d apart from Khufu's other three subsidiaries, it does bear a strong resemblance to GII-a, the very ruined minor pyramid to the south of Khafre's Pyramid

From ground level there seems to be nothing special about the location of GI-d. However when seen from the air, a different picture emerges. Khufu's builders

	GI-a	GI-b	GI-c	GI-d
Estimated Height	99'	100'	95'	45'
Face Angle	51°50'	51°50'	51°40'	51°45'
Base	156'	157'	151'	71'
Volume (cubic feet)	803,000	822,000	722,000	76,000

same general plan with only slight variations. Each pyramid has a descending passage (A) leading to a turning space (B) designed so that long objects could make the 90° turn into a short, second descending passage (C) which leads to the burial chamber (D). Cross-hatching indicates laid limestone blocks which lined the burial chamber.

constructed an inner enclosure wall 33 feet from the base of the main pyramid (Maragioglio and Rinaldi 1965:66) and excavated two rectangular boat pits just outside the wall to the south. These boat pits date to the end of Khufu's reign since large wooden boats apparently used during the funeral ceremony and cartouches of Djedefre,



**ABOVE: Outline drawing of GI-b is typical of the three subsidiary pyramids, GI-a, GI-b and GI-c. RIGHT: The area east of Khufu's Great Pyramid. North is toward the bottom of the picture. The Great Pyramid is the large structure at bottom right; the three subsidiary pyramids are along the left side of the image. The arrow points to GI-d. Image by spaceimaging.com**

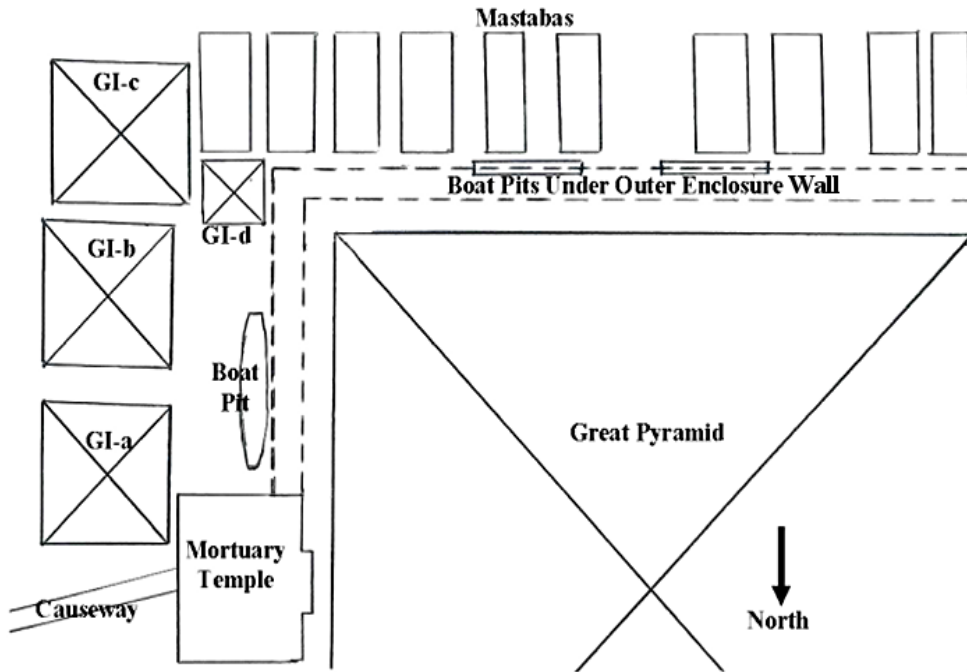


Diagram of the area shown in the aerial photograph, south and east of the Great Pyramid. Dashed lines indicate the positions of the inner and outer enclosure walls. The position of the outer enclosure wall east of the Great Pyramid is estimated. GI-d was built last in a small space defined by the already-existing structures.

Feature	GI-d (Khufu)	GII-a (Khafre)
Base	71' Square	69' Square
Height	Estimated 45'	Estimated 46'
Exterior Angle	51°45', essentially the same as the main pyramid	53°, essentially the same as the main pyramid
Descending Passage	39" wide, height unknown, enters chamber above floor level	41" square, enters chamber above floor level
Passage Incline	32°	31°
Chamber	27' by 10', 9' high, lined with pink plaster	25'9" by 8'8", 6'11" high, lined with pink plaster
Pyramid Volume	76,000 cubic feet	73,000 cubic feet
Internal Floor Plan (to scale) - A descending passage leads to a rectangular chamber		

Comparison of subsidiary pyramids GI-d and GII-a. Data for GI-d from Hawass 1996, and from author's measurements and calculations. Data for GII-a from Maragioglio and Rinaldi 1965:88-90.

the next king, were discovered in the pits. Apparently these boat pits were covered by sand and forgotten when an outer enclosure wall was constructed over top of the boat pits 61 feet from the Great Pyramid base. Remains of this wall are found to the south, west, and north of the Great Pyramid; no remains are visible to the east.

Ten mastabas, dated by Reisner to the end of Khafre's reign or the beginning of Menkaure's (Reisner 1942:83), about 30 years after completion of Khufu's mortuary complex, are aligned with this wall. If the mastabas were built before the wall, it is likely that the mastabas would have been sited closer to the Great Pyramid, over the top of the hidden southern boat pits and aligned with the inner enclosure wall. Therefore, the wall must be either contemporary with or of an earlier date than the mastabas. While there are no remains of the outer enclosure wall to the east of the Great Pyramid but there are on the other three sides, it is likely that the wall was also present on the east side.

The outer enclosure wall, the mastabas, the three subsidiary pyramids, and boat pit set the boundaries of a small, relatively flat area close to the Great Pyramid. It is very unlikely that GI-d was built here first and defined the locations for the outer enclosure wall and mastabas. It is much more likely that the boundaries created by these constructions defined the space and size for a pyramid as the last structure built in this area. This sets the earliest

possible construction date for GI-d to after the completion of the southern mastabas and at a time either contemporary with or slightly later than Khafre's subsidiary pyramid (GII-a). We may be seeing the same architect's hand in GI-d and GII-a. For whom GI-d was built and why a site was chosen next to the Great Pyramid is unknown and likely unknowable. Possibly it belonged to an immediate relative of Khufu who gained prominence during a later reign. Whomever it was built for, the physical evidence leads us to the conclusion that GI-d was built during the reign of either Khafre or Menkaure and was not contemporary with the Great Pyramid.

## NOTES

1. George Reisner used the letter "G" to identify Giza; the Roman numerals I, II, and III to identify the three primary pyramids - Khufu, Khafre, and Menkaure - in chronological order; and letters to identify the subsidiary pyramids. Khufu's three subsidiary pyramids were identified as GI-a for the northern, GI-b for the middle, and GI-c for the southern. I have identified the new pyramid as GI-d.

2. GI-a, b, and c were not built on a flat surface but on a slope. Therefore the length of each pyramid face is slightly different as the builders accommodated to the incline. For purposes here we measured the east-west distance through each pyramid's center.

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# Unit Fractions: Inception and Use

James Lowdermilk

The ancient Egyptians used the mathematical construct that we call unit fractions to perform arithmetical division. Unit fractions are fractions with a numerator of one, and they were added together by Egyptian scribes to solve division problems, such as

$$\frac{4}{5} = \frac{1}{2} + \frac{1}{5} + \frac{1}{10}.$$

These methods will be analyzed below. In modern mathematics we use common fractions, ratios or decimal representations to achieve the same means, such as

$$\frac{4}{5} = 4 : 5 = 0.8.$$

The Egyptians' chosen method to perform division has been called cumbersome and laborious because this method is difficult and hard for an unaccustomed mind to decipher. The scribes who used these methods understood their applications and were accomplished in their use. However, it has been questioned why the Egyptians would choose this difficult method over the simpler choice of common fractions and why unit fractions persisted throughout pharaonic times.

The cattle herders who roamed the humid prehistoric Sahara mingled and eventually merged with the agrarian settlers of the Nile valley. The traditions of the cattle herding nomads go back at least 12,000 YBP (Years Before Present), soon after the rains began to fall on the sands of the Sahara creating pasturelands. The domestication of cattle around this time (Midant-Reynes 2000:89) presented these people with the need to understand larger numbers in order to manage their herds. They also would have used the stars to navigate their herds to the proper pastures during the rainy or dry seasons. Seasonal lakes brought many of these nomadic tribes together every spring at the Nabta Playa depression in southern Egypt.

Standing stones have been discovered at Nabta Playa that date to the late 5th millennium BCE. These stones are aligned to the rising points of various stars during that epoch (Malville 1998:488). The alignments gave the people who erected these stones

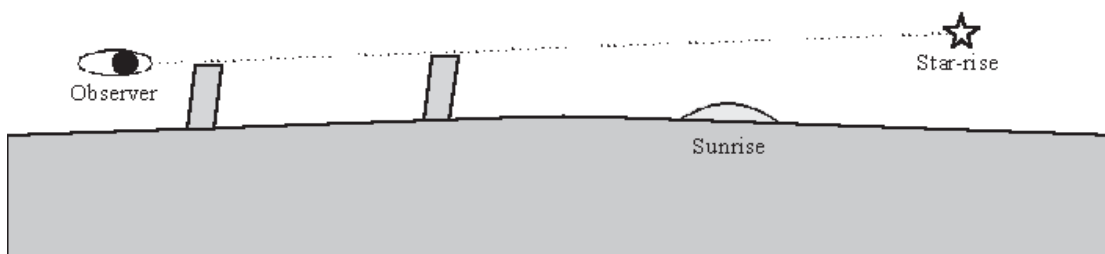
a referenced, unchanging horizon for viewing the stars. When a star is aligned with the stones an observation can be made. When this observation takes place as the sun rises, we call this a heliacal rising (figure 1).

Once a year, each star will rise above the observed stone alignment within minutes before the sun rises. The number of sunrises until this referenced heliacal rising is observed again can then be counted. The first thing noticed about this count is that each star's heliacal rising occurs 365 days apart on most occasions. Very soon it could be confirmed that almost every fourth rising takes an extra day, or 366 days – what we call a leap year. Quickly thereafter, it would be noticed that some stars occasionally only require three years to achieve a leap year while others might sometimes require five years. The high number of stone alignments at Nabta Playa reflects the inhabitants' attempts to collect and analyze this data.

As the observations continued year after year, every star would exhibit the 365, 365, 365, 366-day per observed year pattern. Slowly each star would break this pattern with an occasional early leap year, or late leap year, only to return to the pattern of a leap year every fourth year. By sheer coincidence the brightest star in the sky resided in just the right location for it to almost never break its four-year leap cycle. The location of the star we call Sirius caused the time from one heliacal rising to the next to be within seconds of 365 + 1/4 days (Ingham 1969:36). Other stars had rising times minutes away from the quarter day behavior of Sirius, making this brightest star unique. In predynastic times Sirius was positioned so that it would return according to its expected four-year pattern for more than a thousand years.

A 1st Dynasty tablet bears the image of a recumbent cow, the goddess Isis-Sothis, representing this star. It reads, "Sothis [Sopdet], the opener of the year" (Parker 1950:34). The depictions of Sopdet as a cow thus identify the original worshipers of this star as the cattle herders who frequented the Nabta Playa depression and erected the stones aligned to this and many other stars. Another artifact connecting cattle to the stars is the Naqada III period "Hathor" palette (Midant-Reynes 2000:193-4). Five stars surround the head of a bull; one of

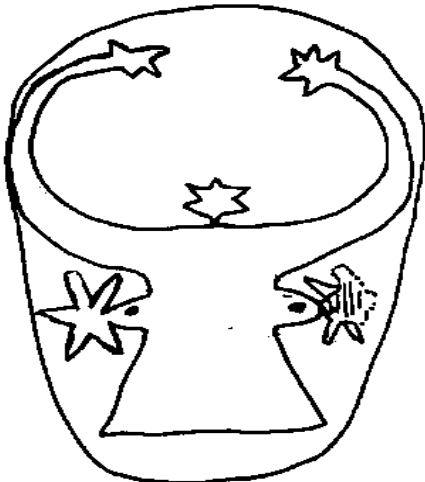
these stars rests on the bull's head just as a star would appear as it rises above a stone alignment (figure 2). The people who erected the standing stones recognized the star Sirius/Sopdet for never breaking its four-year pattern and it was probably these cattle herders who began worshipping this star as Sopdet. The coincidence of the rising of Sirius/Sopdet



**FIGURE 1: Using standing stones to determine when a star appears above the horizon. A star's heliacal rising occurs when it first appears each year.**

with the Nile flood was recognized later when these cattle herders merged with the inhabitants of the Nile valley.

While few stars maintain a four-year leap-cycle, most routinely break their cycle at fairly regular intervals. A process we call precession of the equinox is the cause of this and is also responsible



**FIGURE 2: Naqada III period “Hathor” palette showing the connection between cattle and stars**

for these stars’ rising points to move over thousands of years to new rising points today. The ancient stone alignments are no longer aligned. The effects of precession caused Sirius to maintain its 365.25-day year in predynastic times. Near the celestial equator, the effects of precession are canceled out and each star in this region of the sky maintains a year equal to the Sidereal year of 365.2563 days. This value is within seconds of  $365 + 10/39$  days. This means that these stars would achieve 10 leap years every 39 years or that every 10th leap year comes on the third year of a cycle. The cattle herders making these observations noticed this and worked this information into a new calendar, which we now know as the Egyptian civil calendar (Lowdermilk 2000:9).

The Egyptian calendar counts 365 days every year and does not take leap years into account as our calendar does. When an observed event exhibits a leap year, its date on the Egyptian calendar changes by one day. Therefore, most events on the calendar move one calendar day every fourth year. The calendar was broken into weeks of 10 days each, called decans. The choice of 10-day decans reflects the recognition of the 10 leap years every 39-year cycle exhibited by the equatorial stars. When an observed star moves to the end of its decanal period its date changes after only 3 years to move into the next “week” (figure 3).

Sirius, or Sopdet, and the stars residing close to the celestial equator follow regular, recognizable patterns. Every other star in the sky has its own unique year, and in order to realize the simpler patterns, the entire sky must be analyzed. Sopdet was worshiped for its unique cycle of  $365 + 1/4$  days each year. This formed a baseline for the analysis of all the other stars. The proper mathematical tool for this investigation is unit fraction division.

Every year has 365 days and a small, additional part of a day. That additional fraction of a day adds up, year after year. When it adds up to more than one day, a leap year with one additional day occurs. This analysis is obvious in the simple case of Sopdet’s extra  $1/4$ -day each year, which gives one whole extra day in an interval of 4 years. The question is why, when other stars are observed, does this pattern sometimes break early, in a third year, or sometimes late, in a fifth year. The answer is that most star's years do not exactly equal  $365 + 1/4$  days, and the trick is to find out by how much each star's year is off that standard.

If a star breaks pattern by having a three year interval between leap years, then its own year is longer than  $365 + 1/4$  days. Conversely, if a star breaks pattern by having a five year interval between leap years, then its own year is shorter than  $365 + 1/4$  days. In the situation where the break comes regularly, as when every 39th year brings a three year interval, the difference is  $1/4$  times  $1/39$ , making that star-year

$$365 + \frac{1}{4} + \frac{1}{4 * 39}$$

days long. In the situation where the break does not come regularly, the number 39 above has to be replaced with the average number of years between breaks. The data needed to perform this analysis requires at least 100 to 150 years of accurate record keeping.

Some time after the stones were erected at Nabta Playa, deep wells were dug, enabling some members from the tribes to reside there year round and maintain observations during the wet and dry seasons, while the rest of the herdsmen were tending to the cattle in other pastures (Wasylikowa 1997:933). The means used to maintain the necessary records can only be speculated upon without specific evidence. However, to create the calendar, the residents of Nabta Playa must have collected the data on the stars. Some form of unit fraction analysis was performed before the calendar was created and implemented. The creators of the calendar understood the workings of the calendar before they inaugurated it.

The Egyptians began counting the years of their calendar on the day of the Sothic rising, the heliacal rising of Sopdet (Clagett 1995:29). Over the years the Sothic rising wandered



**FIGURE 3: The Sidereal year starts one day later every 4th (or occasionally 3rd) Egyptian 365-day calendar year.**

off the first day of the calendar and then slowly returned, coinciding with the first day of their calendar again approximately  $365 * 4 = 1,460$  Egyptian years later, because almost every 4 years Sirius’ rising would move one calendar day. This length of time is called a Sothic Cycle. According to Censorinus, writing in 239 CE, the first day of the Egyptian calendar coincided with the Sothic rising in 139 CE (Clagett 1995:307). Counting backwards by increments of 1,461 Julian years this coincidence of dates also occurred in 1321 BCE, 2782 BCE,

and 4243 BCE. The 4243 BCE date corresponds to radiocarbon dating of sacrificial cattle burials at Nabta Playa (Malville 1998:488) and is probably very near the starting date of the calendar.

The count of years the calendar ran would have first been kept by the tribesmen who devised the calendar and then by the priests who took charge when Egypt was unified. The astronomer Harkhebi tells us in an inscription on his statue (c. 600 BCE) that he was “one who announces the rising of Sothis at the beginning of the year and then observes her on her first festival day, calculating her course at the designated times, observing what she does every day; everything she has ordered is in his charge” and he “does not disclose at all concerning his report.” (Claggett 1995:495-6 v.2)

Evidence of knowledge of the workings of the calendar being held secret is also found in the Reisner papyrus, c.1900 BCE. If the Egyptian calendar year of 365 days is 10/39ths of a day short of a sidereal year, then it takes  $39 \div 10 = 3.9$  years for the calendar to lose one day to the sidereal year, not exactly 4 calendar years. In the Reisner papyrus, a hired scribe wrote the approximation  $39 \div 10 = 4$  even though elsewhere in the papyrus he has correctly worked the problems  $30 \div 10$  and  $9 \div 10$ , which when added together give the correct value of  $39 \div 10$ , proving his ability (Gillings 1972:221). Apparently the author of the Reisner papyrus knew or was told that the calculation  $39 \div 10$  was not to be performed in such a profane location as the official registers of a dockyard workshop.

Furthermore, when the geographer Strabo (2nd century CE), wrote of Plato’s and Eudoxus’ studies in Egypt in the 4th century BCE, he tells us that the Egyptian priests “did teach them the fractions of the day and the night which, running over and above the 365 days, fill out the time of the true year.” (Strabo, Geography, p.83-5) These priests understood that the “true year” contains 10/39ths of a day more than the 365-day calendar year they used, but they were “secretive and slow to impart” this knowledge.

The cattle herders of the prehistoric Sahara would have been familiar with numbers on the order of a few hundred to keep count of the many tribes’ herds. When collecting the data from the stars aligned with the standing stones they would first need numbers less than one thousand. In analyzing this data they would need to investigate larger numbers. By the time of Narmer (c. 3000 BCE) they had established numbers on the order of millions. The count of booty taken when Narmer conquered Lower Egypt is found on a mace head with his name. It shows that 1,422,000 goats, 400,000 oxen, and 120,000 prisoners were captured (Claggett 1989:6). These counts were undertaken not only to collect new data about their world, but also the people were taught to count so that those who enjoyed working with numbers and excelled could be identified and educated in the higher mathematics of fractions and calendars. The ruler could then utilize and exploit their talents for his benefit.

Following the creation of unit fraction division by one man or a small group working together, future generations had to be taught how to work with this difficult mathematical tool. The calendar was in use throughout pharaonic Egypt and its maintenance required the use of unit fractions. For this reason unit fractions were taught and used throughout pharaonic times. The Rhind papyrus (circa 1500 BCE) takes the form of a mathematical primer used to teach methods of unit fraction

division, among other mathematical tools. The papyrus provides examples of mathematical problems without the benefit of a written explanation. The priests who specialized in this branch of teaching provided explanations orally.

The Rhind papyrus is a copy of a papyrus written 300 years earlier (Claggett 1999:113). An oral tradition would have accompanied this papyrus for every generation of those 300 years, continuing on with the new copy. This may indicate that the traditional method of teaching unit fractions was oral all the way back to the first use of unit fractions near the beginning of their calendar, prior to the implementation of hieroglyphic writing. The 300 years the previous copy of this papyrus was in use also reveals the working life of a papyrus used as a high school or college equivalent text.

The papyrus begins with the division problems  $2 \div 3$ ,  $2 \div 5$ ,  $2 \div 7$ , ...  $2 \div 101$ . These provide examples of how to perform division when the divisor grows larger and larger. The next examples in the papyrus show  $1 \div 10$ ,  $2 \div 10$ ,  $3 \div 10$ , ...  $9 \div 10$ . These problems show how to treat a quotient, as the dividend grows larger. The methods of unit fraction division have been called cumbersome and laborious. Once mastered, unit fraction division is no more cumbersome and laborious than modern long division.

Each division problem performed by the ancient Egyptians was always accompanied by ancillary numbers written below the problem, with one ancillary number for each unit fraction in the answer. For example:

$$\frac{11}{15} = \frac{1}{2} + \frac{1}{5} + \frac{1}{30}$$

$$\left[ \begin{array}{c} 7 \\ 2 \end{array} \right] \quad [3] \quad \left[ \begin{array}{c} 1 \\ 2 \end{array} \right].$$

These numbers are built so that when each of them is multiplied with the denominator of its corresponding unit fraction, the denominator of the original problem is the result. When all the ancillary numbers are added, the result is the numerator of the original problem. These numbers are not unlike the subtractions undertaken in a modern long division problem. They are used to determine the next step in the problem. The ancillary numbers in the beginning steps of unit fraction division are built to get the result close to the correct answer. The ancillary numbers near the end are used to zero in on the correct result. This method is only one means to divide numbers into a unit fraction answer.

An interesting aspect of unit fraction division is that answers to division problems are not unique – for example 11/15 can also be expressed as:

$$\frac{11}{15} = \frac{1}{2} + \frac{1}{6} + \frac{1}{15}.$$

Beginning certain answers with

$$\frac{1}{2} + \frac{1}{6}$$

makes many problems easier because that value is equal to 2/3. The Egyptian mathematicians realized this and preferred the use of 2/3 in place of  $1/2 + 1/6$  for ease and brevity in their work.

A good first step to any division problem is to quickly estimate whether the answer is bigger than 2/3, 1/2, 1/3, 1/4, etc. The largest of these values is often but not always the preferred choice for the



first fraction. Some fractions, such as  $1/7$ th, are difficult in most problems so they can be avoided by using the next smaller fraction, such as  $1/8$ th. These hints are only gleaned from continued practice, without the aid of a calculator, sometimes without pencil and paper. Some proficient Egyptian scribes would have excelled at unit fraction division.

Unit fraction division was taught in the schools and temples of ancient Egypt. In Mesopotamia, when division problems were beyond the reach of a scribe, he would consult a division table written on a clay tablet to find the answer. A base-60 number system works well with division tables because the number 60 is an abundant number, containing many divisors. The methods of unit fraction division inherently do not lend themselves to reference tables of division and must have been performed for each problem by a competent scribe. The Mathematical Leather Roll in the British Museum suggests tables of addition and subtraction of fractions existed, but they have not been found. Division tables clearly did not exist (Gillings 1972:11-12).

People with curiosity about and talent in unit fractions would have investigated their structure. The Wedjat eye is an example of the results of their investigations. The Wedjat eye drawn as a right eye represents the sun and drawn as a left eye represents the moon. The Wedjat eye is also an example of an infinite geometric series. Separate parts of the eye break down into the hieroglyphic signs for the numerical fractions  $1/2$ ,  $1/4$ ,  $1/8$ ,  $1/16$ ,  $1/32$ , and  $1/64$ . These numbers form a geometric sequence. When the obvious pattern is continued indefinitely, these numbers form a convergent infinite geometric series, or they all infinitely add up to a finite number, in this case one, i.e.

$$\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \dots = 1.$$

By representing the Wedjat series as a deeply religious symbol, the ancient Egyptians acknowledged their understanding of this mathematical situation. To deny the Egyptians ever gained this knowledge is to say they never investigated the nuances of the mathematical systems they used daily or that every Egyptian scribe was incapable of understanding the mathematics that they regarded so highly as to view it religiously. A text that confirms this understanding has never been found, but individual scribes with sufficient ability would have pondered on the significance of the Wedjat fractions. The Wedjat eye represents an infinite path that leads to one.

The mathematics of the series represented in the Wedjat eye implies possible investigations that involve infinity. Without further textual evidence we cannot know in what directions the Egyptians took their investigations of the valuable and interesting tool we call unit fraction division. Modern investigations of the underlying structures of unit fractions are found in upper level modern algebra texts under the guise of the multiplicative inverse of a number, the modern mathematical term for unit fractions. An example of the modern definition of multiplicative inverses is found in problem 9 of the Rhind papyrus. It states, using modern notation, that  $4/7 * 7/4 = 1$ . The definition of multiplicative inverses states that two numbers, a and b, are multiplicative inverses of each other if they multiply to equal one, or  $a * b = 1$ .

The adept and varied skills exhibited in the small number of surviving mathematical texts that contain examples of unit fraction

division suggest that over the thousands of years the Egyptians used this tool they gained a deep understanding of their use and structure.

In conclusion, the cattle herders of the Sahara erected standing stones to collect data on the rising times of many stars. In trying to decipher this data, someone created a new tool called unit fraction division to correctly interpret the numbers. This understanding of the behavior of the stars led to the creation of the Egyptian calendar of 365 days each calendar year. The maintenance of this calendar required an understanding of unit fractions so the use of unit fractions persisted as long as the calendar was used. Unit fraction methods were taught to scribes throughout ancient Egyptian history. These mathematicians investigated the structures of unit fractions and became very accomplished in their use.

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# Even the Gods Will Die: Divine Mortality in Ancient Egypt

Richard H. Wilkinson

**A**s in most ancient civilizations, the tenure of the gods and goddesses of ancient Egypt was one of cosmic proportions. Egyptian deities, like some of the stars themselves, were often characterized as “undying”. Yet unlike the gods of most other cultures, the deities of ancient Egypt were not viewed as immune from decline — and even death and eventual non-existence. In fact, the inherent vulnerability of the gods is an integral part of Egyptian mythology and one which has important ramifications for our understanding of ancient Egyptian religion.

## DECLINE of the GODS

A number of Egyptian texts show that although the gods were not considered to be mortal in the usual sense, they could and would eventually die — though the evidence for this must be carefully assessed and understood in context. The death of gods is clearly implied in the so-called Cannibal Hymn of the Pyramid Texts where the deceased king is said to cook and eat certain gods in order to absorb their power (Utterances 273-4). This potential for death is of great importance in the development of even some of the greatest cults of Egyptian religion — particularly those of the netherworld god Osiris and the sun god Re. Although the Egyptian texts never specifically say that Osiris died — almost certainly because such a statement would be believed to magically preserve the reality of the god’s death — they, and later classical commentators, do clearly show that Osiris was slain at the hands of his antagonist Seth, and was mummified and buried. The great sun god Re himself was also thought to grow old each day and to “die” each night (though again, and for the same reason, specific mention of the god’s death is not found) and then to be born or resurrected each day at dawn. This latter concept is admittedly clearest in late evidence such as texts found in the temples of Ptolemaic date, but it was doubtless an idea long speculated on by the Egyptians and is implicit in many of the representations and texts found in New Kingdom funerary works. This aspect of the sun god’s ageing is also found in several Egyptian myths which describe the god as immensely old and clearly decrepit. One spell from the Coffin Texts includes an overt threat that the sun god might die (Coffin Texts VII 419), showing

that the idea of this god’s demise extends at least as far back as Middle Kingdom times.

## DIVINE DEMISE

The principle of divine demise applies, in fact, to all Egyptian deities. Texts which date back to at least the New Kingdom speak of the god Thoth as assigning fixed life spans to humans and gods alike, and Spell 154 of the Book of the Dead unequivocally states that death (literally, “decay” and “disappearance”) awaits “every god and every goddess”. Thus, when the New Kingdom Hymn to Amun preserved in Leiden Papyrus I 350 states that “his body is in the West”, there can be no doubt that this refers to the god’s dead body according to the metaphorical expression commonly used by the Egyptians.

The story known as The Blinding of Truth by Falsehood (Note 1) refers to “the tomb of the god” and scholars such as François Daumas and Ragnhild Finnestad (Note 2) have shown that there are clues in late Egyptian temples that the innermost areas were regarded as the tombs of the gods. There are also various concrete references to the “tombs” of certain gods, with some sites — such as Luxor and western Thebes — being venerated as the areas of gods’ tombs from at least New Kingdom times.

But all this evidence must be viewed in its proper context, for death need not imply the cessation of existence. From the Egyptian perspective, life emerged from death just as death surely followed life, and there was no compelling reason to exempt the gods from this cycle. This idea was itself aided by the fact that the Egyptians utilized two views of time which contrasted eternal sameness (*djet*) with eternal recurrence (*neheh*). This is clear in statements such as that found in the Coffin Texts, “I am the one Atum created — I am bound for my place of eternal sameness — It is I who am eternal recurrence” (Coffin Texts 15). The gods could thus die and still remain in the ongoing progression of time. As Erik Hornung has stressed, the mortality of Egyptian gods “... enables them to become young again and again, and to escape from the disintegration that is the inevitable product of time”. (Hornung 1982:162)

## THE END of TIME

Because Egyptian deities could partake of a cycle of life, death and rebirth, the end result of their deaths was

still one of life in all the examples considered above. Ultimately, however, a final end did await the gods. In Egyptian mythology, it is clear that only the elements from which the primordial world had arisen would eventually remain. This apocalyptic view of the end of the cosmos and of the gods themselves is elaborated upon in an important section of the Coffin Texts in which the creator Atum states that eventually, after millions of years of differentiated creation, he and Osiris will eventually return to “one place”, the undifferentiated condition prevailing before the creation of the world (Coffin Texts VII 467-68). In the Book of the Dead this “end of days” is even more clearly described in a famous dialogue between Atum and Osiris. In this text it is said that when Osiris mourned the fact that he would eventually be isolated in eternal darkness, the god Atum comforted him by pointing out that only the two of them would survive when the world eventually reverted to the primeval ocean from which all else arose. Then, it is said, Atum and Osiris would take the form of serpents (symbolic of unformed chaos) and there would be neither gods nor men to perceive them (Book of the Dead 175). Thus, despite their seemingly endless cycles of birth, ageing, death and rebirth, the gods would finally perish in the death of the universe itself, and there would then exist only the potential for life and death within the waters of chaos. Such a view of the gods, and of the universe itself, is an advanced one in many ways. It underscores both the flexibility of Egyptian theological thinking and the willingness of the ancient Egyptians to confront the ultimate conclusion of their own religious concepts.

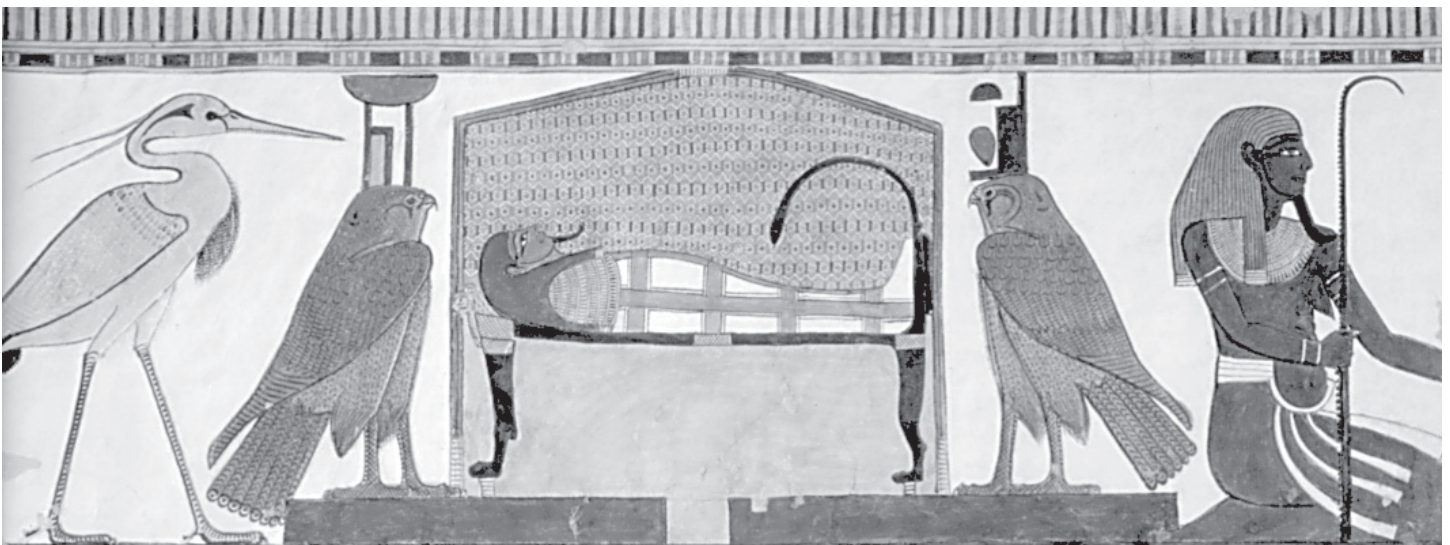
## NOTES and REFERENCES

1. See “The Blinding of Truth by Falsehood”, translated by Edward F. Wente. *The Literature of Ancient Egypt* (New Haven: Yale University Press, 1972), 127-132.
2. See, for example, R.B. Finnestad. “Temples of the Ptolemaic and Roman Periods: Ancient Traditions in New Contexts” in Shafer, B., ed., *Temples of Ancient Egypt* (Ithaca: Cornell University Press, 1997), 185-238.

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\* *This article is an adaptation by Dr. Wilkinson of material from his book, The Complete Gods and Goddesses of Ancient Egypt, published in May 2003 by Thames & Hudson in London and New York, and by The American University in Cairo Press in Egypt.*

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**Nephtys and Isis in the form of birds of prey watch over the mummy of Osiris. 19th dynasty. Tomb of Nefertari, Valley of the Queens, western Thebes.** Figure and caption after Wilkinson, *The Complete Gods and Goddesses of Ancient Egypt*, p159

# Cultural Geography of the New Kingdom in the Amarna Age\*

A lecture by Dr. Richard Hess of the Denver Seminary, March 2002

Reviewed by Charles Cook

What's in a name?" brings to mind the simple response, "A rose by any other name smells as sweet". In Dr. Hess' lecture, however, we find that looking into personal names found on clay tablets is more like splitting a geode to display its crystals.

Dr. Hess displayed two maps: one of Canaan-Palestine and the other showing Egypt to the Persian Gulf. In addition, he displayed a half-dozen transparencies like pages from a telephone book, with 132 entries for 31 geographical locations and 101 personal names that he considered in his presentation. The maps displayed 10 separate cultures with overlapping tensions and intentions: the Indo-Europeans and Indo-Aryans bearing down on the Hittites, Hurrians, Mitanni, Assyrians, Babylonians and Kassites. They, in turn, were pressing down on the Canaanites, while the Egyptian New Kingdom empire was pushing up into Canaan. These 10 realms intermingled and infringed upon one another in Canaan. A significant grouping of 3 kinds of names are found in the Amarna Letters: Egyptian names for a couple of administrators, West Semitic names for the indigenous people, and Northern names for the Indo-Europeans and Aryans coming down from Asia Minor.

The Amarna Letters were written in the Late Bronze Age during the reigns of Amenhotep III and IV (Akhenaten). These famous tablets came from the royal diplomatic archives in Akhenaten's Amarna Period capital of Akhetaten (c. 1350 BC). The correspondents included Pharaohs and Kings, bureaucrats of various empires, governors, administrators and leaders of local cities and towns. Dr. Hess' data are gleaned from lists of personal names, such as those found on the 12 tablets from Taanach that name some 70 kings' servants, army draftees, corvée laborers and the like. The primary records were royal and international letters relating to problems in local situations and how to handle them. Akkadian was the lingua franca of the time and all correspondence was written in cuneiform. Each of the records included personal names.

Dr. Hess presented the personal names as evidence of cultural influence in Canaan brought in from afar. Each name was analyzed to reveal its historical and cultural origins. The citations that follow are specific examples of

the personal name data; each one lists where the name was found, an English transliteration from the Akkadian cuneiform, and the linguistic grouping. Each also includes observations and conclusions by Dr. Hess.

From Hazor: PU-RA-AT-PUR-TA; Northern Semitic; perhaps Kassite. Circa 1595 BC, Hittite troops marched down to Babylon, destroyed it, and returned home. Thereafter, tribes from the Zagros mountains moved in and established the Kassite Kingdom. They replaced the ruins with new buildings but they preserved the Babylonian culture and language. Some members of these tribes moved on down into Canaan.

From the Acco Plain: SA-TA-AT-NA; Indo-Aryan; Sanskrit. Around 2000 BC, people from northern and eastern Asia moved into India, provided the basis for the Sanskrit culture, and moved into Mitanni, bringing horses and chariots for military purposes. Some of these people moved down into Canaan.

From Tushulto: A-MA-AN-HA-AT-PA; Egyptian. This man was an Egyptian administrator tending to local affairs. Relatively few Egyptian names are found in the records. Evidently, Egyptians did not generally live in Canaan.

From an uncertain location: ZI-BI-LU; West Semitic; Canaanite. This man was probably a local resident entrusted with Egyptian interests. The name has the Semitic root for "prince" and relates to the god Baal in Ugaritic myth. The root word is found in the name of Queen Jezebel and in the name of Zebulun, a tribe of ancient Israel.

From Taanach: TAL-WI-SHAR; Northern; Hurrian. The many Hurrian names in the area suggest that Hurrian influence permeated the region. Even the indigenous West Semitic people of the region adopted Hurrian names, as found elsewhere.

Also from Taanach: K-K-B; West Semitic; Ugaritic. The reader will note that in the other names as transliterated above, the name is rendered in syllabic, consonant-vowel

combinations. Here there are only consonants, as in Hebrew, Aramaic and Arabic. This is because a cuneiform alphabet of 30 consonants came into use in Ugarit at about this time.

The names listed above give only 6 personal names from among the 101 Dr. Hess examined. But these are representative of the groups discussed in the lecture and are evidence of cultural influences that are found in these personal names. Many of the personal names examined by Dr. Hess include references to their homeland deities: “Upheld by Indra”, “Servant of Hebat”, “Son of El”, “Servant of Sharu”, “Offspring of Baal”, and “Baal is my judge”. Religious impact on the existing culture was certainly among the most significant influences of the invaders and intruders.

In addition to the cultural diversity of personal names, the Amarna Letters give amazing insight into the political formalities and the people of that time. The recognition of variables in social status was discreetly practiced in the use of “brother” for equals, and of “father” for superiors.

A typical letter from an inferior to the Pharaoh opened with the honorific, an extended reference to the greatness of the one addressed, the humility of the sender (with his 7 forward and backward bows), and his loyalty and support for whatever cause might be most important to the Pharaoh at that time. Then the sender stated the actual problem, which was usually trouble with neighboring enemies, and a request for immediate help. Such letters to the Pharaoh often went unanswered. Traditionally this was explained as a

Pharaoh being too busy with his ruling and personal priorities to worry about other things. Akhenaten was a good example of a Pharaoh who used that excuse. However, some Egyptologists have proposed that it was the official policy to let the locals wrangle among themselves. Sending help was costly. Letting them fight among themselves would keep them busy and exhaust their military strength so they would be no threat to the Egyptian empire.

Dr. Hess called attention to the archaeological treasures of burials, such as pottery, ceramics, shards, and the like, from which so much is learned of the history, culture and daily activities of people. He then pointed out that a careful examination of personal names provides remarkable parallels to the same information. A political map of the extension of the Egyptian New Kingdom empire in Canaan, with attention to details of this study, would show the Egyptian stability in Canaan, with indigenous West Semitic control at key points and along the Mediterranean coast, and relatively limited control by Egypt of the Northerners in upper Canaan.

Dr. Hess’ lecture provided intriguing information that the audience might use to further study and research this fascinating aspect of Egyptology.

*\* This review was inadvertently left out of the Summer 2002 issue of The Ostrakon. The editor and staff of The Ostrakon apologize to Charles Cook and Dr. Hess for that oversight.*

# The Painted Box of Tutankhamun

**A lecture by TGH James, Retired British Museum Keeper  
of Egyptian Antiquities, 18 April 2003**

Summarized by Jan Stremme

**T**G.H. “Harry” James shared some observations about Tutankhamun’s painted chest on April 18, 2003 at the Denver Museum of Nature and Science. This chest was first seen in modern times when Howard Carter’s team entered the antechamber of Tutankhamun’s tomb. The chest stood in front of the sealed burial chamber, at the foot of one of a pair of guardian statues. At the time, Carter described the chest as one of the “greatest artistic treasures of the tomb”. James was quick to point out that many more artistic treasures were found in the tomb later, but the chest remains a masterpiece. Carter, an artist himself, was taken by the details

in the painting on the sides and top of the chest, and commented on the detailing in the horses’ harness trappings and the stippling of the lions’ coats. He was also intrigued by some stylistic departures from the traditional formulaic art of the ancient Egyptians.

A quick overview of the chest shows fairly typical pharaonic themes, depicting the ruler’s prowess in battle and hunting scenes. These themes were seen as early as the 1st Dynasty scene of the pharaoh Den smiting foreigners, and through the Ptolemaic Period. Although Tutankhamun was a young king and probably not battle-seasoned, the scenes represent his power.

As James took us through the scenes on the chest, he used slides of Nina Davis's facsimiles which show the details as clearly as when they were first unearthed.

First we studied a scene of the pharaoh smiting Nubians. The pharaoh dominates the center of the scene in a beautiful chariot with his elaborately harnessed horses. Trampled enemies lie below the chariot in grotesque positions. To the left, the pharaoh's retinue is arranged in three registers. There are even some Nubian fan bearers shading the pharaoh in his chariot although James wryly observed, "I can't believe this actually happened" in battle. In front of the chariot, on the right side of the panel, is a chaotic tangle of bodies of Nubians. Even the Egyptian soldiers in this portion of the scene are unshaven. James pointed out two features rarely seen in traditional Egyptian art. Some of the soldiers are shown full face, and one chariot rider's cloak flies in the breeze. He pointed out that the artist left no blank spaces. The chaotic scene is skillfully laid out, free of repetition, with the contorted bodies and body parts. All remaining space is filled with flora.

The opposite side of the box features a similar scene of the pharaoh smiting Asiatics. The pharaoh is shown in a different chariot, protected by the vulture goddess Nekhbet. Again, some of the figures are portrayed full-face, and a retainer again wears a wind-blown cloak. James commented that the painter was enough of a master that he was not afraid to experiment, and even speculated that the artist "was obviously rather pleased" with the effect of the billowing cloak since he used this motif on several sections of the box.

Moving to the lid of the chest, we studied two hunting scenes. In the lion hunt, the pharaoh is again in the center and here his chariot horses' tails are braided. His three-tiered retinue follows on the right, complete with Nubian fan bearers, who carefully watch their fans lest they strike the king. James observed that the warriors are all clean-shaven in this scene, and pointed out another retainer in a wind-swept coat. Lions are in various contorted positions in the left front of the scene. Some lions are shown with full faces. No

two lions are the same and their coats have shading and stippling. These techniques, while not typical of contemporary art, are not unprecedented.

The second scene on the lid features a hunt of various desert animals. The familiar figure in a wind-swept cloak appears again among the retainers. The chaotic scene includes antelope, desert asses, a hyena and an ostrich. James pointed out that Carter's father was a noted animal artist, so Carter could not have helped but admire the careful portrayal of animals in this scene.

More typical, formal art decorates the two ends of the chest. The pharaoh is portrayed as a sphinx, wearing the Atef crown of Osiris and protected by Nekhbet. His name is painted in two cartouches and he is again trampling the enemy. James showed the audience the fine detailing where the pharaoh's name is spelled out on the palm fronds of the fan used to shade him. The figures are rigid and formal, with the exception of the trampled enemies.

The chest was made of wood, possibly sycamore. The interior is whitewashed and plain, and contained deteriorated clothing including sandals, gloves (some small enough for a child) and a headrest. We were left to speculate about the purpose of this beautiful box, and why it was included in the hasty burial of this short-lived pharaoh.

When Carter first removed the chest, he believed the only preservation measures required were a dusting and a protective coating. Unfortunately, within three to four weeks, it became apparent that the change in humidity was damaging the chest. The joint cracks widened as the wood began to buckle, cracking the paint. Melted paraffin wax was used to fix the gesso plaster to the wood. At the time, this tended to brighten the colors of the paint. But over the years, the colors and details in the painting have deteriorated significantly. There are modern conservation techniques that might be used successfully, but the task of conserving this artifact would be formidable and costly. Today, the painted box is prominently displayed in a glass case in the Tutankhamun exhibit at the Egyptian Museum in Cairo.

# House Of Scrolls

## *A Traveler's Guide to the Geology of Egypt*

by Bonnie M. Sampsel

**D**r. Bonnie M. Sampsel, a member of the Egyptian Study Society, talked recently with the editor of *The Ostrakon* about her new book, *A Traveler's Guide to the Geology of Egypt*. 2003, Cairo, The American University in Cairo Press; 228 pp.; \$22.50 soft cover; ISBN 977 424 785 X

**Ostrakon: Can you tell us something about the book and why a traveler in Egypt might want to know about the geology of that country?**

Sampsel: I think that serious travelers in any foreign country would want to learn many things about that country: its customs, its history, the names of its native plants and animals. By studying the geology of the country, they will become familiar with, and appreciate, the landforms they're likely to see. Even more important, however, is the fact that the physical environment serves as the stage on which a society develops and provides both opportunities and restrictions. So, if you want to understand a country, I think you have to start with its geology.

It turns out that Egypt has a fascinating geology that played an enormous role in the development of the ancient Egyptian civilization. In the book, I try to tell two stories: I describe the geology, and I explain how it has been important to Egyptian history.

**Ostrakon: Why did you write this book?**

Sampsel: Because there wasn't a book like this available. For the past ten years, I've been studying ancient Egypt and reading about the geology of the country in diverse, hard-to-find, sources. All along, I'd been hoping to find a book like this. Finally, a few years ago, some friends encouraged me to write the book I'd been looking for.

**Ostrakon: How did you do your research?**

Sampsel: Well, much of the research was done in libraries, although I've made eleven trips to Egypt looking at the scenery so I could compare what I'd read with what I'd seen. I also wanted to be familiar with geological features a traveler could easily see at various sites.

**Ostrakon: Some of the references in the book's bibliography are pretty specialized — for example,**

**articles from the Journal of Tectonophysics. Do you think that a reader is really going to go and look that up?**

Sampsel (smiling): Probably not. But the bibliography has several purposes. One is just to acknowledge the many sources I used, since there aren't any footnotes. It also permits readers to find additional information if they want to do so. I've found that it's very important to go to the primary sources whenever I can. Secondary sources are useful to get an overview and to identify the primary sources, but too often a secondary author may make a mistake in citing a fact, or may misinterpret what he's read. I was fortunate in having several excellent university libraries near my home, and I've visited other libraries as I've traveled. One of the skills that I was able to bring to this project, as a result of my background in science and teaching science as a college professor, was the ability to read specialized literature and to present it in a way that's clear to the non-specialist. And the book is intended for non-specialist readers.

**Ostrakon: Even so, isn't geology a sort of daunting subject for most people?**

Sampsel: It certainly can be. But I think people will find this book very accessible. I've tried to make it user-friendly in a number of ways. I am not assuming that the reader has any prior knowledge of geology, so I begin with a chapter that reviews the important principles of geology. These include plate tectonics, the geological time scale, rock formation and properties, weathering, and other important processes. I tried to be very selective in the technical vocabulary I use. It can't be avoided completely, but I highlight and define those words when they're first used, and I've included an extensive glossary.

**Ostrakon: The book seems to have a lot of maps.**

Sampsel: I'm a "map person" myself, and I think a map fulfills a requirement for visual understanding — you know, "a picture is worth a thousand words". But I felt that the reader needed maps that would correlate with the text, so each map was drawn especially for this book. I would like to have included even more figures, but I didn't feel that the kind of cross-sections and highly complex diagrams, so beloved by geologists, were appropriate.

**Ostracon: You said there was no book like this when you began.**

Sampsell: I said there was no book like this for Egypt, but in fact I used the very nice “Roadside Geology” series as a model. I go further than the Roadside books, however, in discussing extensively the impact of geology on the Egyptian society. I use examples from ancient Egypt as well as ones from the more modern era.

**Ostracon: Can you give us some examples?**

Sampsell: Sure. I try to show why different kinds of stone were used for certain monuments: for example, why the ancient Egyptians used sandstone in the Luxor temples but limestone in the ones at Giza. I explain how geologists can answer questions that have puzzled Egyptologists, such as whether the stone in the Colossi of Memnon came from quarries at Aswan or near Cairo. I talk about the weathering processes that are threatening tombs in the Valley of the Kings. I discuss the good and bad consequences of the Aswan High Dam. And I explain why so many modern Egyptian homes have rebar sticking out of their roofs.

**Ostracon: When should a traveler read this book?**

Sampsell: Ideally, the introductory chapters would be read before travelers leave home and they would continue to read it while they’re traveling in Egypt. There are chapters devoted to each region of the country and to some of the individual, popular tourist destinations such as Luxor and Giza. At the same time, someone who has already been to Egypt should find it interesting because it discusses things he or she will already have seen and perhaps wondered about – like the rebar sticking out of houses. Most of the book supplements rather than repeats what one hears from a professional guide or lecturer.

**Ostracon: This is your first book. Did you have any trouble finding a publisher?**

Sampsell: No. I was really very fortunate. I looked at a lot of Egyptian guide books, as well as books about Egyptology, and made a list of possible publishers. It seemed to me that the American University in Cairo Press was the best choice because they publish a wide range of high-quality guidebooks on various parts of Egypt. And they have good distribution channels in Egyptian bookshops as well as in the U.S. I sent them a proposal describing the book. They’d been aware that there was a real gap in their offerings with respect to geology and were therefore very receptive. The only changes they asked for were to expand the sections on the Red Sea and Sinai. I hadn’t been aware of how many tourists go to

these places to hike and dive. So I was happy to add more material on those areas.

**Ostracon: From all reports, it sounds like the book has been a great success.**

Sampsell: Again, I’ve been very fortunate. Shortly after the book was published this spring, I was asked to give a lecture on the geology of Egypt at the Cairo Chapter of the Egyptian Exploration Society. While I was in Egypt for the lecture, I was also interviewed for a 20-minute broadcast on one of the Egyptian television stations, and by one of the Cairo newspapers. Another Cairo newspaper asked me to write an article for them, which I’ve just completed. And a friend has told me that the Aboudi Bookstore in Luxor said in June that the book was its fastest selling item. I never thought a book on geology would cause such a stir!

**Ostracon: The book was published in Cairo. Is it readily available in the United States?**

Sampsell: Yes. American University in Cairo Press books are distributed in the U.S. by Books International. The book is also available on-line from Barnes and Noble and Amazon.com. I should warn buyers that the title on some of the Internet sites is listed as *The Geology of Egypt: A Traveler’s Guide*. And ESS members can buy the book at the Museum Store at the Denver Museum of Nature and Science.

**Ostracon: What do you think is the most amazing thing a reader will learn from your book?**

Sampsell: For sheer amazement, I would say the fact that the Mediterranean Sea totally dried up 6 million years ago. And while it was dry, a huge river, the ancestor of today’s Nile, cut a gorge as wide and deep as Arizona’s Grand Canyon from Cairo to Aswan.

**Ostracon: That would be some tourist attraction! Why don’t we see that today?**

Sampsell: Actually, we do see remains of it. After the Mediterranean refilled, the Nile Canyon was gradually filled with sediments. The cliffs we see today on each side of the Nile Valley are the rims of that vast canyon.

**Ostracon: Why did the Mediterranean dry up?**

Sampsell (laughing): Let’s leave something for the reader to discover by reading the book.

*The Editor of The Ostracon, Richard S. Harwood, interviewed Dr. Bonnie Sampsell.*