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Private Tombs in the New Kingdom
The Creation of Sacred Space

Ashleigh Goodwin

The most basic function of an ancient Egyptian tomb was to provide a place for the storage of human remains. As time went on, the tomb evolved beyond its practical purpose; it was meticulously designed to aid the deceased in his desire for secrecy, memory, cult and passage. The survival of the mummy depended heavily on the concealment of the burial chamber; yet it was also essential for the deceased to be remembered, which required some sort of visibility. Obviously, the necessity for secrecy and memory conflicted with one another to a large extent. Fortunately, a compromise was found in the creation of accessible and inaccessible zones within the tomb. The division of the tomb into four zones: chapel, transverse hall, intermediate hall and burial chamber, created spaces that could be either inaccessible or accessible. Dramatic changes in the decoration of post-Amarna tombs furthered this division by producing an abundance of sacred space, facilitating the third function of cult as well as the fourth function of passage, allowing the deceased to move between this world and the next and ultimately creating a temple space that would enable the deceased to worship his gods eternally.

The construction and styles of private tombs predating the Amarna Period were simple and utilized an inverted T-shape (Fig. 1), a shape that may be connected to the rejuvenation of the ba (or "soul") of the deceased in the funerary cult. Recognizing this allows us to speculate that the entire tomb was, in fact, a source of renewal. The crossbar of the T or transverse hall located at the entrance to the tomb generally featured scenes of daily life while the walls of the intermediate hall dealt with funerary preparation, rituals and images of funerary gods. At the far end of the intermediate hall, it was often common to include a niche for displaying statues of the deceased with his family.

It may seem difficult to attach any symbolic meaning to the use of the T-shape in the construction of tombs given that it is a rather simple shape. However, there must have been some underlying significance because, if simplicity were the only goal of the architect, it would have been much easier to make the tomb square. Amy Bomann suggests that, like the modern Christian tradition of displaying a tree at Christmas, the original meaning of the T-shape may have become lost to the Ancient Egyptians. Fortunately, there are other examples of the T-shape found in tombs that may give clues as to its true significance. The T-shape occurs in tomb paintings that suggest the shape may have represented the elements of creation before they took physical form. The T-shape is commonly depicted in tomb paintings involving images of a tree deity and the primordial waters, which may be a visual reference to lines 1485–6 in Pyramid Text 574:

Hail to you, you tree which encloses the god, under which the gods of the Lower Sky stand, the end of which is cooked, the inside of which is burnt, which sends out the pains of death: may you gather together those who are in the Abyss, may you assemble those who are in the celestial expanses.

In the funerary cult, the T-shape is often represented as a basin filled with water surrounded by some type of foliage such as lotus plants but more commonly a sycamore tree. In Fig. 2 the deceased and his family receive libations from a goddess perched in a sycamore tree growing at the edge of a T-shaped pond. The ba of Userhat and his wife in Theban Tomb (TT) 56 are seen perching on the edge of such a basin, cupping their hands to their mouths to receive offerings from a goddess (red box, Fig. 3). In some cases, the basin is brimming with fish and waterfowl. Some illustrated papyri show the deceased using a T-shaped basin to draw water from a pond. These scenes probably represent the continuation of vital offerings given to the deceased through the water by means of the goddess. The water in the pool, along with the goddess and tree’s ability to give sustenance, creates a cycle of life and rejuvenation imperative to the survival of the ba.

The most common use of the T-shape was in the form of an offering table (Fig. 4), which was essential for the sustenance and renewal of the ba. In the Old Kingdom, the T-shaped offering table was formed by two rectangular basins on either side of a conical loaf of bread, later recognized as the hieroglyphic sign for ḫtp ("to offer" or “offering”), which depicts a mat with a loaf of bread on it forming a crude T-shape. By the Middle Kingdom, stone offering tables formed the shape of a T while also utilizing an interior T consisting of the conical loaf and two small basins. New Kingdom offering tables were often grooved around the interior T, joined by a spout forming yet another T. This feature would have allowed libations to be poured onto and drained from the table. The offering table was an essential part of maintaining the deceased’s ba, especially in conjunction with the false door, which allowed the ba access to its offerings.

The construction and decoration of the false door in the New Kingdom may help us understand the overall layout of the tomb. False doors were usually constructed of a series of panels and recessed

Fig. 1. Tomb plan of Rekhmire (TT 100). After Bomann (1991).
have entered the netherworld at night, illuminating it with his light and waking the dead. This was now accomplished in the morning as the Aten returned from his absence. Perhaps by changing the layout of the tomb it was believed that the sun could enter the tomb through the long hall and illuminate the inner chamber in order to wake the dead.

The removal of the false door left the deceased with no way to pass between worlds. It was not necessary for the actual corpse to make the crossing because of the ba’s new freedom of movement and the new emphasis of existing as a living ba. It may be suggested that, according to Amarnian beliefs, the ba never actually left the current world but instead slept in the tomb by night and left to visit the temples by day. The removal of the false door did, however, leave the ba without the vital offerings he needed and it was therefore necessary for him to leave the tomb and enter the temple in order to receive sustenance. Texts found inside the tombs describe the ba’s journey to the temple in order to receive bread, beer, roasted meats, cool water, wine, milk, and the breath of life given by the Aten.

The ba’s newfound ability to leave the tomb in order to enter the temple is specific to the Amarna Period but it did have an influence on later tomb scenes such as the previously discussed scene of the tree goddess providing libations to the deceased’s ba. Without the means of receiving offerings through the false door the ba had to rely on the gods to provide sustenance, whether that meant (as in the Amarna Period) he needed to leave the tomb for the temple, or symbolically receive offerings via the tree goddess as depicted in later tomb decoration.

Since the concept of Osiris and the act of transitioning into his divine presence had been rejected, the tomb took on a new purpose. The artwork in most Amarna Period tombs suggests that the tomb had now become the domain of the ba—a place where he could reside and come and go as he wished. An Amarna tomb was not a place where the deceased was worshipped or a place for him to worship various gods, since there was only one god and the Aten could only be worshipped outside the tomb.

In the Ramesside Period, there was a major change in the structure, layout and decoration of the tombs. Instead of reinstating the false door, which was phased out in the Amarna tombs, a new device was formulated to further emphasize necessary divisions. A stela niche shared a similar structure to that of the false door: it was framed and crowned with a cornice, a continuation of the concept that the framing may have represented the tomb itself. The actual stela found within the niche was important because its purpose was to organize the architectural and decorative scheme within the tomb. These stelae were usually divided into two sections or scenes, one above the other. The upper register was almost always reserved for the images of deities receiving adoration from the deceased while the lower register contained scenes of the deceased receiving offerings from the living. It is this same layout that continued throughout the tomb, organizing the wall decorations into two or three sections by portraying sacred images involving the gods in the upper registers and reserving the lower registers for images of the funerary cult.

Accessible and inaccessible zones were also achieved architecturally through the tomb’s superstructure (pyramid, pylon or courtyard), transverse and intermediate halls, and finally the burial chamber. The superstructure of the tomb was essential as a transitional zone between the outer world and the sacred compartments inside; it acted as a “place of transition, purification, consecration and initiation into the temple, which was the tomb.” The iconography of the tomb had, by the Ramesside Period, been turned inside out, with scenes

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Fig. 2. Unknown tomb from Qurna. Nut pours libations from a sycamore above a T-shaped pond. After Bomann (1991) following Champollion (1835–45).
of funerary rites now located in the court where texts and images illustrated the mummy being exposed to the sunlight—an act called the "erection of the mummy before Re" or "dressing before Re"—as well as the Opening of the Mouth ritual. Some Theban tomb courts even included sculptural detail in the form of pillars with niches containing statues of the deceased either in mummiform (TT 41) or in normal attire (TT 106 and TT 183). Besides architectural divisions, the tomb utilized imaginary partitions which further supported the division of the tomb into accessible and inaccessible zones through the use of decoration. The walls of the transverse hall often included the deceased's biography, dedications to the gods, banqueting scenes, funerary processions and the weighing of the heart followed by the deceased's introduction to Osiris. These scenes followed strict divisions such as were laid out according to the blueprint provided on the stela located at the entrance to the tomb. For example, if a horizontal division were used in the transverse hall (as it was in the tomb of Samut, also called Kyky [TT 409]), then religious icons or images of the deceased were only allowed in the upper register while images involving the living (banqueting scenes, funerary processions etc.) were allowed only in the lower register. This layout would have been prescribed in the stela found in the entrance to the tomb. Along with allowing entrance into the burial chamber, the intermediate hall usually included scenes of the deceased's entrance into the realm of Osiris and his presentation to various gods, which in most cases also utilized the division presented by the stelae.

The tomb of Amenemipet Ipy (TT 41) provides a good example of the transition between the pre-Amarna and post-Amarna layout. Scenes that used to take up the entire span of a wall no longer existed, but they were not yet organized into stacked, horizontal sections. It is evident by such tombs as TT 41 that this was the eventual goal since scenes which began on one wall would continue onto the adjoining wall without interruption. The corners of the tomb were used as partitions to divide the scenes vertically instead of horizontally as would later be seen in Ramesside tombs. For example, in TT 41 the funeral procession to the tomb begins on the south wall and continues onto the west wall. The corner acts as a division between what happens prior to the actual burial and what happens after the burial. This same scene would later be divided horizontally into an upper register showing the funerary procession in the tomb (i.e., images involving priests and any deities) and a lower register depicting the funerary procession making its way to the tomb (Fig. 5). At least five stela niches inside the tomb were divided in the same manner discussed above: deities are found in the upper register while the lower register is reserved for the funerary cult. Jan Assmann suggests that the large number of stelae niches in this tomb may have been an attempt to impose this new decorative division before utilizing it on the walls.

This new organization of the iconography and the division of accessible and inaccessible zones allowed the entire tomb to act as a sacred place. No longer was it a place where the deceased could be served and worshipped but it became the deceased's very own temple where he could worship the gods. Images of deities were no longer restricted to certain areas of the tomb but were represented everywhere, especially in the upper register. It is likely that this is also the reason why there suddenly appears to be an increase in the number of gods portrayed within the tomb, including Ptah, Sekhmet, Sokar, Thoth, Isis, Horus, Hathor, and the deified Amenhotep I and Ahmose-Nefertari. The longing for a close relationship with the gods was not a new feature found in the Ramesside Period—there are examples of it from earlier periods.
both inside and outside the tomb—but it was not until the Rames-
side Period that entire tombs were designed to fulfill the needs of
individuals for intimacy with their gods.

The tomb of Samut (TT 409) offers a rare example of how the
new allocation of sacred space into accessible and inaccessible zones
could be used to portray an individual's personal piety (Fig. 6). In
two lengthy texts occupying walls H, K and M, Samut replaced the
usual biography with a proclamation of his deep devotion to the
goddess Mut whom he had chosen above all others to be his personal
god. 

Text A in the top register of walls H, K and M begins with
his search for a protector among the gods and how he was guided
to the goddess Mut: “Then he pondered deeply to himself, to find
a protector for himself. He found Mut at the head of the gods, Shay
[and] Renenet with her, the span of life and breath
under her control, and all that happened is at her
control.” Once Samut established Mut as his protector,
he devoted his life to her and states that all of his
belongings are hers: “See, I now give to her all my
wealth; all that [I] have brought into being.” He
does this because he realizes that he would not have
gained any of his possessions if it had not been for
her: “I was a weak one of her city, a poor man close
to her town. I entered into my property because of
her strength.” Samut makes confirmation that it
was Mut whom he chose and that he did not seek
a protector among men or other gods: “I do not
make protection for myself from human beings; I
[do not attach myself] to the great, and there is not
even my son. I have found her.” However, his love
for Mut is not without a price. He asks that “You
shall keep me safe until my end, from every evil.
Give that my eyes see the sun’s rays, for you are the
Sun Disc; my ears hear, without becoming] deaf,
and my nose inhales the breezes.” Mut is not just
the protector of Samut alone, but to everyone: “You
open the eyes of all, to see the sunlight. … I rejoice
at your power, according to you are greater than
any [other] god.” Samut even encourages others to
choose Mut as their personal god:

Text B, in the middle register of walls H, K and M, although
mostly damaged, appears to serve as an official document detailing
his dedication of property to the temple of Mut and perhaps how
it is to be used. “On this day, the Scribe and the Counter of the
Cattle, Samut [called Kyky, justified] of the Temple of Amun-Re,
King of the Gods, declared as follows: I give my properties and [all
my gains to] Mut, and to the Temple of Mut.” He reiterates that it is
Mut and only Mut who should receive his belongings: “There shall
not be a [son nor daughter], nor [brother], nor sister (involved), as
I entrust myself to Mut the [Mistress who has given] the breath (of
life) [to me].”

By dedicating his wealth to Mut, Samut was able to buy his
way into her patronage, becoming her client and ensuring that she
would vouch for him in life and in death. One might even say
that by placing this dedication in his tomb he envisioned the trans-
verse hall—and perhaps the entire tomb—as her domain. These
texts provide a good example of how an individual can express his
personal beliefs through the allocation of sacred space made avail-

As for the one who makes Mut as a protector, no
god can harm him. … As for the one who makes
Mut as a protector, evil cannot assail him. He has
protection in the course of every day, until he unites
with the necropolis. As for the one who makes Mut
as a protector, how happy is his lifetime. Royal favors
end and uniting with his body belong to the one who
puts her in his heart. As the one who makes Mut as
a protector, [he is] one come out from the womb
favored, for whom good has been fated at his delivery.
… As for the one who makes Mut as a [protector],
how fortunate is the one who longs for her, the god
will not overthrow him, as one who does not know
the word.
able through the architectural and decorative divisions of accessible and inaccessible zones.

The burial chamber of a Ramesside tomb uses the sloping passages that were introduced in the Amarna Period tombs and were usually accessible through a side door in the intermediate hall. It seems strange that the one room that contained the mummy, which in earlier tombs needed to be inaccessible and hidden in order to keep the mummy protected, was now easily accessible. It is unclear exactly why the sloping passage became popular in the Amarna tombs. However, in the Ramesside tombs, it may have had ties to the Sokar festival. In the tomb of Neferhotep (TT 50) there is an inscription referring to the opening of the burial chamber for the duration of eight days in accordance with the *Book of the Dead* spell 169:

Month 4, Akhet, Day 18
The day of moistening barley
To open the burial chamber for Osiris NN [NN standing for the name of the deceased]
Starting from this day until day 25, altogether 8 days.
Spell to recite for the burial chamber.

It may have been belief in this spell that made it necessary for the burial chamber to be accessible. The sloping passage down to the burial chamber bears a strong resemblance to the depiction of hours four and five of the Amduat and its sloping passage that leads to the cavern of Sokar. One of the epithets of Sokar is “he of Rosetau,” this being the name of the entrance to the netherworld from the necropolis. It may be that the deceased was hoping to gain access to the netherworld through these sloping passages ending in the cavern of Sokar (i.e., the burial chamber). Beginning with the royal tomb of Seti I until that of Ramses III, the Fourth and Fifth Hours of the Amduat were always depicted in the third corridor just before the well shaft. Along with its practical functions as a deterrent to tomb robbers and the collection of floodwater, the well shaft also acted as a symbolic representation of the underworld, which may explain why the Fourth and Fifth Hours of the Amduat were depicted just before the well shaft. As Re leaves the Third Hour, which was a landscape plentiful in resources, he enters the Fourth Hour, where the desert of Sokar stretches out before him. It is in this hour that Re must travel a zigzag route, made up of sloping passages (Fig. 7). The barque of Re is pulled through these dark halls, which are reminiscent of the dark sloping passages leading down to the burial chamber in the Ramesside tombs. During this hour, the gods Horus and Sokar are protecting and renewing the Solar Eye until Re reaches the end of the passage and is able to see the morning sky. Finally, in the Fifth Hour, Re reaches the cavern of Sokar. The entire scene embodies the netherworld with its essential elements including the presence of Isis and Nephthys in mourning over the grave of Osiris, Re emerging as a scarab, and the primeval waters and evil serpents that may cause harm. The barque continues to be pulled around the central oval guarded on either side by a sphinx (Fig. 8) that represents the cavern of Sokar and may be a general representation of the netherworld where the nightly union of Re and Osiris, who is identified with Sokar, occurs. In this context, it is easy to understand and appreciate the connection with the tomb’s sloping passages and the descent to the cavern of Sokar.

These changes to the architectural and decorative schematics of tombs could not have taken place without an underlying change in ideology. Moreover they could not have taken place without a change in the way an ancient Egyptian viewed his relationship with...
the gods. The wish of the deceased to “go forth by day” becomes a dominant theme in the Ramesside tombs. More specifically, the deceased wished to return to four places: his tomb to receive offerings, his house to see his family, his garden to enjoy the shade of his trees, and to attend various feasts of the gods. In order to fulfill these wishes, it was necessary for the dead to return to earth in the form of his ba. The ba’s return satisfied the deceased’s desire for drink, food, light, air, company, to see the gods, and the ultimate goal of worshiping his gods.

Ramesside tombs allowed an easy interface between this world and the next as well as acting as a temple so that the ba would have a place where he could be close to and worship his gods—a theme which was carried over from the Amarna tombs. As was discussed earlier, Atenism held that the ba remained on earth, sleeping in the tomb at night and leaving by day to worship and receive offerings in the temple outside the tomb. It was always believed that the deceased was able to enjoy the proximity of the gods in the next world, but now the ba had the sacred space required to worship the gods within his tomb without crossing over.

Before the Amarna Period it was believed that the dead did not need to return to earth other than to partake of offerings (real or symbolic) left outside the false door. Gradually, the possibility of the ba returning to enjoy the comforts of life beyond what was waiting for them at the false door was conceived and the tomb architecture was changed accordingly. Images of the gods were portrayed freely throughout the tomb. It is for this reason that the courtyard of the temple outside the tomb. It was always believed that the deceased was able to enjoy the proximity of the gods in the next world, but now the ba had the sacred space required to worship the gods within his tomb without crossing over.

Architecture and decoration allowed the tomb to become more than just a place for the storage of human remains. The tomb became a space purposely designed and decorated to allow the deceased a certain degree of secrecy, memory, cult and passage. Beginning in the Amarna Period, the ba was given the freedom to extend itself beyond the false door. A person’s ba could leave his tomb in search of the sustenance it needed to survive as a “living ba.” By the Ramesside Period, the ba could leave the tomb in order to enjoy the comforts of life but the sacred space within the tomb provided the ba a place of his own to worship his gods. Changes in ideology meant that these evolving personal beliefs needed a place where they could be communicated in the realm of funerary beliefs. The tomb could now serve as a blank palette on which an individual could express his personal beliefs in an extraordinary display of piety (e.g., the tomb of Samut). By the time Samut constructed his tomb, previous architectural and decorative changes allowed him to create the new temple-tomb, a place where his ba could forever worship and be in the presence of his chosen god.

ENDNOTES
2. Ibid., 107.
5. Ibid., 106.
7. Ibid.
9. Ibid., 95.
16. Ibid., 49.
17. Ibid., 52.
18. Ibid., 51.
19. Ibid.
20. Ibid., 49.
21. Ibid.
22. Ibid., 52.
23. Ibid., 49.
25. Ibid.
30. Ibid., 36.
31. Ibid., 37.
32. Ibid.

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Ashleigh Goodwin obtained her MA in Egyptology from the University of Liverpool and her BA in Anthropology from the University of Arizona. She works with the University of Arizona Egyptian Expedition Tausert Temple Project in the mapping and surveying of Mortuary Temple of Queen Tausert on the West Bank at Luxor.
The University of Arizona Egyptian Expedition (UAEE) began excavation of the unfinished temple of Queen Tausert in Western Thebes in 2004. This article summarizes the third field season, conducted throughout May 2006.

The site of Tausert’s memorial temple was briefly examined by William Flinders Petrie in 1896, but our first two seasons’ work proved decisively that Petrie’s examination was far from complete and hardly thorough. Many of the areas we excavated were previously undisturbed and even areas which had apparently been probed by Petrie’s men produced large numbers of small artifacts, unknown features and valuable unrecorded information. Most telling, we discovered that the plan of the temple published by Petrie is inaccurate and does not properly record the layout of foundation trenches and surface units of the site.

In our 2006 season we moved westward into the inner part of the temple area, clearing a section approximately eight meters (26 ft.) wide all the way down to the gebel (bed rock) except where some features were left for preservation or further work.

We continued to find how incorrect Petrie’s published map of the site is. Examples of this have already been given in our previous reports and another example became apparent in our current season. Our excavation unit S21/22 was recorded by Petrie as being a single surface unit but our own work revealed that it is, in fact, two separate surface areas (intended to be rooms in the finished temple) divided by a foundation trench. The nearby surface unit S20 was also found to be much shorter than as mapped (or guessed) by Petrie.

Shallow plates with a wide red inner rim are abundant, as well as a wide variety of jars painted with blue, red and black bands on a cream background. Nu type offering jars found in association with foundation deposit pits have been mentioned in earlier reports. Fragments of one very large biconical jar which could be partially reconstructed exhibit a vibrantly colored floral motif reminiscent of the Blue Ware of the 18th Dynasty. The remains of this elaborately decorated vessel were found near the newly discovered foundation inscription discussed below and may possibly represent a vessel utilized in the temple’s foundation rituals.

Most importantly, our ceramicist stressed that well-dated ceramic assemblages of the late New Kingdom are very few in number, and the corpus from our own site is particularly valuable as it is from a sealed (foundation sand stratum) level which can be dated precisely by the foundation inscription. For this reason, every diagnostic sherd from the foundation sand level was recorded, drawn and described with special attention to its type and decoration.
The body sherds found with the diagnostic pieces were also sorted into silt, marl, and foreign wares, then counted and described.

A number of mud bricks with stamped cartouche impressions were also found in our third season and, while many of the impressions were partly or wholly illegible, some provided valuable information. Some bricks bear the throne name of Tausert, while others appear to have the cartouches of Merenptah and Tuthmosis IV. This seems to indicate that building materials from these earlier royal memorial temples (which are located to the immediate south and north, respectively, of our site) were used in the construction of Tausert's monument.

Other clues regarding the history of the site's development also emerged as the season progressed. In our 2005 season we discovered several relatively small patches of dekka or mud-gypsum flooring on weathered surface units on the north side of the temple courtyard, showing that construction had extended to this outer area of the temple. But in our current season, all the surface areas cleared on the north side of the temple had substantial areas of this flooring still extant, showing that the rooms of the inner area of the temple were doubtlessly fully “floored.” The fact that the inner area of the temple is better preserved than the outer area is particularly important in helping us reconstruct the temple's history.

While the foundation trenches of the temple's outer courtyard area had revealed only jumbled or broken remains of foundation blocks (apparently left by later rulers who had robbed most of these blocks for their own use), in our latest season's work we began to find whole foundation blocks in situ, carefully embedded on top of the foundation sand layer in the trenches entering the inner temple area.

One of these foundation blocks in our excavation unit TA13:5 (the nearer stone in Fig. 6) revealed an important hieratic inscription on its upper surface. The text is in two rows, of which the first is clearer than the second, but the inscription clearly seems to be a regnal date formula from Tausert's eighth year. The text was translated by Prof. Eugene Cruz-Uribe as follows:

First line:

HAt-sp 8 tpy Smw sw 24 (“regnal year eight, first month of summer, day 24”)

Second line:

tA h.t (?) an wAst (?) (“the temple ‘beautiful of Thebes...’”)
This text is immensely important for the history of the temple, not only because it dates artifacts and the site’s ceramic corpus quite precisely, but also because of what it suggests about the queen's reign as pharaoh. A temple for King Siptah had been constructed during the queen’s regency and it is somewhat unlikely that Tausert would have waited two years into her independent reign to begin work on her own temple. Having already ruled, to some extent, as Siptah’s regent for six years the queen had plenty of time to plan her monuments. The inscription suggests that Tausert could possibly have begun a small mud brick temple at the rear of the site early in her independent reign and then gone on to have foundations laid for a more extensive, stone-built structure later in her reign. In any event, the date of the inscription is close to the end of the queen's reign, which might also suggest that the dynastic change that replaced her may have occurred swiftly and perhaps even unexpectedly. These conjectures may be given more life as the inner part of the site is excavated, but for now this text is an important piece of new evidence for Tausert's temple.

While many mysteries remain regarding the life and reign of Tausert, excavation of her temple is producing puzzles of an architectural nature. Throughout the foundation trenches that we have excavated at the temple site, we have found small mud brick (in some cases mud brick and stone) walls spanning the trenches. These walls are of two distinct types, which we have called “Type A” and “Type B.” Type A walls are built up from the gebel at the base of the trenches and rise only as far as the layer of sand that was placed in the trenches to receive the foundation blocks, whereas Type B walls sit on top of the sand and typically rise part way toward the top of the trenches. Type B walls seem to be associated with foundation deposit pits as they are always found near them, but the purpose of both types of walls is not yet understood. It is possible that they were somehow utilized in stabilizing the sand in the trenches as building progressed, but walls such as these appear to be unknown in the other temples in the Theban area. Strangely, one intact wall found in unit TA11:15 during the 2006 season was built from the gebel base to the top of the foundation trench and fit neither type.

Our latest season’s work at the Tausert temple has built considerably on our previous seasons in many ways. Not only have we been able to expand the area of the site that is now properly surveyed and mapped but we have recovered a great number of artifacts and a great deal of information that would otherwise have remained unknown. Our work is leading to an increased understanding of the history of the temple and, ultimately, of the little-known queen who planned and began its construction. Considering the area of the temple that still remains to be excavated, it is expected that the project will require at least another three field seasons to

Fig. 5. Partially reconstructed biconical jar with elaborate floral decoration found in the proximity of a temple foundation text and possibly utilized in part of a foundation ritual. (Computerized illustration by L. Pinch-Brock.)

Fig. 6. Foundation blocks in situ in the inner temple’s foundation trenches. A regular building block may be seen on the rear foundation slab. (Photo: UAEE.)
complete. Because of the closeness of the road that runs along the west side of the temple site, at the base of Sheikh Abd el-Qurna, we had been concerned that some of the remains of the temple might lie under the embankment of the road. Our original calculations indicated that all of the site would be accessible to us, but a meter or two of the site may, in fact, lie under the embankment. If the Supreme Council of Antiquities carries out its proposed plan to move this road east to the edge of the cultivation, the westernmost edge of this temple—and a number of other temples in Western Thebes—will become fully accessible for investigation and recording.

ENDNOTES

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3. Our field staff for the 2006 season consisted of Richard Wilkinson (director), Richard Harwood (section supervisor), Damian Greenwell (section supervisor), Karin Kroenke (registrar and conservator), Rexine Hummel (ceramicist), Lyla Pinch-Brock (artist), Erin Nell (AutoCAD specialist), Ashleigh Goodwin (surveyor), Jennifer Harshman (database specialist and field assistant), Heather Kelly (field assistant) and Danielle Phelps (field assistant). Fifty-five Egyptian workmen were employed for the season.

4. Petrie’s work at the site of the Tausert Temple is recorded in his book *Temples at Thebes* (London: 1897), 13–16.

5. Our artifact log now has well over one thousand entries (many of them multiple-item) for the site. All the artifacts found during this and previous seasons were placed in storage in the SCA magazine on the Luxor West Bank (behind Carter House), and the most important of these items will be documented in our final site report.


Dr. Richard H. Wilkinson is a professor of Egyptian archaeology at the University of Arizona, the director of the University of Arizona Egyptian Expedition, and the author of a number of important books about Egyptology including *The Complete Gods and Goddesses of Ancient Egypt* and *The Complete Temples of Ancient Egypt.*
Members of the Egyptian Study Society and other readers of *The Ostracon* are well aware that ancient Egypt is often in the news. Hardly a week passes without a report of some new find of a tomb or other monument. Most of these discoveries occur along the Nile Valley or in the Delta, since that is where almost all of the cultivatable land is located, and hence where most of Egypt’s inhabitants have lived over the millennia. But occasionally something will turn up in a spot far from the Nile.

In the past decade, the Bahariya Oasis has been the site of several sensational discoveries.

In 1999, Dr. Zahi Hawass, Director General of the Supreme Council of Antiquities, announced the discovery of hundreds of “golden mummies” in a Greco-Roman cemetery in Bahariya. This created worldwide media frenzy and put the oasis on every Egyptologist’s radar screen. An article in the professional journal *Science* in 2001 made headlines only briefly but was equally dramatic for a certain segment of the scientific world. A team from the University of Pennsylvania working in Bahariya discovered bones of what was deemed the second largest dinosaur ever found.

After reading a popular account of the Pennsylvania team’s adventures, I decided to use an upcoming trip to Bahariya to learn more.

**BAHARIYA IN EGYPTIAN HISTORY**

Bahariya is one of several oases in the immense Western Desert that occupies nearly 2/3 of the land of Egypt (Fig. 1). The oasis is 212 miles southwest of Cairo and has an area of 700 square miles. All the western oases lie in depressions that have been hollowed out of the rocky plateau by wind or water, or some combination of these forces. The floors of the depressions are low enough that groundwater can be tapped by natural artesian wells or by pumping. The water represents a huge aquifer held in the stratum of Nubian sandstone. Unfortunately, this is “fossil water” that collected during wetter periods such as the Pleistocene epoch (1.8 million to ten
thousand years ago) and is not being replenished as fast as it is being withdrawn. In the past, Baharian wells could reach water at a depth of little more than 20 feet, but modern wells range from 2500 to 3500 feet, at which depth they encounter a highly permeable layer of the Nubian aquifer.4

Dynastic-era inscriptions from the Nile Valley mention the western oases, but none seems to apply specifically to Bahariya until the New Kingdom when Tuthmosis III appointed new governors there. During his reign, scenes of men carrying tribute from the oasis begin to appear in tombs of officials in Thebes. The earliest evidence in Bahariya of contact with the central government is a tomb from the end of the 18th Dynasty. More tombs and temples were built in 19th and 20th Dynasties. However, it was in the 26th Dynasty (730–663 BCE) that Bahariya saw its fortunes peak as indicated by a number of elaborate tombs of local officials. The Ptolemaic Period (332–30 BCE) brought another era of prosperity to the oasis. Also during the first two centuries of Roman rule, new wells were dug and much building took place (Fig. 2).

These cycles of boom and bust may have been the result of varying degrees of attention and contributions from the government in the Nile Valley. During times of prosperity, the oasis was connected by trade to the economy of the Valley, its chief exports being dates, olives, wine, and minerals. The Egyptian central government valued the western oases for more than just these products, however. They were important waypoints on the caravan routes, and they formed the first outposts against invaders from the desert.

Even more critical to the local Bahariya Oasis economy than support from the central government may have been the vagaries in the availability of irrigation water. Water in the oasis comes from natural springs, artesian wells, and man-made wells. In the past, it was common for a shallow well to produce for a while and then dry up. Sometimes this happened because another well was sunk that tapped the supply of an older one. Sometimes there was no clear reason.

Digging and maintaining wells, irrigation canals, and the unique underground distribution channels took a lot of effort. Widespread ruins throughout the oasis indicate that either the population was much greater at certain periods or that villages moved as different areas proved more suitable for cultivation.

The first reports of dynastic and other ruins in Bahariya came from explorers in the eighteenth and nineteenth centuries. However, in the late 1930s and early 1940s, Egyptian archaeologist Ahmed Fakhry was the first to conduct a professional study of the ruins of the oasis. After overcoming the suspicions of the oasis residents and offering to pay them for their labor, he began to get information that led him to many ancient sites.

Many of the tombs that Fakhry excavated had been dug into the walls of hills on the oasis floor; other tombs were reached by shafts sunk into the bedrock. Several of these were located beneath the modern town. A few of these tombs contained painted scenes reminiscent of those favored in the Nile Valley, albeit rendered with some local variations and a certain provincial quality (Fig. 3). Fakhry discovered that the sandstone blocks that had been used to build chapels above or outside the tombs had been taken by modern villagers for their own houses and walls. The same fate had befallen several ancient temples whose inscribed blocks were found in various modern structures.3 In spite of this reuse, remains of several temples, including one built in the 26th Dynasty and one dedicated to Alexander the Great, could be identified. Following Fakhry’s reports, the Egyptian antiquities service assumed responsibility for the ancient remains, but few inspectors were hired and excavations were not continued.

Beginning in 1993, Dr. Hawass headed a team to reexamine Fakhry’s 26th Dynasty tombs. They have discovered many more from the same period. Most were robbed in ancient times and were then reused for burials during the Roman era. The most serious damage to the tombs has occurred more recently, however. Modern houses have been built over the tombs, whether by chance or to permit residents to rifle them, and sewage from these homes is seeping into the tombs. Many of the houses have been removed in recent years, and the tombs have been conserved. A few such tombs are now open for visitors.

In 1996, the donkey of a guard at Alexander the Great’s temple wandered away and broke through a hole into an underground tomb. The Bahariya antiquities inspectors immediately notified Dr. Hawass at his headquarters in Giza. Hawass was occupied with other projects at that time so it was not until 1999 that he took a team to Bahariya for a three-week work season. By the end of their work, they had found 105 mummies in 5 tombs.6 Two more seasons brought the totals to 234 mummies from 11 tombs. At that point Hawass decided to stop the excavations, conserve those tombs already discovered, and then re-cover them. Six mummies were removed to the local museum in Bahariya for display and study. The rest remain in their original tombs.

The tombs were excavated into the bedrock in the form of halls with niches or benches along the walls. The mummies, most without coffins, had been placed on the benches in family groups. The tombs may have been used for many generations. The sandstone roofs of some of the tombs had collapsed, allowing the chambers to fill with sand. Although the rock falls caused some damage, the dry sand and absence of precipitation preserved the mummies. After studying the tomb structures and burial customs, Hawass has concluded that the burials occurred in the first century CE. The mummies differ in the quality of their burial preparations: some are wrapped in a few linen sheets, and some are wrapped with linen strips that form elaborate patterns, while others show lavish preparations with masks and breast plates made of cartonnage that were painted and gilded—the basis for the “golden mummies” designation.

Soundings in the area of these tombs suggest that similar tombs might be found over an area covering nearly four square miles. Hawass has estimated that there could be as many as 10,000 mummies, in hundreds of tombs. Such a huge cemetery must reflect a large population in the oasis during the Greco-Roman period. Although no estimate of the population can yet be offered, the richness of many of the burials shows that a prosperous upper class of merchants and landowners headed a diverse society.7

![Fig. 3. Scene in 26th Dynasty tomb of Bennentiu, Bahariya Oasis.](image)
The Bahariya Oasis is currently home to about 30,000 people. Most inhabitants make a living farming grains, fruits and vegetables as well as dates, their traditional cash crop. Other people serve an increasing number of tourists who are attracted by the desert scenery and the small number of archaeological sites now open for visitors. Although tourist amenities in the oasis cannot yet compete with those along the Nile, improvements are underway and the area retains a calm and simplicity that is very appealing. Since 1959, the oasis has been part of the ambitious New Valley Project, which is designed to tap the underground Nubian aquifer and attract residents from the Nile Valley. While conditions are improving, it is still uncertain how sustainable the development will be. Today about 20,000 acres (or less than 5% of the total area of the oasis) are irrigated. After the government digs another well, the current residents should be able to put an additional 30,000 acres into production.

Society in the oasis has waxed and waned throughout Coptic and Islamic times up to the present. Regardless of their level of prosperity, human residents of Bahariya of all eras would have seen a landscape much like the one we see today. While there have been more humid periods, no major changes in the geography of the oasis have occurred since man began to occupy it. But geologists tell us that, in the remote past, the area now occupied by the Bahariya Oasis frequently lay deep beneath the sea, while at other periods it lay on the shore of an ocean.

THE GEOLOGY OF THE BAHARIYA OASIS
The bedrock of the northern Western Desert is a layer cake of different rocks formed during many different times during the earth’s past. The table below lists the upper-most layers from the ground level down. Note that the younger rocks overlay the older ones, and that there are no rocks from the Paleocene epoch, 65–58 million years ago, in this particular region, either because conditions were not right for deposition of sediments or because these layers have since eroded away.

<table>
<thead>
<tr>
<th>ROCK TYPE</th>
<th>WHEN FORMED</th>
<th>AGE (in millions of years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limestone</td>
<td>Miocene</td>
<td>24–5</td>
</tr>
<tr>
<td>Conglomerate, volcanic rocks</td>
<td>Oligocene</td>
<td>37–24</td>
</tr>
<tr>
<td>(basalt and dolerite)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limestone</td>
<td>Eocene</td>
<td>58–37</td>
</tr>
<tr>
<td>Sandstone and shale</td>
<td>Cretaceous</td>
<td>144–65</td>
</tr>
</tbody>
</table>

Different kinds of stone are formed in different sedimentary environments. For example, limestones are primarily marine deposits formed either by the accumulation of shells, etc., from marine dwelling organisms or by precipitation of calcium carbonate from seawater. Fossils occurring in limestone are generally those of marine organisms since the rock forms beneath oceans. These oceans were formed in Egypt and the Middle East by repeated transgressions from the Tethys Sea (the precursor to the Mediterranean), which lay to the north of Egypt. The Miocene transgression did not extend as far south as those of the Eocene and Cretaceous. This means that on the Desert Road from Cairo to Bahariya, one first crosses a plateau of Miocene limestone. About halfway to the oasis this formation ceases and the road continues on an older Oligocene surface.

The Oligocene conglomerates contain gravel deposited by rivers flowing north from the rising mountains of the eastern desert towards the Tethys Sea or coastal lagoons. These rocks are often rich sources of terrestrial remains—both plants and animals.

Shale is a fine-grained rock formed from silt carried by rivers into still lagoons. It often contains a variety of terrestrial fossils and is easily eroded. Sandstone may form from water-deposited sand or from sand dunes that flank seashores. It can therefore contain
have debated for years about the processes that formed the desert bedrock, unless it has been covered by wind-blown sand. Geologists vegetation over much of the depression makes it easier to study the layers and expose a sequence of rocks in their walls. The absence of layer of rock. The desert depressions, however, penetrate through the pre-existing sedimentary rock, forming basalt and dolerite. These volcanic rocks, as well as some of the limestones and the sandstones in Bahariya, contain substantial amounts of iron-rich minerals that give the rocks a deep brown or black color.

While traveling across a plateau, one sees only the uppermost layer of rock. The desert depressions, however, penetrate through the layers and expose a sequence of rocks in their walls. The absence of vegetation over much of the depression makes it easier to study the bedrock, unless it has been covered by wind-blown sand. Geologists have debated for years about the processes that formed the desert depressions. Some favor wind ablation, others water erosion, and others some combination of these or other methods. Today in the oases, the wind blows fiercely, sand-blasting the rocks in its path, but rain is nearly unknown. The limestone capping the desert plateau weathers readily in warm wet climates, but it is relatively impervious in dry ones. But the depressions need not have formed under conditions like those prevailing today. In fact, much wetter periods are known from Egypt’s past, and the limestone cap may have been disrupted by tectonic forces.

There is evidence that, following the Cretaceous, the region of Bahariya was subject to strong compressive forces operating from the northwest and southeast that created an uplifted and elongated hump of rock oriented northeast to southwest. The hump was either above water or high enough to receive only thin layers of limestone during the Eocene. The old compression lines seem to have been the sites of later faulting and earth movements. These would have cracked the brittle limestones and allowed the erosion of the friable shale and sandstone beneath.

The rock layers revealed in the walls and floors of the western oases are much older than the human species, so the remains found in them are fossils rather than artifacts. The Fayum depression (Fig. 1) has long been famous for its fossils that include some of the earliest primates. These are found in the Oligocene strata formed about 30 million years ago, a time when birds and mammals were evolving into many forms to replace the dinosaurs. Because the Bahariya depression penetrates even deeper into older layers of rocks, the fossils in them potentially provide dramatic information about even earlier forms of life.

I had been to Bahariya on two previous occasions and visited its archaeological sites. The Lost Dinosaurs of Egypt stimulated my interest in returning to focus on its geological and other natural features. My traveling companions were Richard Harwood (Colorado Springs) along with Mohamed Shata and Morad Nasr (Cairo). As we made the five-hour drive from Cairo to Bahariya, I struggled to interpret the scenery according to the geology books I had read. But the changes from Miocene limestone to Oligocene conglomerate to Eocene limestone were too subtle to observe from the car.

Most of the desert surface is bare rock, carved into ridges by wind-blown sand. Sand pockets collect wherever the flow of sand is blocked by a bush or even a bit of trash. Eventually, on the western horizon, a “ridge” appears that gradually converges with the road. It turns out to be a huge sand dune many miles long but only a few hundred feet wide. This is just one of many such “seif” dunes, some of which can be seen on satellite photographs (Fig. 1). The dunes trend from northwest to southeast, parallel to the prevailing northwest winds.

The monotony of the scene is mostly broken by manmade objects. On the east side of the road is a railroad that carries ore from Egypt’s only operating iron mine, northeast of Bahariya, to the steel mills in Helwan, south of Cairo. Oil wells dot the blank plateau. This northern stretch of the Western Desert is one of the few oil-rich areas of the country and is second in production only to the Gulf of Suez. Halfway from Cairo to Bahariya is a simple but welcome rest house.

When we finally reached the depression that contains the Bahariya Oasis, we stopped briefly at the top of the escarpment. From there we got a good view of the north end of the depression about 300 feet below. We saw several villages and palm groves that mark the irrigated sections. The rest of the oasis is barren desert with many conical or flat-topped hills rising abruptly from the floor. The lowest point within the oasis is at the north end where irrigation run-off and excess water from the springs form a large lake. The road down into the oasis passes just to the west of Gebel Ghorabi, which is covered with brown, red, and yellow rocks containing a low grade of iron ore.

While the plateau surface is composed of Eocene limestone, the oasis escarpments and floor reveal the brown Cretaceous sandstone and shales that Stromer and Said called the Bahariya Formation. Although composed of sandstone and shale, most of the hills appear black because of a thin surface layer of basalt or blackish quartz-
Black rock fragments litter the floor and, along with the black hills, produce a gloomy landscape that earns its name of the Black Desert (Fig. 4).

We were eager to examine the volcanic rock layer found on three large hills at the north end of the depression. We chose to visit Gebel Mayesra, known locally as Black Mountain or English Mountain. A road ascends nearly to its top, and the top and slopes of this hill are thickly covered with shattered pieces of dolerite. The residents of the oasis apparently do not use rock for building or any other purpose. However, during World War I, an Englishman, Captain Williams, built a house of this material on the top of the mountain from which he kept watch for possible troops coming from Libya (Fig. 5).

Descending from the top of Black Mountain, our 4WD nearly fell into a large open shaft on the lower slope. It turned out to be a Roman well about 30 feet deep that the SCA had recently cleared. Ball and Beadnell reported that some Roman aqueducts were still in use around 1900.

Another hill that attracted our attention was Gebel el-Dist or the "hill of the pot" (Fig. 6). It is a conical hill, 560 feet high, with a tiny cap of Eocene limestone. In an eroding hill like this one, the softer layers, particularly shales, erode easily, forming slopes of fine debris. Harder stones such as certain limestones and sandstones are more resistant and stand out as protruding layers with vertical faces. Its geological significance lies in the fact that it provides an excellent display of the entire sequence of strata of the Bahariya Formation. The rocks around the base of Gebel el-Dist were formed around 100 million years ago. This is the stratum in which Stromer, as well as Simons and Rasmussen 1990; Kamil 2004.

As we drove and walked around the oasis, we studied the incredible diversity of rocks on the desert floor. None of us was competent to distinguish fossil bones from stones, but we all kept looking. It certainly gave us new respect for the skills of the paleontologists. We did recognize the fairly fresh skeleton of a camel (Fig. 7). The bones were strewn over a wide area—a common occurrence when scavengers dismember a dead body before sediments can cover it. These bones will probably never become fossils, since the present conditions are not suitable for their burial and lithification.

END OF THE TRAIL: THE EGYPTIAN GEOLOGICAL MUSEUM IN CAIRO

As Nothdurft explained in *The Lost Dinosaurs of Egypt*, Josh Smith and his colleagues took some of the dinosaur fossils back to Philadelphia for the lengthy and tedious process of removing them from their plaster casings and for analysis. By 2004, the Cairo newspaper *Al Ahram* reported that the bones had been returned to the Egyptian Geological Museum in Cairo. The museum is the repository of rock samples and fossils from geological surveys throughout the country. Among the fossils on display are many from the Fayum, and these include examples of primitive elephants, whales, primates, reptiles, and turtles. After I returned from Bahariya, I went to the museum to see the fossils and to meet Medhat Said Abd el-Ghany, one of the Egyptian geologists who accompanied the Pennsylvania expedition in 2000 (Fig. 8).

The enormous *Paralititan stromeri* fossils are well displayed in the museum. The famous humerus was not the only bone found, but since the skeleton had been scavenged many bones were missing. The team unearthed parts of a second humerus, two scapulae, fragments of radius and ulna, a couple of pieces of ribs, a piece of ischium (hip bone), and three caudal (tail) vertebrae, each as big as a basketball.

The exhibition of these dinosaur fossils in the museum in Cairo makes them accessible to a much broader public, including thousands of Egyptian school children, than if they were housed in a site in Bahariya. For me, however, the thrill of standing on the spot where these bones had been buried for 100 million years made the long trip to the oasis worthwhile. Standing on the rocky desert floor, surrounded by towering cliffs of Late Cretaceous and Eocene rock, it was hard to imagine the scene as an ocean shore with waves lapping gently at groves of mangrove trees. No birds would have been singing or flying overhead. Instead, the ground would have shaken with the tread of gigantic feet while the lonely cry of a dying *Paralititan* dinosaur rang out.

ENDNOTES

5. Sandstone is readily available in quarries around the oasis, but it was always easier for the inhabitants to reuse blocks from pre-existing structures than to quarry new ones.
8. A number of published tour guides describe the sites accessible in the oasis. Vivian 2000 is one of the best, along with other references by Fakhry and Hawass listed in the bibliography.
9. Personal communication from M. Ayieda.
10. Sampsell 2003 provides an overview of Egyptian geology and relevant geological concepts. Said 1962 and 1990 are the ultimate resources on this topic.
12. Basalt and dolerite have the same mineral composition, but basalt is extruded onto the surface of the ground. It cools quickly and has small crystals. Dolerite cools underground and has larger crystals. This distinction becomes moot when an intruded mass of dolerite is exposed by the erosion of overlying rock.
15. *Seif* is the Arabic word for “sword.”
16. Hussein 1990, 551. The only other iron mine in Egypt, at Aswan, is not being worked at this time.
18. The date of the volcanic rock is likely Oligocene. Ball and Beadnell (1903) hypothesized that the ferruginous sandstone was produced in a shallow lake possibly during the Oligocene as well. This material was very resistant to erosion and removal by wind, thus it remained on the surface as the depression was later eroded to its present depth (Ball and Beadnell 1903, 61–62). The minable iron ore deposits northeast of the oasis were prob-
ably formed at this same time, but the exact mechanism is still disputed (Hussein 1990, 551–2).

19. Ball and Beadnell 1903, 76. Fakhry (2003, 34) also mentions these underground galleries and suggests that some of them predate the Romans.


REFERENCES


Dr. Bonnie M. Sampsell is a long-time member of the ESS and a frequent contributor to The Ostracon. Her book A Traveler’s Guide to the Geology of Egypt was published by the American University in Cairo Press in 2003. A retired professor and frequent traveler to Egypt, Dr. Sampsell lives in North Carolina.

House of Scrolls

The Lost Dinosaurs of Egypt by William Nothdurft and Josh Smith et al.


Scientific discoveries often make dramatic headlines. So it was in June 2001 when major American newspapers including the New York Times, Washington Post, and Los Angeles Times proclaimed the discovery of the bones of the second largest dinosaur ever found. It was unearthed by a team from the University of Pennsylvania in the Bahariya Oasis, a remote area of Egypt’s Western Desert. The team’s report in the professional literature was considerably less lurid than these news accounts. But with the cooperation of Josh Smith and other members of the Pennsylvania expedition, science writer William Nothdurft has produced a highly readable account of the discovery with vivid details of what goes on behind the scenes on a scientific expedition.

Fossils of many extinct creatures, including dinosaurs, were found in Bahariya by the German paleontologist Ernst Stromer in 1911. Unfortunately, his fossils were completely destroyed when the Allies bombed Munich during World War II. The Alte Akademie, home of the Bavarian State Collection of Paleontology and Historical Geology, was an unintended target during a raid on the nearby railway station. Graduate student Josh Smith and the team he recruited set out to search for more fossils like Stromer’s. Nothdurft searched the historical records to learn the details of Stromer’s work, and he skillfully weaves the older story together with the recent one.

As Nothdurft describes the work of Stromer in the early 1900s and the Pennsylvanians almost a century later, we learn that some
things have changed a lot in the way that fossil hunters go about their business. Today travel is by 4WD jeeps over paved roads instead of by walking or camel caravans across the unmarked desert. Maps and GPS provide precise means of locating sites. Teams are composed of a variety of specialists instead of a single excavator with his dragoman.

Some things do not change, however. Paleontologists still rely a lot on luck in searching for fossils, they excavate with dental picks and brushes, and they jacket the bones with plaster and burlap. Above all, they still have to deal with problems of adequate funding and many levels of government bureaucracy. Nothdurft's descriptions of these challenges indicate that a lot of creativity and patience are essential skills for any fossil hunter. He also shows how the worlds of science and politics interact.

In the early 20th century, Ernst Stromer had decided to specialize in the paleontology of the Western Desert. For three decades at the end of the 19th century another German, Georg Schweinfurth, had been locating vertebrate fossils in the Fayum and Wadi Natrun that were helping scientists decipher the evolution of mammals. Stromer was eager to add to their knowledge and sought even older forms that might be revealed in Bahariya, an area he knew had exposures of older rocks.

In 1911, Stromer journeyed for six days by camel and on foot from the Fayum across the desert to Bahariya. Enduring numerous hardships, he spent less than two weeks in the oasis itself. But during that time, he managed to find a large variety of fossils and carried eight crates of them home to Germany.

Stromer hired Richard Markgraf, a professional fossil hunter, to continue collecting for him at Bahariya. Markgraf sent one large shipment to Europe in 1912 but another—consisting of twelve cases—got caught in the increasing chaos of the First World War. Fortunately, British friends of Stromer's stored the crates in Cairo and finally, in 1922, they managed to ship the crates to Munich. From these bones, Stromer was able to reconstruct a large number of different marine reptiles such as crocodilians, turtles, and plesiosaurs that lived about 100 million years ago. He also identified several new species of dinosaurs. He published his results in several illustrated monographs that turned out to be the only traces of his collection after the bombs fell in 1944.

Josh Smith and his colleagues were familiar with Stromer's work and the fate of his collection. Paleontologists had continued to mine the productive cliffs of the Faiyum, but no one had wanted or been able to return to Bahariya. Smith decided to make that his goal. Nothdurft describes the myriad preparations leading up to the team's expedition and their efforts to find the money necessary for the project. Even though Smith knew the general areas in which Stromer and Markgraf had collected their specimens, at first he had trouble locating the places. Then he got lucky.

Searching for fossils depends on luck and a well-trained eye. Fossilized bones of large animals are generally broken into pieces, and those of a single animal may be distributed over a wide area. Bone exposed by erosion is quickly weathered into a dark, fragile lump. It takes much experience to be able to look at such a lump and recognize that it was once bone, let alone to identify the bone and the animal from which it came. Fortunately the University of Pennsylvania team included people with just such expertise.

Their technique was to search the oasis floor for exposed bones that were still partially buried. Then the remainder of the bone could be excavated, stabilized, jacketed, and removed from the ground. Their most important find turned out to be a huge bone: the humerus (or upper forelimb) of a dinosaur. Because the team had been authorized through the Egyptian Geological Survey and Mining Authority (now named the Egyptian Mineral Resource Authority), they had received permission to take some of the bones back to Philadelphia for preparation and study. Such permission contrasts with the some of the current rules in effect for archaeologists working through the Supreme Council of Antiquities. All archeological artifacts are the possession of the Egyptian government and must stay in Egypt for their study and conservation. The Pennsylvania scientists received considerable assistance from the EGSMA and included three Egyptian geologists on its expedition.

The Pennsylvania team concluded that their gigantic bone came from a sauropod dinosaur, a type characterized by a small head, long neck, bulky body, and long tail. It walked on four massive legs and was a herbivore. From the size of the humerus, they estimated the animal's size at 80 feet in length and from 65 to 70 tons in weight. By contrast, Stromer's dinosaur fossils had been mostly from species of theropods—small, fast-moving carnivores that walked on their hind legs. The new dinosaur discovery answered a question that had lingered since Stromer's work: what had all those carnivores been eating? Since none of the Pennsylvania finds duplicated dinosaur species identified by Stromer, it indicated that there were a large variety of dinosaurs co-existing in this spot. Smith's team named their new dinosaur species *Paralititan stromeri* or “Stromer's tidal giant.”

The discovery of additional fossils in Bahariya not only adds to our knowledge about the variety of animals that existed in the past and the evolution of existing species, but also tells us about the ancient environments. Comparing the habitats of currently living forms, we can determine in what sort of environment a particular animal lived. Evidence about environments can also come from direct geological study of rocks and other kinds of fossils—especially the assemblage of small fossils that are much more abundant than the remains of large animals.

The Pennsylvania team included two geologists, one of whom was an expert in the environments that would have produced the sandstones and shales found in the oasis. At first they were puzzled by the succession of sands and muds, an arrangement slightly different from what one would expect from a typical seashore. But the geologists realized that this succession was characteristic of a modern environment they had studied before: the mangrove swamps of the Florida Everglades. This provided a clearer picture of the Bahariya Oasis 100 million years ago. It was not the depression in an arid desert that we see today; it was the lush shore of an ocean teaming with many kinds of reptiles. The shore was inhabited by a variety of dinosaurs, some feeding peacefully on swamp plants while others preyed on their giant neighbors.

In addition to telling the story of this particular expedition, Nothdurft has included a great deal of background information on the geology of Egypt, the changes in the landscape over millions of years, and the processes by which fossils are formed. He skillfully makes all of this intelligible and fascinating. This book will give the reader a good idea of how a scientific expedition works in the field—especially in a location a long way from urban comforts. It describes how scientists choose their professions and what excites them. It gives examples of the rewards and difficulties of a scientific career. This is a terrific book for any reader—young or old—who ever dreamed of digging for dinosaurs.

Bonnie M. Sampell