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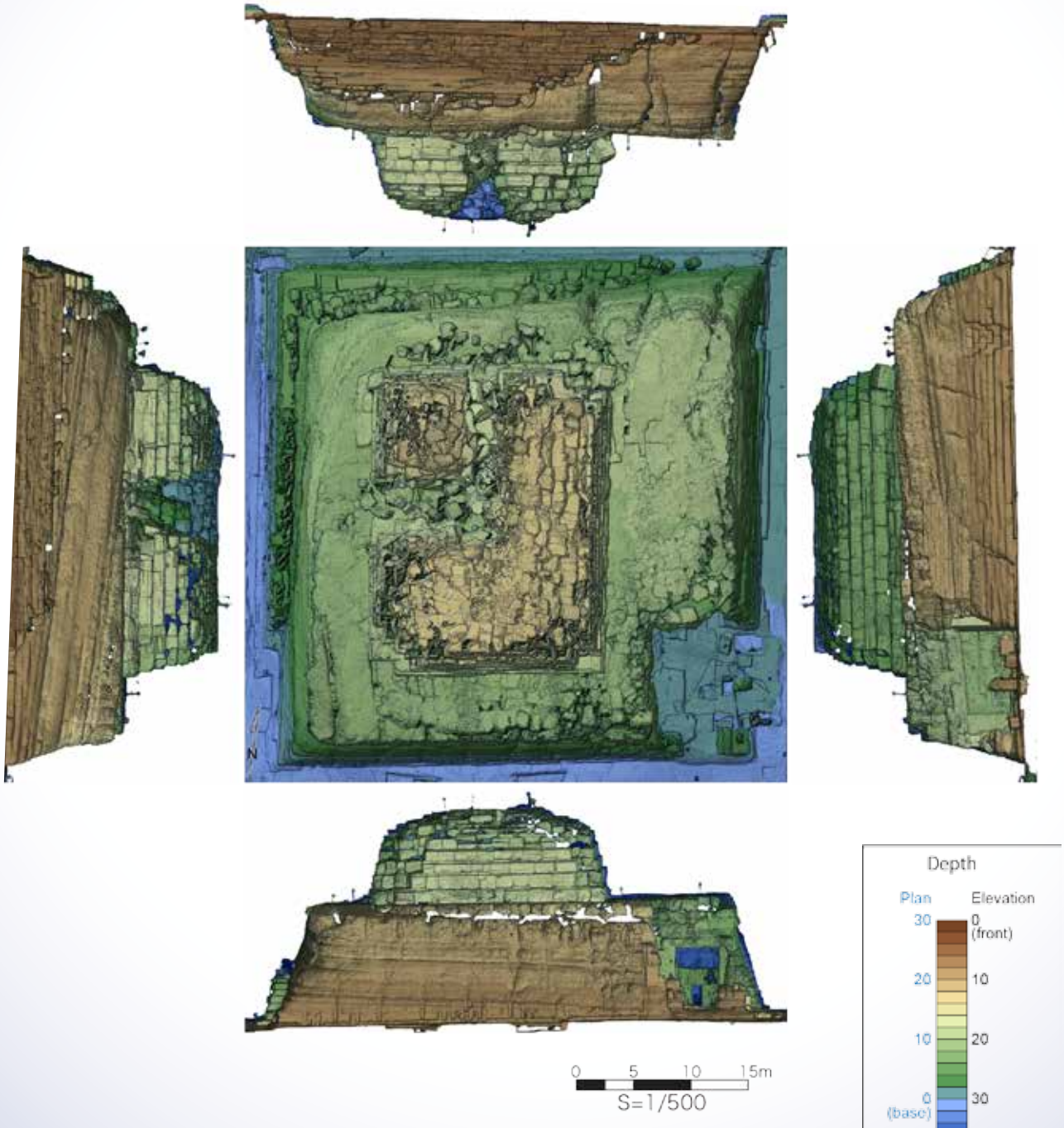
PEAKIT: The Future of Archaeological Mapping?

Learn how this new technology created these images of Queen Khentkawes's tomb at Giza on page 2.



"PEAKIT" Punches Up 3D Laser Scanning, Adds Accurate Surface Relief *by Yukinori Kawae*

Working with a Japanese consortium in 2006, Yukinori Kawae ushered in a new era of mapping on the Giza Plateau. His team, using a new laser scanning technology, mapped the funerary monument of Queen Khentkawes[1] in three dimensions.[2] Like conventional hand-mapping, laser scanning takes the coordinates and elevation of points on its target subject to create a map. But the similarities end there. Laser scanning is far more precise and incomparably faster than hand-drawing. Using infrared signals, laser scanning gathers data from millions of points—at Khentkawes, 287,975,386 points. And it amasses the data at the astounding rate of 10,000 points per second. The data is usually displayed as a "point cloud," an image that looks like a photo, but is in fact an extremely detailed, accurate representation of the subject made of millions of points. In producing the image, laser scanning provides minimal interpretation of the data; it "capture sites as they really are: monuments, strata, traces of erosion, modern activity, and even wind-blown sand."[3] But the point cloud images are not adequate for all the analyses that archaeologists usually do. Yuki explains here the shortcomings and the approach that he and his Japanese colleagues are now using to make 3D laser scanning an even more valuable mapping technology and tool for analysis.

Since 2006, AERA has taken the initiative in conducting 3D laser scanning in Egyptian archaeology. In addition to the funerary monument of Queen Khentkawes, shown below, we have completed comprehensive surveys of the Workers' Cemetery located adjacent to the Lost City of the Pyramids (Heit el-Ghurab site) and the Djoser Step Pyramid at Saqqara.[3]

3D laser scanning offers many advantages over conventional hand-mapping, but the resulting image—the "point cloud"—has limitations for analytical work. 3D data are presented as point clouds either with color information or as a surface model with pseudo shading. Both display methods enable us to get an intuitive understanding of the surface shape of objects, as can be seen in the image of the Khentkawes Monument on the facing page. But, they are not the most suitable displays for archaeological analysis. Particularly, when we produce orthophotographic[4] point-cloud plans and elevations, these images do not indicate the undulation structure—ridges and valleys—which is important for understanding the shapes of archaeological materials. Furthermore, even though the original data contain 3D information, point cloud images can represent only two-dimensional information by their nature.

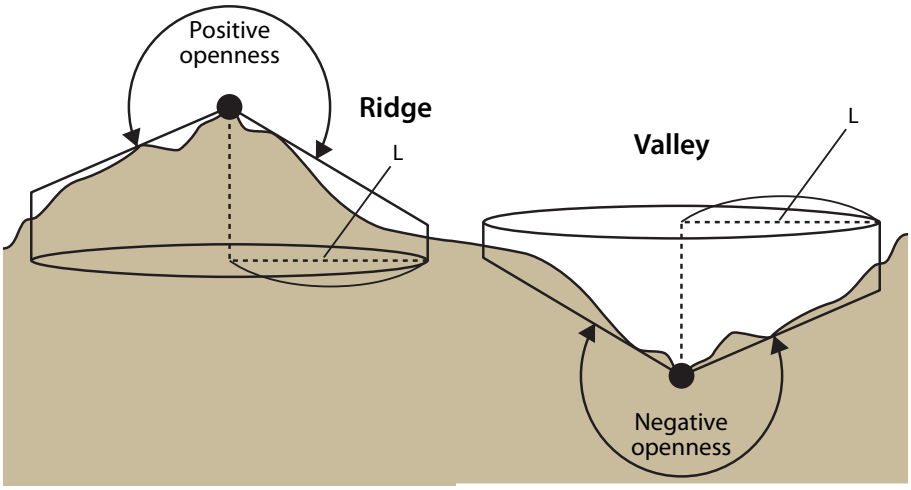
To overcome this problem of not being able to display undulations, we adopted a new method called "PEAKIT." Developed by LANG CO., LTD. (Iwate, Japan) for 3D data display, it will allow us to carry out more analytical studies of the tomb of Khentkawes. The detailed and accurate information on undulations displayed through PEAKIT allow for a quantitative and reproducible approach to the study of a monument.

What Is PEAKIT?

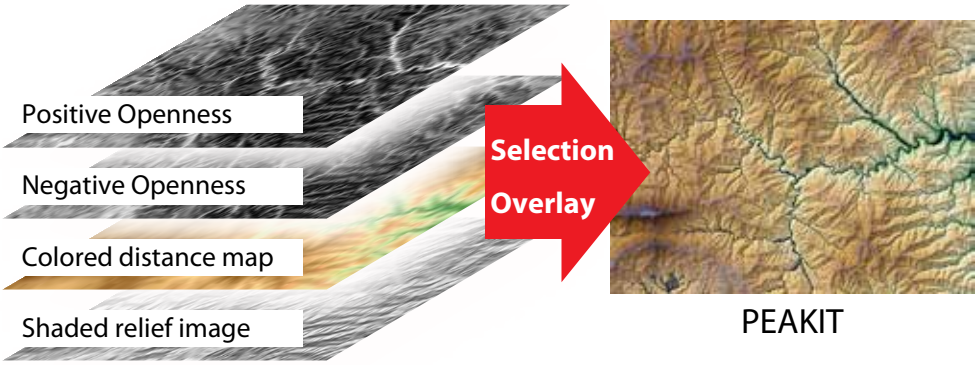
PEAKIT was originally developed using "openness" for defining the undulation structure of an object, borrowing the concept from the field of topography. Openness measures the angle between the surface relief and the horizontal plane. Positive

1. Khentkawes of Giza, a 4th Dynasty queen, is sometimes referred to as Khentkawes I to distinguish her from a 5th Dynasty queen also called Khentkawes who is buried at Abusir.
2. The first AERA laser scanning project is described in "Mapping Khentkawes," *AERAGRAM* 8-2, Fall 2007, pages 10–12. Available for free download at our website, aeraweb.org.
3. Kawae, Y., K. Sato, H. Kamei, T. Nakano, and I. Kanaya. "Saqqara Laser Scanning Survey 2009." In *Giza Plateau Mapping Project Season 2008, Preliminary Report*, *Giza Occasional Papers 4*, pages 63–71. Boston: Ancient Egypt Research Associates, 2009. Available for free download at aeraweb.org.
4. An orthophoto is an aerial photograph that has been corrected for distortion so that the scale is uniform across the whole.

The mastaba-like funerary monument of Queen Khentkawes, flanked by the pyramids of Khafre (left) and Khufu. View to the northwest. Photo by Yukinori Kawae.



Openness measures the angle between the surface relief and the horizontal plane over a distance L. Positive values measure ridges; negative values, valleys.



PEAKIT overlays multiple images that were created by calculating digital elevation models: positive and negative openness, a colored distance map, and a shaded relief image.

values express openness above the surface, in other words, ridges. Negative values describe this attribute below the surface, that is, valleys. These negative and positive values are mapped with gray-scale tones: white representing the highest openness value, black, the greatest negative value.

PEAKIT now incorporates other features as well that enhance the visibility of the point clouds. One of the most useful is a Colored Distance Map (CDM): a digital image that uses color to express distances. The color of the points in a CDM indicate how far a point is from an arbitrary plane. A warmer color means a shorter distance from a reader's viewpoint and a cooler color, a longer distance. The CDM makes it possible to add 3D information to 2D display by coloring a point cloud with predefined colors.

PEAKIT selectively overlays multiple images created by calculating digital elevation models (or DEM), such as openness, a shaded relief image, or a Colored Distance Map. Each of the images created by DEM has strengths and limitations, but overall, the features of the scanned objects are understandable by overlaying these multiple images.

PEAKITxKhentkawes

When archaeologists draw artifacts such as stone tools or potsherds, they usually focus on the structure of ridge lines on the surfaces. For analyses of such artifacts, it is effective to combine a shaded relief image and a positive openness image.

When archaeologists draw a building consisting of multiple components, both ridge and valley structure lines are generally shown. In addition, since buildings are constructed with horizontal and perpendicular orientations, contour is sometimes drawn with structure lines—similar to contour lines used to represent relief in the landscape. These lines show the positional relationship between the ground and the building; that is, distance from the ground. Given that archaeologists use all of this informa-

An orthophotographic point cloud image of the south face of Queen Khentkawes's funerary monument, prepared by the Giza Laser Scanning team in 2006. Compare this with the photo of the monument on the facing page.

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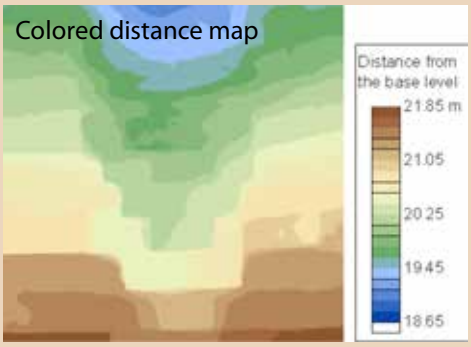
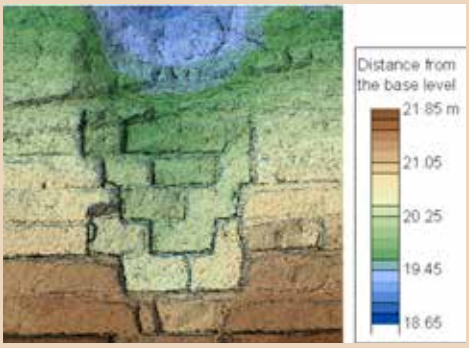


= PEAKIT image of recess on the east side



The PEAKIT images of the Khentkawes Monument on the cover combine four images that each represent relief in a different way. Shown here is a recess on the east side of the monument. The last figure, with the four images overlaid presents the "undulation structure" of the monument accurately, and can be used in analyzing the monument.

Yukinori Kawae at Saqqara during the Saqqara Laser Scanning Survey in 2008. The Step Pyramid, the target of the survey, stands in the background. Photo by Manami Yahata.

tion to map buildings, we concluded that all the DEM information (shaded relief image, positive and negative openness, and Colored Distance Map) must be overlaid in order to provide the necessary information for analyzing the funerary monument of Queen Khentkawes. The resulting PEAKIT image is shown on the cover, and the components of the image, on the left.

Raw Data in Archaeology: The Future

Primary data in archaeology consists of the archaeological remains themselves, of course. But research reports, including line-drawing plans and sections, are also considered raw data. However, they are, in fact, archaeologists' interpretations.

In the future, with the widespread adoption of 3D surveys in archaeology, these 2D line drawing would no longer be considered raw data. Instead, 3D point cloud data—archaeological remains presented as they *really* are—would become accepted as *the* raw data.

Each archaeological project would undoubtedly develop its own way of presenting 3D displays, just as they have established their own standards and conventions for line-drawing. The Giza Plateau Mapping Project, for example, developed its own recording system based on the well-established Museum of London Archaeological Service (MOLA) system.

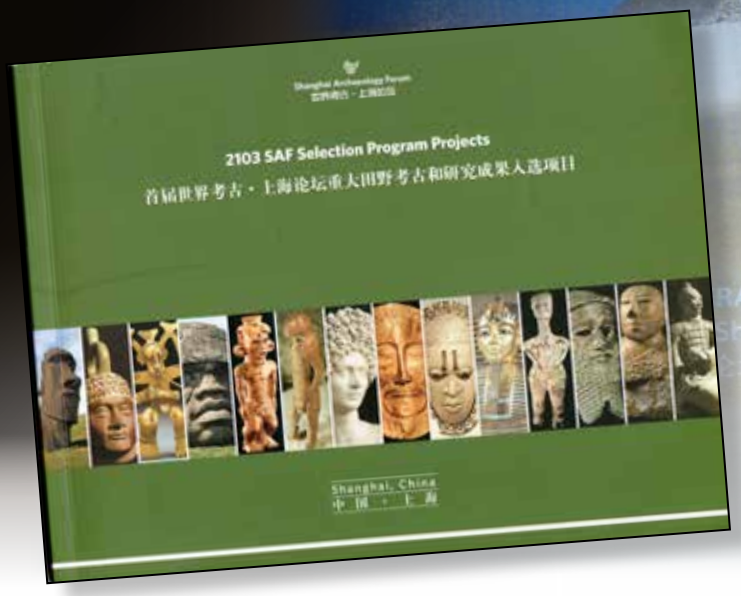
Our new 3D display method generated with PEAKIT could possibly become the mainstream of archaeological recording.

The PEAKITxKhentkawes project was carried out by Dr. Fumito Chiba, technology development manager of LANG CO., LTD., Shin Yokoyama, president of LANG CO., LTD., Dr. Ichiroh Kanaya from Osaka University and the author. A longer article about this work by Fumito Chiba, Shin Yokoyama, Ichiroh Kanaya, and Yukinori Kawae will appear in the forthcoming *Giza Occasional Papers 6*, published by AERA.

AERA Honored at the Shanghai Archaeology Forum:

Lost City of the Pyramids - 1 of 10 Major Field Discoveries in the World

Mark Lehner presents "In Search of the Pyramid Settlements: Archaeology of Everyday Life at Giza" at the Shanghai Archaeology Forum. Photo by Francis Dilks.



Booklet describing projects selected by the 2013 SAF, in English and Chinese.

In August, AERA President Mark Lehner traveled to Shanghai, China, to receive an award for AERA's Lost City of the Pyramids excavations at the inaugural session of the Shanghai Archaeology Forum (SAF), August 23–27, 2013.

AERA's work was chosen through a rigorous selection process. A committee of 40 eminent archaeologists representing different regions of the world first assessed 99 nominations for major field discoveries and major archaeological research findings. Their assessments were then reviewed by a group of highly respected archaeologists from the Institute of Archaeology at the Chinese Academy of Social Sciences and Peking University. They short-listed 40 nominations (20 for each category), from which 10 finalists were chosen. AERA's excavation and survey of the Lost City of the Pyramids, and AERA's broader research into the settlements at Giza, made the final list of ten for major field discovery. We are thrilled with the recognition and delighted that our work met the stringent criteria set forth by the SAF, shown in the box on the far right.

Professor Wang Wei, Director of the Institute of Archaeology at the Chinese Academy of Social Sciences, leads the SAF and introduced the inaugural session, themed the comparative archaeology of ancient civilizations. He wrote in the program booklet:

> SAF members and friends are gathering here together for the first time out of our passion for the past and commitment to archaeology. It is our objective to learn from each other and to learn from the past, so that we can better understand the present and that we are better prepared for the future.

It was a "stimulating and rewarding" program, as Professor Wei predicted, with keynote and public archaeology lectures and 30-minute presentations given by all the nominees.

Attended by 180 delegates, about half from China and half from countries across the world, the SAF was made possible by the Chinese Academy of Social Sciences and the Shanghai Municipal Government.

"The SAF Selection Program recognizes individuals and organizations that have achieved distinction in innovative, creative, and rigorous works, and generated new knowledge about our human past, which has significant relevance to the contemporary world and our common future."

Hanan Mahmoud (left) and Lisa Yeomans excavate the silos in House E in the Khentkawes Town, Giza. View to the west. Inset: the ash layer they found under the silos. Light virgin soil lies underneath the ash. The insects from left to right: the red flour beetle, the grain weevil, and the lesser grain borer. Not actual size. Photos by Mark Lehner.

An Ancient Egyptian Insect Repellent by Claire Malleson

Claire Malleson, Director of Archaeological Science and AERA archaeobotanist, spent the AERA 2013 study season identifying, counting, and recording over 57,000 individual charred seeds and plant parts from excavations in House E, a priest's home at Khentkawes Town on the Giza Plateau. Here she discusses how the residents tried to protect their household grain stores from pests.

Insect pests must have threatened the cereals stored in ancient Egypt's communal grain silos and household granaries. Nowadays granaries without the protection of insecticides lose 5% to 40%—sometimes even 100%—of their stock to granary weevil (*Sitophilus granarius*) larvae, hatched from eggs laid inside cereal kernels. The sawtoothed grain beetle (*Oryzaephilus surinamensis*), the lesser grain borer (*Rhyzopertha dominica*), and the red flour beetle (*Tribolium castaneum*) also feed on stored grain.

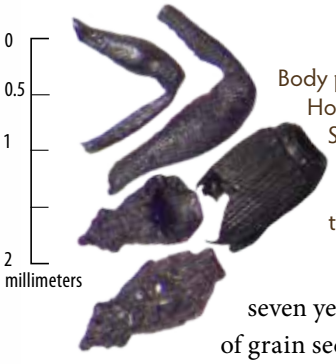
Remnants of these four pests, and others, have been found in Egyptian archaeological sites, such as the House of Ranefer at Amarna, dating to the 18th Dynasty, which also contained charred barley showing insect damage.[1] One of the oldest grain weevil specimens in Egypt was found with cereals in Djoser's Tomb in the Step Pyramid at Saqqara, dating to the 3rd Dynasty.[2] Other examples of cereal storage pests are scattered throughout ancient Egypt's archaeological record from the Old Kingdom through Greco-Roman times. The large 4th Dynasty granaries we excavated in House E of the Khentkawes Town must certainly have been under attack in their heyday.

Protecting the Grain Stores in House E

How did the residents of House E protect their food stores? Lisa Yeomans and Hanan Mahmoud found a probable answer when they discovered a thick layer of ash beneath the granaries during their 2009 excavations.[3] Since there were no signs of burning *in-situ*, they concluded that the ash was laid down on purpose during construction, probably to deter insects.

Ash and fine dust have been used widely in traditional and ancient societies as an insecticide. In the Workmen's Village at Amarna excavators found a layer of loose ash under quern stones used to grind cereals, apparently intended to inhibit insect pests.[4] The medical treatise the *Ebers Papyrus* recommended burnt gazelle dung to control what was probably the grain weevil.[5] The Biblical story of Joseph recounts how he averted

1. Panagiotakopulu, E., P. C. Buckland, and B. J. Kemp, "Underneath Ranefer's floors – urban environments on the desert edge," *Journal of Archaeological Science* 37, pages 474–481, 2010.
2. Solomon, M. E., "Archaeological Records of Storage Pests: Egyptian Pyramid Tomb," *Journal of Stored Product Research* 1, pages 105–107, 1965.
3. Yeomans, L. and H. Mahmoud, "KKT-N: Building E and the Adjacent Khentkawes Causeway," *Giza Plateau Mapping Project Season 2009, Preliminary Report. Giza Occasional Papers* 5, page 49, 2011.
4. Miller, R., Appendix. "Ash as an insecticide," In Kemp, B. J., ed., *Amarna Reports IV*. Egypt Exploration Society, London, pages 14–16, 1987.
5. Panagiotakopulu, E., P. C. Buckland, P. Day, A., Sarpaki, and C. Doumas, "Natural Insecticides and Insect Repellents in Antiquity: A Review of the Evidence," *Journal of Archaeological Science* 22, page 6, 1995.



Body parts that were found in the ash under the House E silos resemble those of grain weevils. Since they are not carbonized, the insects presumably died after ending up under the silos, perhaps killed as they tried to burrow through the ash. Photo by Claire Malleson.

seven years of famine by storing vast quantities of grain securely. "He mixed dust of dry soil and ashes (burnt straw) and added this to the stored grain ears," and so prevented insect infestations, according to one translation of the Hebrew interpretation of *Genesis*, the *Sepher Hayasher*.[6]

Special Ingredients in the Insecticidal Ash?

Ash works as an insecticide by abrading the waxy epicuticle of the insect's exoskeleton and absorbing moisture, causing desiccation and death. But laboratory studies have established that some plant ashes are more effective than others.[7] Thus I wondered if the Egyptians selected any particular plants for the ashes they used under the silos? No one has looked at the contents of ash found at other sites to see if this was the case, but my work on House E plants presented an opportunity to be the first.

I identified all the material in the silo ash and found a mixture of spent fuel—cereal processing by-products and wood charcoal—with charred straw added, probably used to bulk up this foundation material.[8] Since I had also analyzed samples from features inside House E, I was able to determine that the spent fuel came from a bakery in the house when the silos were built as part of a remodeling project.

Among the silo ashes were three plant materials that have been shown through laboratory studies to be effective insect repellents as extracts: roots (rhizomes) of joined flatsedge (*Cyperus articulatus*), seeds of bishop's weed (*Trachyspermum ammi*), and the leaves of dented dock (*Rumex dentatus*). Were these three plants tossed in as special additives?

Looking to my samples from features inside House E for comparison, I found that they also contained the insecticidal plants. Dented dock, a very common weed in ancient Egypt, turned up in almost every sample. Jointed flatsedge seeds appeared in a hearth. Many sedge rhizomes—which cannot be identified to species—were scattered through a few house samples, while Bishop's weed seeds were in the bakery ash (see map right). Thus it seems, so far, that the silo builders were not using specific additives, but we hope to have a new sample to compare soon.

Did the Insecticidal Ash Work?

Insect thoraxes, abdomens, and legs resembling anatomical parts of granary weevils turned up in my silo samples. They had not been charred, so the critters to which they once belonged must have died trying to make their way through the ash. The insecticide apparently worked!

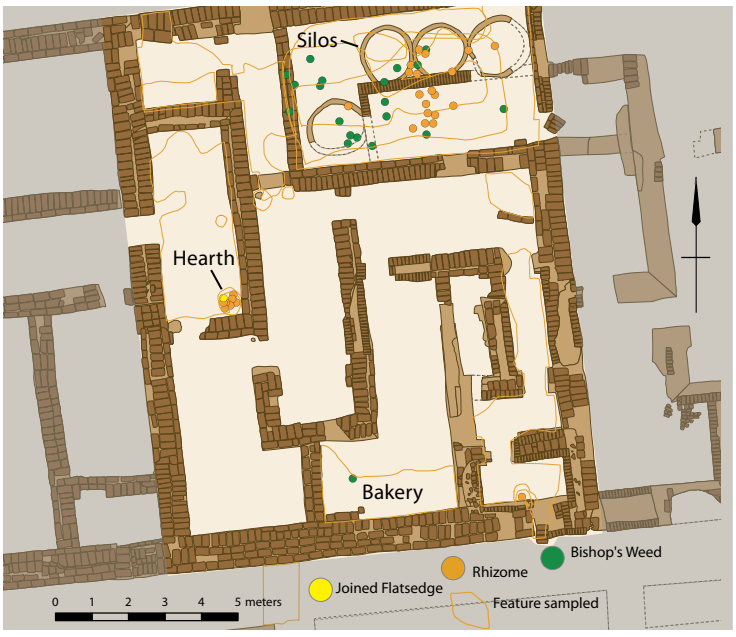
But did it protect the contents of the silos? Probably only to the extent that it stopped insects trying to penetrate these granaries from the ground. We know from many accounts of insecticidal ashes and dusts used in traditional societies—and from the Biblical story of Joseph—that the material is usually mixed *with* the grains, thus assuring that insects come in direct contact with it. Insects that made their way into the House E silos through any route other than the foundation—such as by infesting the cereals during harvest—would not have been desiccated by the ash, unless ash had also been mixed amongst the cereals.

But we do not know if ash was also mixed with grain in the silos, since any traces—such as dark smudges on the plastered walls—would have been long gone. The Khentkawes Town site had already been excavated by Selim Hassan in 1932–33 and then left open to the elements.

However, the upcoming 2014 field work in the Silo Building Complex (see pages 10–11) will give us another chance to examine how Old Kingdom Egyptians might have used ash to protect their grain stores. Since we have standing silos here that have not been previously disturbed, we will be able to search for evidence of ash mixed internally. Under the silos we will look for ash that may have been used as an insecticide. If we find any, I will have a chance to determine if special plant additives were added to it.

Storage pests may seem far afield from Egyptology. But these tiny creatures could have been one ancient Egypt's major threats to food security, like poor Nile floods. Thus understanding how Egyptians developed ways to protect their harvests offers important insights into life in the Old Kingdom.

Below: Map showing the distribution of charred specimens of jointed flatsedge seeds, Bishop's weed seeds, and sedge rhyzomes in samples from House E in the Khentkawes Town. Map by Rebekah Miracle, AERA GIS. Map of Khentkawes Town on page 13.



6. Levinson, H., and A. Levinson, "Control of stored food pests in the ancient Orient and classical antiquity," *Journal of Applied Entomology* 122, page 141, 1998.

7. Akob, C. A., and F. A. Ewete, "The Efficacy of Ashes of Four Locally Used Plant Materials Against *Sitophilus zeamais* (Coleoptera: Curculinonidae) in Cameroon," I*nternational Journal of Tropical Insect Science* 27, pages 21–26, 2007.

8. Malleson, C., "Weeds and Seeds: On the Trail of Ancient Egyptian Agriculture," *AERAGRAM* 14-1, Spring 2013, pages 22–23.

George Link Memorial Fountain Completed

After many years of silence, the fountain on the grounds of the AERA-Egypt Center in Giza once again gurgles and splashes. In August we completed our renovation of the crumbling, dry fountain standing on the property when we purchased it in 2009.

We named the fountain in honor of George Link, our late legal counsel and long-time AERA board member. Four frogs, part of the original fountain and a symbol of regeneration in ancient Egypt, spurt water from the edge of a basin. Tawaret (goddess of fertility) sends forth another stream from the back wall. Flanking Tawaret, we included a relief of fishermen pulling in a fish-laden net, based on an Old Kingdom tomb scene. In the mosaic at the bottom of the basin, five different species of fish, all important in ancient Egypt, swim in a semicircle (from the left: Nile catfish; Nile perch; Nile tilapia; the Globe, or puffer, fish; and the elephant-snout fish). All of these species occur at AERA sites, but only the first three are common.

We hope this fountain honors all that George did for AERA.

Below: The original fountain at the AERA Egypt Center before reconstruction. Right: Detail of the rebuilt fountain: a figure of Tawaret, ancient Egyptian goddess of fertility, and one of the four frogs. Photos of rebuilt fountain by Sayed Salah. Photo below by Mark Lehner.

When GEORGE LINK passed away in December 2006, we lost a great advisor and friend of 21 years. George offered his legal counsel *pro bono* for AERA just after we incorporated and established our legal beginnings, continuing to advise us until shortly before his passing. He also joined the AERA board of directors and helped guide us as we evolved from a small excavation to one of the largest archaeological projects in Egypt .

George was one of the most eminently qualified people to help us with legal matters. A Harvard Law School grad, he was a partner of Brobeck, Phleger, & Harrison through his most of his legal career.

Considering George's long list of philanthropic and volunteer activities, we are especially grateful to have had his interest, support, and enthusiasm for more than two decades. He was a great friend and lasting influence.

Returning to the Field

Plans and Preparations for Season 2014 Excavations

Before setting foot on site, archaeologists develop research goals to address in the field: questions and hypotheses related to our broader research issues. Our pre-excavation planning began last October for AERA's 2014 field season.

We return to the Silo Building Complex (SBC; photo on the next page), where we worked in 2011 and 2012.[1] We are particularly eager to resume this work as the site offers a unique window onto life on the Giza Plateau *after* the last pyramid was completed, when the royal house move to Saqqara for building the king's memorial tomb complex. At this time, people abandoned the Lost City site, which had been home to the backroom operations of pyramid building.

Khufu, Khafre, and Menkaure and his queens were dead and buried, but their souls "lived" on. Keeping deceased royals going in the Afterlife was the work of whole priestly communities called "pyramid towns," which were attached to a pyramid complex or a royal tomb. An institution called the *per shenau* (storeroom or commissariat) processed produce, livestock, and other goods coming from lands designated for the support of the town.

The Curious Silo Building Complex

The results of our limited 2012 excavations suggested facilities we would expect to find in these processing centers: a bakery, grain silos, an overseer's quarters, and possibly a brewery. But much about the complex remains uncertain.

Initially we thought that it was part of the adjacent complex for Khentkawes, a late 4th Dynasty queen. We found the SBC at the end of a long corridor running east along the north side of the Khentkawes Basin (see photo on the next page, map on page 13).

However, in 2012 we learned that the SBC is situated within the northwest corner of a thick enclosure wall, older than the Khentkawes Basin. Next we found an intriguing clay sealing (discussed on page 16) that included the name of the pyramid "Great is Khafre." So the older enclosure might belong to Khafre's pyramid town. Curiously the other name was Niuserre, a mid-5th Dynasty king, suggesting that Khafre's pyramid town persisted long after his passing (see pages 12–13 for a time line of kings). Other sealings and the pottery also suggested a 5th Dynasty date.

With the 2014 field season we hope to discover what preceded the 5th Dynasty complex and the relationship between the Khafre and Khentkawes complexes.

To this end we developed the excavation plan presented on the next two pages. Ultimately we hope to determine if the SBC was indeed a *per shenau* and if so, how it functioned and worked with the other sites on the southeast edge of the Giza Plateau. Our goal is to shed light on the poorly understood institutions of pyramid towns and the post-pyramid-building economy at Giza and its place in the wider ancient Egyptian economy.

Although the political situation in Egypt remains in flux, AERA's commitment to our work at Giza remains the same—both in our excavations and our mission of outreach and education. We look forward to 2014 and our continued partnership with our Egyptian colleagues.

~ *by Freya Sadarangani and Ali Witsell*

Our 2014 SBC excavators: from top, Rabee Eissa, Hussein el-Rikaby, and Hanan Mahmoud, all of whom work with the Egyptian Ministry of State for Antiquities (MSA), and Dan Jones, AERA Senior Archaeologist. From the top, photos by Jason Quinlan, Rabee Eissa, Mark Lehner, and Ashraf Abd el-Aziz.

1. Results of AERA's SBC excavations can be found in "KKT-E+: The Buried Basin and the Town Beyond," *AERAGRAM* 12-1, Spring 2011, pages 10–13; "Conundrums and Surprises: The Silo Building Complex," *AERAGRAM* 13-2, Fall 2012, pages 6–9; J. Nolan, "Fifth Dynasty Renaissance at Giza," *AERAGRAM* 13-2, Fall 2012, pages 2–5. All back issues of *AERAGRAM* are available at our website, www.aeraweb.org, for free download.

SILO BUILDING COMPLEX (SBC) 2014: Areas to Dig, Stories to Tell

SONDAGE 1

TAKES IN:

- ✦ All of Room H (partially excavated in 2012)
- ✦ Portions of:
  - ✧ Eastern edge of the Khentkawes Basin
  - ✧ Retaining wall [32,993]
  - ✧ Basin Enclosure Wall [33,031]
  - ✧ SBC Western Enclosure Wall [33,423]
  - ✧ Fill [34,064] used to block an early door in [33,423]

WE CHOSE THIS LOCATION:

- ✦ To see how the basin, Western Enclosure Wall, and filling in the door are related stratigraphically—which came before, after, or at the same time. This will help us determine how the SBC developed over time.
- ✦ To "capture" one complete room in the SBC, per the request of AERA specialists. The 2012 excavations of Room H's final occupation showed that this was a busy chamber with beer jars and bread molds on the floor, and jars embedded in the floor. We plan to excavate down to the earliest levels.

POTENTIAL INFORMATION FROM:

Animal bone: We hope to find a good sample from deposits laid down when the SBC was in use. We want to determine the diet eaten here, if it was mainly "costly" foods for high-status people or even mortuary offering delicacies, and if the food was provided by the state or obtained from local sources. This information will tell us about the residents and the economy here during the 5th Dynasty.

Plant remains: We want to determine how much information we can obtain from different types of deposits (i.e., hearths, ash, floors, or fills of pits). By looking at one room we will be able to compare what the different deposits yield.

Ceramics: Pots are invaluable in dating sites as the styles were in use in particular periods and changed over time. They will help us work out the history of the SBC. Specific types of pottery also reflect function: molds for bread-baking, bowls for serving food, jars for storing liquids, etc. We expect the Room H pottery will give us insights into the function of the room and the SBC as a whole.

AERA Co-Field Director Ana Tavares, Hussein el-Rikaby, and Dan Jones will oversee this work.

CLARIFICATION AREAS

Senior AERA archaeologist Dan Jones and MSA archaeologist Rabee Eissa will carry out checks in the areas outlined in dashed yellow lines, chosen specifically to resolve questions raised by the 2012 SBC excavations.

Excavations in the Silo Building Complex, February 2012. AERA's limited work 1) exposed walls in order to capture the complex's footprint, and 2) excavated down to the final occupation layer in selected areas. One of our goals in 2014 is to excavate to the earliest levels in the targeted areas.
The Khentkawes Basin, which we excavated in past seasons, filled with water in 2012 as a result of a high water table. Most of the Khentkawes Complex that we had previously exposed is buried under backfill sand to protect it. But on the north side of the basin, the sand was removed to reveal a terrace and the faint remnants of a corridor. Photo by Mark Lehner.

SONDAGE 2

TAKES IN:

- 2 silos
- Portions of:
  - Northern wall [33,411]
  - Room A (a courtyard partially excavated in 2012, which included a bin, ash, garbage deposits, and signs of *in situ* burning)
  - Southern face of SBC Northern Enclosure Wall [33,262]

WE CHOSE THIS LOCATION:

- To excavate silos in order to find evidence of what was stored there and the duration of their usage.
- To excavate an outdoor space that has garbage deposits and evidence of craft activities.
- To check for earlier settlement beneath the SBC and see how any underlying settlement relates to the SBC Enclosure Walls.

POTENTIAL INFORMATION FROM:

Small finds: Room A, as an outdoor space, may have been the site of craft work. We will be looking at the objects for evidence of crafts, most specifically, to determine if people milled cereals here, as suggested by a quern stone we found in 2012. If we indeed find evidence of crafts and grain processing, it will help us understand the function of the SBC and its economy.

Animal bone: Garbage deposits we uncovered in Room A in 2012 may yield a large collection of animal bone, which will help us determine the diet of the local residents and where they obtained food.

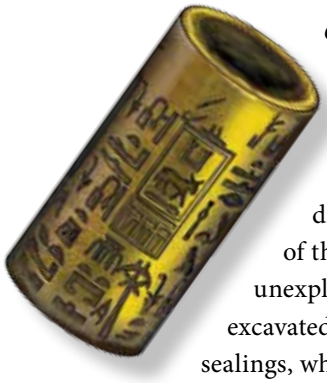
Sealings: The 2012 excavations yielded many clay sealings in and around the silos, some apparently used to secure the silos. In 2014, we hope to find more evidence of how people closed and sealed the silos. We also hope to find more sealings with 5th Dynasty kings' names to help us understand the history of the SBC (see article starting on page 12).

Plant remains: In House E of the KKT, silos were built on a bed of ash, possibly used as an insecticide (see article on pages 6–7). We are keen to see whether the same was done for the SBC silos.

AERA Co-Field Director Mohsen Kamel, Hanan Mahmoud, and Dan Jones will oversee this work.

Piecing the Story Together, One Clay Sealing Fragment at a Time *by John Nolan*

During the 2013 study season at Giza, John Nolan and Ali Witsell analyzed the trove of clay sealings recovered from AERA's first excavations in the mysterious Silo Building Complex (shown on pages 10–11). This complex was an unexpected discovery in 2011 and continued to surprise us during our 2012 excavations as we uncovered its puzzling history. During the excavations we learned that the Silo Building Complex (SBC) probably operated as a storage, production, and distribution center during the 5th Dynasty. But it seems that much earlier, another structure stood inside the same thick enclosure walls. Both structures might have served Khafre's pyramid town—a center to support the king's cult after his death. More discoveries lay ahead when John and Ali began looking at the bits of SBC clay sealings that had once secured jars, papyrus documents, other containers, and doors. Here John describes how they pieced together glimmers of an intriguing story about life on the Giza Plateau post pyramid-building.*



Left above: From the Silo Building Complex three examples of clay sealings, which had been used to seal a variety of containers and were impressed with cylinder seals. Left: A drawing of a partially reconstructed cylinder seal. It was pieced together from sealing fragments found in the Lost City site and then projected onto a cylinder shape. It may have been made of gold. Right above: This drawing of a pot shows how a clay sealing would have been used to secure the contents of a vessel. Right: A papyrus document secured with a clay sealing impressed by a cylinder seal. Objects not shown to scale. Photos by Yaser Mahmoud.

The Silo Building Complex (SBC) is one of AERA's most important discoveries to date, yet many aspects of this enigmatic set of structures remain unexplained. However, scattered among the excavated deposits we found an abundance of clay sealings, which offer important clues to the date and function of the SBC.

First Hints from the Sealings

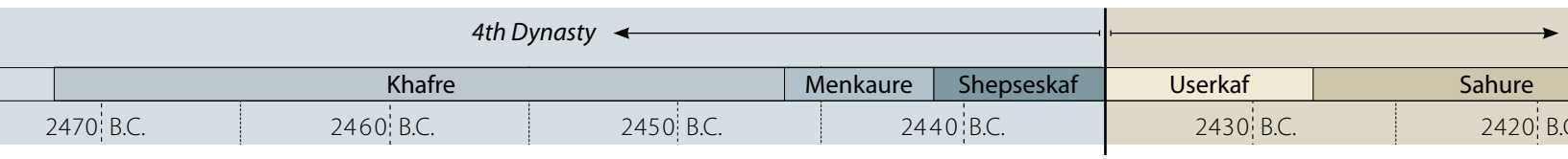
As square supervisors Rabee Eissa and Hussein el-Rikaby were excavating the SBC in 2012, they identified and photographed over 30 large, well preserved sealings and sent them up to the Giza Field Lab along with other bags of clay bits that they also thought might be sealings. Some of the 30 sealings they identified mention the name of Niuserre, a king of the 5th Dynasty who reigned long after the Giza pyramids were completed and the royal house moved away. One of these Niuserre sealings even preserves the name of Khafre's pyramid, "Great is Khafre" (shown above, bottom sealing). These few sealings hinted that the SBC was an active place during the reign of Niuserre in the middle of the 5th Dynasty—much later than the Lost City site, 250 meters to the southeast, where we have worked since 1988. We had entered new territory.

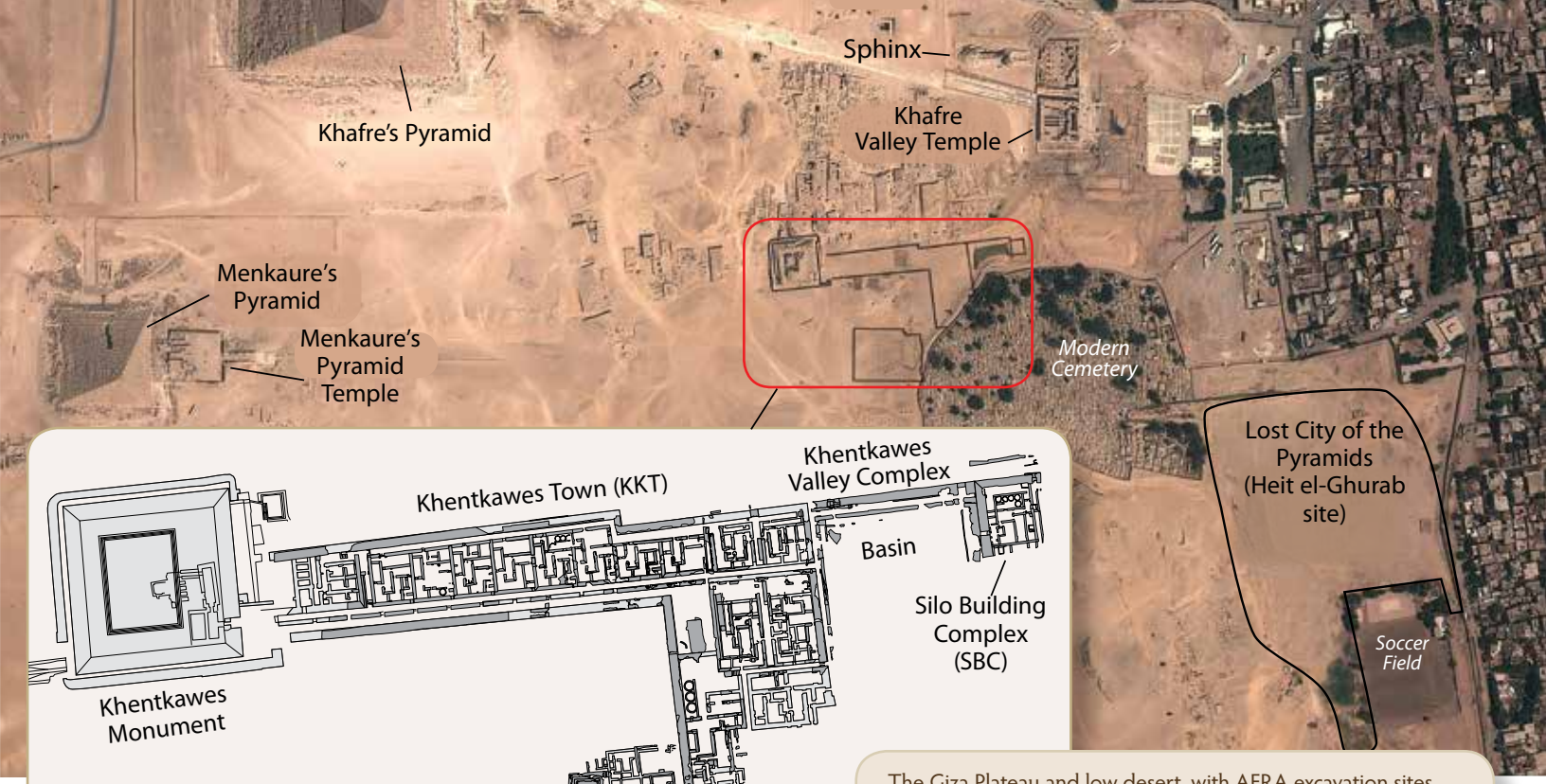
The 30 sealings Rabee and Hussein found proved to be just the tip of the iceberg. When Ali Witsell and I analyzed the rest of the sealings from the SBC—along with the backlog of sealings from the Khentkawes Town (KKT, described in the caption on the facing page) and the Menkaure Valley Temple (MVT)—our results cast new light, not just on our view of the SBC, but also our understanding of the SBC and adjacent Khentkawes Town together.

Over the course of three weeks in 2013, we registered a total of 244 sealings, 144 of which came from the SBC. Seventy others were from the KKT and the MVT. The remaining sealings came from the old Lost City excavations. Considering the limited extent of the excavations in the SBC, these 144 sealings suggest

* A footnote on page 9 lists articles about the SBC and its discovery in previous issues of *AERAGRAM*.

Time line of the kings from Khafre to Niuserre. Some of them are represented in the sealing collection from the Silo Building Complex, the Khentkawes Town, the Menkaure Valley Temple, and the Lost City site. The bands show the approximate, or idealized, dates of the kings' reigns. Dates from E. Hornung, R. Krauss, and D. Warburton, "Chronological Table for the Dynastic Period," In *Ancient Egyptian Chronology, Handbook of Oriental Studies, Section One: The Near and Middle East*, edited by E. Hornung, R. Krauss, and D. Warburton, page 491. Leiden: Brill, 2006.





The Giza Plateau and low desert, with AERA excavation sites indicated. Satellite image courtesy of Google Earth. Inset: Map of the Khentkawes Complex (built for a late 4th Dynasty queen), the Menkaure Valley Temple, and the Silo Building Complex. (A photo of the Khentkawes Monument appears on page 2.) The Khentkawes Town may have housed priests in the queen's mortuary cult. An extension off the east end of the town, referred to as the Khentkawes Valley Complex, included a basin bounded on the north by a walled corridor. Map by Rebekah Miracle, AERA GIS.

that over the course of future field seasons the complex might prove to be one of the richest sealings finds from Giza.

A Lengthy Occupation

After analyzing all of the 144 sealings from the SBC, we realized that this compound actually came into use well before the reign of Niuserre. The Horus names of four of the first five 5th Dynasty kings appear on 20 of the SBC sealings. The reigns of these kings, along with Niuserre, span about 60 years, circa 2435 to 2374 B.C. Because the Horus name was only used when the king was alive, it is very likely that the SBC was active during this time.

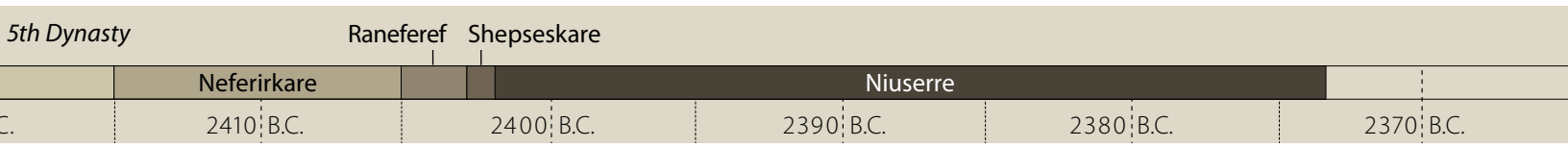
The sealings from the KKT, just west of the SBC, appear to be even older. Some of them bear the name of Menkaure, in addition to the first three kings of the 5th Dynasty. All in all, the complex encompassing the KKT and SBC appears to have functioned continuously from the late 4th well into the 5th Dynasty.

Reaching Across Dynasties on the Giza Plateau

During the 4th Dynasty, when royal attention was focused on Giza, the nearby Lost City of the Pyramids settlement bustled with the activity of workers, craftsmen, administrators, and priests, as Menkaure's pyramid complex was being built. After Menkaure died, everyone abandoned the town and the royal house moved to Saqqara. What happened to the town residents? We believe some priests may have moved to the Khentkawes Town to serve the cult of their now-dead king. Our evidence comes from clay sealings found in both the Lost City and the SBC as well as from an ancient decree.

Our first clues came in 2007, when the sealings team reconstructed at least 16 different cylinder seals from 747 sealing fragments that came from Area AA, a complex with production and storage facilities (shown on the map on page 17).[2] Six of

2. "Working through Change," AERA Annual Report 2010-2011, page 24. Available on our website, www.aeraweb.org, for free download.



these reconstructed seals belonged to royal purification priests dedicated to Menkaure, who was still alive when the seals were made. It is likely that the priests worked in this area, since some of the sealings had been used to secure doors, and those sealings would not have been discarded far from where they were used.

These royal purification priests of Menkaure were apparently set up with an endowment following the death of their king. His successor, Shepseskaf, in his very first year on the throne, issued a decree on their behalf, which George Reisner discovered on a damaged stone slab in Menkaure's pyramid temple. The decree was intended to establish a steady stream of food offerings to the purification priests of Menkaure, so that they "may be secure forever."[3]

A sealing from the SBC offers some indication that similar priests were present in the vicinity. It had been attached to a bundle of reeds and bore the title "royal purification priest."

We do not know for certain, but the priests from Area AA may have been among the first residents in the KKT. Their benefactor Shepseskaf completed Menkaure's temples after his death, as well as the original structures in the KKT. Thus it seems reasonable that the purification priests who worked in Area AA were re-settled in the vicinity of the MVT, perhaps even in the newly-constructed KKT.

A Glimpse Inside the SBC

Sealings provide more information than just royal names and titles. The flip side, or back, often shows traces of what the clay had been pressed against, such as a papyrus document or a box. By carefully analyzing the back impression, archaeologists can often figure out what was originally sealed and use the relative frequencies of these "sealing types" to gain insight into the function of a site.

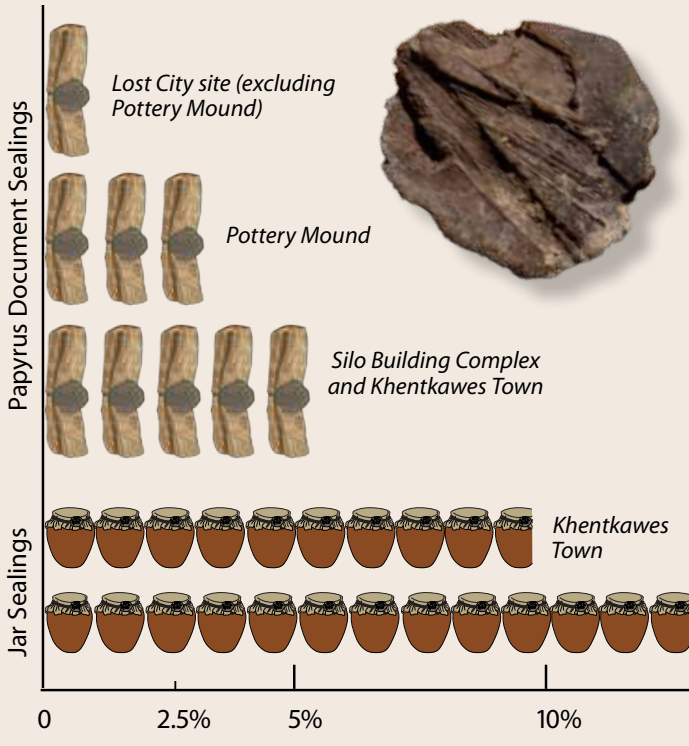
The relative proportions of sealing types in the SBC and KKT suggest major differences in the function of the two complexes. About 20% of the SBC sealings were used to seal jars, while in the KKT less than 10% were jar sealings. People apparently opened jars twice as often inside the SBC as in KKT. This seems consistent with the evidence for storage and production in the SBC, such as the silos and traces of baking.

While the functions of the two sites were different, they both had a relatively large proportion of sealings from documents, over 5% from both sites combined. To illustrate the significance of this figure, we need only look at the sealings in a Lost City trash dump called Pottery Mound, which contained debris from a group of scribes. Only about 3% of the Pottery Mound sealings came from papyrus documents. The figure is even lower for the rest of the Lost City: less than 1%. It appears that more documents ended up in the KKT and SBC, showing that the inhabitants had a high level of literacy.

What was in these documents? We do not know as they are long gone. But some of the sealings bear the titles of the senders, such as *Director of those who are in a phyle* (that is, a group of priests in a temple), *Overseer of the pyramid* (town) *Wer-Khafre* (the second major pyramid at Giza), and *Ruler of the Estate* […].

The results of our work in 2013 illustrate how important it is to carry out a full analysis of the materials we recover. Those first 30 sealings collected by the excavators signaled the importance of the SBC deposit. But only through careful study of the remaining sealings have we been able to gain a richer understanding of the evolving, complex story of the these communities sitting in the shadow of the pyramids at Giza.

3. Papazian, H. "Domain of Pharaoh: The Structure and Components of the Economy of Old Kingdom Egypt." PhD Dissertation, University of Chicago, pages 305–306, 2005.



Above left: The back of a document sealing from the Silo Building Complex,. The impression shows the folds of the document and its texture. The material is not papyrus but leather (velum), which was uncommon in ancient Egypt. The sealing is the one mentioned and shown on page 12 that includes the name of Khafre's pyramid: "Great is Khafre."

Left: Graph showing the relative proportions of papyrus document sealings from the Lost City site, Khentkawes Town, and the Silo Building Complex. Below: Graph showing the relative proportions of jar sealings from Khentkawes Town and the Silo Building Complex.
Quantities expressed as a percentage of the totals for all sites.

Securing AERA's Legacy: The Data Curation Project

by Freya Sadarangani, Dan Jones, Megan Lallier, and Rebekah Miracle

Imagine you have just finished reading about a house at the Lost City site and want to learn more. So you launch the AERA database website and find detailed maps of the house. You notice a broken knife blade on the floor. You recall reading about similar knives in the Lost City. You query the website. A map appears, showing the location of all the blades we have found at Giza. You think the knives might have been used to cut up meat. So you begin to test your idea by clicking through links to photos and data tables, seeing if the knives are associated with animal bone.

Welcome to 21st century archaeology! With an online open access database, you will be able to explore our excavations and work with our material in the same virtual way we do after we leave the dig site and field lab.

That is the goal of the Data Curation Project (DCP) we launched in 2012: to organize all of our material so that it is easy to access and use, and make it available online. We want to secure AERA's legacy by ensuring that our vast archive of material is preserved and understandable for future generations.

Here the AERA DCP team members explain their data curation work, present their progress to date, and lay out their vision for the future.

Archaeologists collect information, as Amelia Fairman is doing here, but we also produce it—in spades! Amelia is recording a plethora of data on her excavation area, filling out feature and architecture forms, checklists, and registers (in the center binder). She will produce single-context plans of each feature (the blue sheets in the foreground), which show only a single feature or context, and also multi-context plans of the whole area (with the clip, at the top), which show all of the features.

Out of the field, she will write weekly reports and a final "Data Structure Report," chronicling all of her excavation work, feature by feature, in both narrative form and in graphic form as a Harris matrix. The matrix is a diagram that shows the relative chronological relations between features (which came before, after, or at same time) based on their positions in the site's stratigraphy (or layers). All of this paperwork has to be carefully verified that it is correct and complete before it goes into our archive. All the data in the paperwork has to be incorporated in our GIS database. Photo by Mark Lehner.

Archaeologists collect information. AERA has amassed a vast trove of information-laden materials over nearly 30 years of working in Egypt: recording forms, drawings, maps, survey data, field notebooks and diaries, photographs, logs, specialists' records, reports, and publications.

As AERA has matured, our methods and practices have understandably changed, incorporating new technologies, new team members, and new excavation areas. But one thing has not changed: the perennial shortage of time during our excavation and study seasons for all that needs to be done. Probably every field season has left some loose ends—tasks not quite completed, forms not checked, and so on.

As a result, until we launched the Data Curation Project (DCP) the AERA archive encompassed vast quantities of data gathered to different standards and recorded in different ways. It included maps, forms, and other original material that had not yet been scanned. It was peppered with small, irksome mistakes, such as the wrong number for a feature or missing numbers. In addition, the vast size of the archive, without indexes or other guides, has posed a challenge for team members trying to navigate to a specific item, especially from our early field seasons.

Also, because specific research questions or publication projects often dictate the areas we excavate and study, our post-excavation archival work targets those areas. Previously excavated areas that are not relevant to the current projects sometimes do not receive the same attention and can become isolated in the archive. The DCP hooks together these "mini-archives," allowing us to connect the stratigraphy (layering) of the "stranded" areas with adjacent areas and work out which came earlier or which came later. By integrating these, we gain an overall picture of how the settlement developed over time.

While our current "tribal" memory might be able to make sense of the problematic materials, they represent potentially lost or confusing information to others if we do not put them in order now. The DCP aims to resolve these many issues by reassessing, standardizing, and fully digitizing our wealth of excavation data, thus "curating" it for the future.

A significant portion of this work includes integrating all the excavation data into our Geographic Information System (GIS). GIS software at first glance seems to simply generate what appear to be conventional maps. But "under the hood" it does

DATA: FROM DIRT TO DIGITAL

As part of the curation process, the paperwork trail of every feature (hearths, walls, pits, etc.) is carefully checked and its geographical location secured in our Geographic Information System (GIS) database. Here we show the steps taken to incorporate one feature in House E of the Khentkawes Town into our GIS.

1. Feature [31,697] is the ashy fill in a cut (probably for a door socket) in the house vestibule (outlined with a red dashed line).

2. Information about the feature is recorded in the field on a paper form—for example, its size, composition, relationship to other features, and the bag numbers of any samples or objects from this feature sent to the field lab for specialist analysis.

3. Each feature is drawn in the field on a top plan that illustrates its location and the elevations (in meters above sea level) of various points on the feature. Our GIS team takes each of these single-context plans (drawings that show only a single feature) and traces the feature in our GIS software, creating digital records that store each feature's precise geographic location.

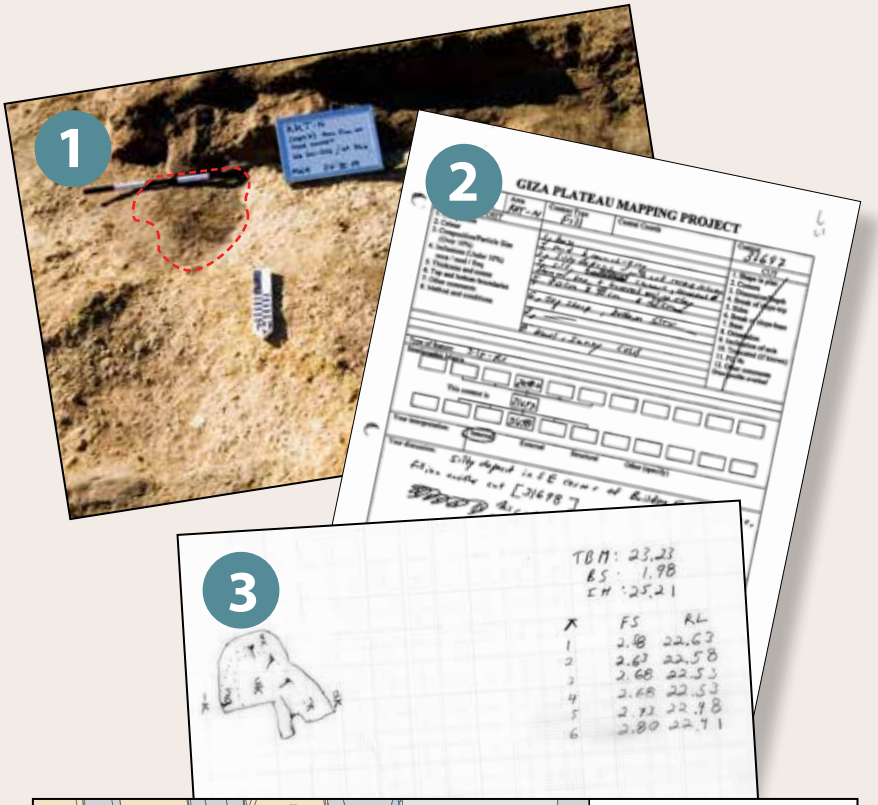
4. Once the feature is digitized, as shown here in this GIS map of KKT (and outlined in red), then it is matched with its descriptive information from the feature form provided by the archaeologist, and specialist identifications from the bags sent to the lab are incorporated from the specialists' databases.

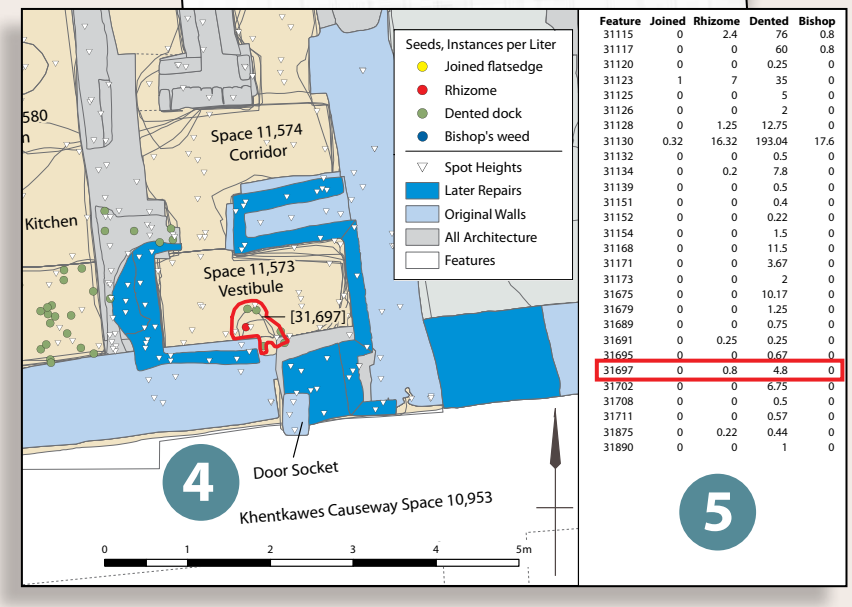
5. After the specialist data is in our GIS, we can simply click on the feature to find out what materials were found there. Here we ask the GIS to tell us more about the archaeobotanical remains from Claire Malleson's work on House E. The table lists counts for the four different types of plants seen in the map legend. Those from feature [31,697] are highlighted in the red rectangle.

6. The DCP process double-checks that
- ✓ the information for each feature is correct
- ✓ the paperwork for each feature is complete
- ✓ every feature has been digitized, has a digital file, and is ready for specialist data to be incorporated, as in the table in 5.

The spaghetti-like gray outlines seen in this inset all represent individual features in these few rooms alone.

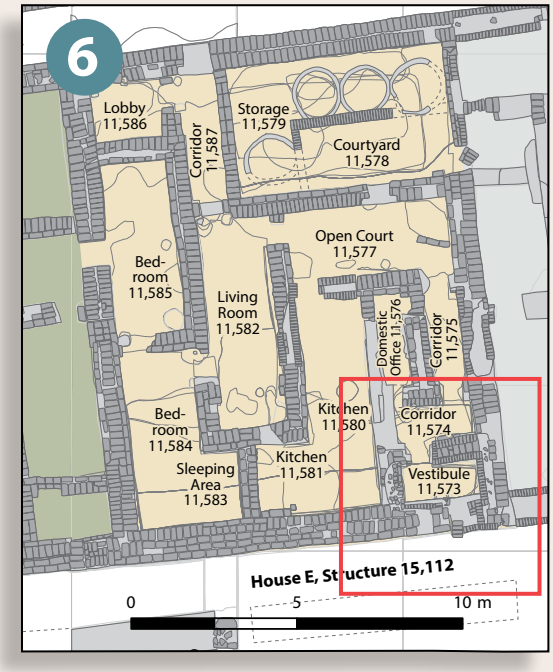
7. By zooming out in our GIS database to view an entire house, or even an entire site, it is easy to see just how much progress we have made! All of our excavated areas in the Menkaure Valley Temple and Khentkawes Town sites have now been fully curated.

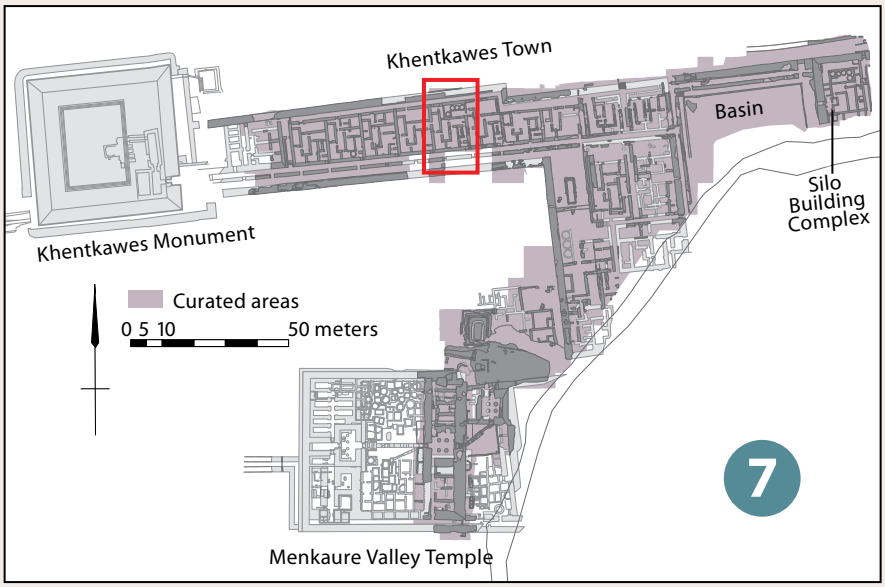




Feature	Joined	Rhizome	Dented	Bishop
31115	0	2.4	76	0.8
31117	0	0	60	0.8
31120	0	0	0.25	0
31123	1	7	35	0
31125	0	0	5	0
31126	0	0	2	0
31128	0	1.25	12.75	0
31130	0.32	16.32	193.04	17.6
31132	0	0	0.5	0
31134	0	0.2	7.8	0
31139	0	0	0.5	0
31151	0	0	0.4	0
31152	0	0	0.22	0
31154	0	0	1.5	0
31168	0	0	11.5	0
31171	0	0	3.67	0
31173	0	0	2	0
31675	0	0	10.17	0
31679	0	0	1.25	0
31689	0	0	0.75	0
31691	0	0.25	0.25	0
31695	0	0	0.67	0
31697	0	0.8	4.8	0
31702	0	0	6.75	0
31708	0	0	0.5	0
31711	0	0	0.57	0
31875	0	0.22	0.44	0
31890	0	0	1	0

5





Curation Work Completed for the Menkaure Valley Temple and Khentkawes Town Data

- ✧ Checked the records for 3,516 archaeological features (walls, hearths, floors, etc.) and 1,358 top plans (viewed from above like a floor plan) and cross-section drawings.
- ✧ Established the geographical locations of 3,516 features in our map coordinate system; integrated them into the GIS.
- ✧ Tagged 13,472 photographs with searchable information (location, field season, photographer, etc.).
- ✧ Wrote a narrative of the chronological development of each area excavated; produced a full bibliography of relevant reports and publications on each area.

much more. A massive central repository, the GIS stores data that has a geographical location, such as the findspots of vats or layering of floors during successive renovations in a house. It allows us to capture, store, and manage information and then interpret and visualize it in many ways (see the facing page for an example of how GIS can be a powerful tool).

DCP Achievements: Two Sites Curated

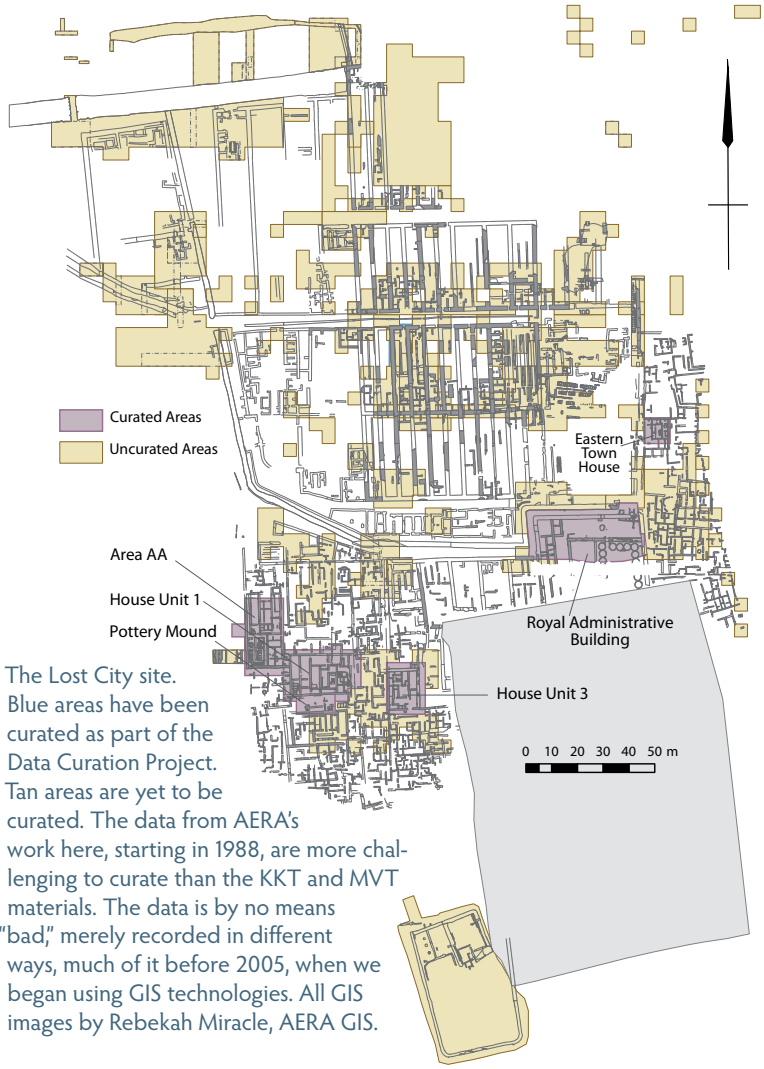
The first phase of the DCP concentrated on AERA's work at the Khentkawes Town and the Menkaure Valley Temple sites. This massive undertaking curated 100% of all excavation data and our information on stratigraphy, or the relationships of site layers to each other—which came before, after, or occurred at the same time. The stratigraphic data are the keys to chronological development. And as a result of our DCP work thus far, all of the individual excavated areas at these sites have now been tied together in terms of relative chronology, allowing us to see how the site developed over time.

Now that we have completed all the excavation data for the Khentkawes Town and the Menkaure Valley Temple sites, our next step is to import all the specialist data for these sites into the GIS, which will enable us to look at distribution patterns of objects over space and time.

Opportunities Ahead: Heit el-Ghurab

For the Lost City (Heit el-Ghurab), where we have worked since 1988, we have curated 21% of the excavation data. These materials are more complex to work with than data from the other sites as they encompass deeper excavations, a greater variety of structures and features, and information that was recorded over many field seasons, including AERA's early years when our methods were not as finely honed as they are today.

We have over 12,000 feature records yet to check and tabulate, about 3,500 drawings to examine, and untold numbers of features to digitize in the GIS. We also need to scan and register site photographs and 35-millimeter slides from 12 years of excavations, as well as tag 19,000 photographs with searchable keywords. The Heit el-Ghurab specialist data also needs to be prepared for incorporation into the GIS.



The Lost City site. Blue areas have been curated as part of the Data Curation Project. Tan areas are yet to be curated. The data from AERA's work here, starting in 1988, are more challenging to curate than the KKT and MVT materials. The data is by no means "bad," merely recorded in different ways, much of it before 2005, when we began using GIS technologies. All GIS images by Rebekah Miracle, AERA GIS.

Throwing Our Doors Open: Everyone's Invited

Following the DCP, we aim to make the results of our work truly accessible to the public. Plans are underway for an open-access online database and a dynamic website with interactive imagery and accurate 3D models, as well as educational tools for K-12 school groups. We invite everyone who is fascinated by ancient Egypt to dive in. Fellow archaeologists will be able to discuss and collaborate on interpretations of our data. Egyptophiles will be able to work with our material, test their hypotheses, and join the discussion. Fresh eyes scrutinizing our data and asking new questions will help advance the field.

Keeping Our Doors Open: AERA's Legacy

We want our data to be accessible, relevant, and useful in the distant future, just as the archive of the Harvard University-Boston Museum of Fine Arts Giza expedition (1902 to 1947) still offers a rich trove of information readily accessible through the Giza Archive Project (http://www.gizapyramids.org) long after the last field season ended. The DCP is doing the housework necessary to assure that our materials live on after we are gone. That will be AERA's legacy.

Help us open the doors to our data for everyone interested in ancient Egypt now and in the future. Please contribute by going online: http://www.aeraweb.org/support/.

AUC-AERA Archaeological Field Training: Launching in January 2015

In the last issue of *AERAGRAM* we announced a new field school program—AUC-AERA Archaeological Field Training—which will bring together Egyptian and non-Egyptian students for eight weeks of intensive study at Giza.* The course was to start in January 2014, but we postponed due to the uncertainty in Egypt this past fall and to allow for a longer application period. But AERA is now accepting applications. Information can be found on our website: aeraweb.org/auc-aera-field-school.

The AUC-AERA Archaeological Field Training (AFT) program builds upon the field school program we have run for Egyptian antiquities inspectors since 2005 in collaboration with the American Research Center in Egypt. AFT opens our program for the first time to foreign students through a partnership with the American University in Cairo (AUC), which will award academic course credit for the program.

The AUC-AERA Field Training takes place within the context of AERA's ongoing multidisciplinary archaeological research at the Old Kingdom pyramid builders' settlement site, Heit el-Ghurab. The program includes six full weeks of excavation and a week in the field lab at Giza. Students will learn excavation, site recording, survey, illustration, and photography, along with an introduction to bioanthropology. In the lab and classroom they will be introduced to the study of archaeological plant remains, animal bone, pottery, artifacts, and chipped stone tools. In addition they will learn about data management and GIS (Geographic Information Systems).

Field school students (right) and bioarchaeologist Jessica Kaiser (far left) peer into a burial, one of several they excavated. Freya Sadarangani (in red scarf) calls their attention to the stratigraphy. Photo by Jason Quinlan.

The AUC-AERA Archaeological Field Training provides a unique opportunity for Egyptians and non-Egyptians to work and study together while being trained by both Egyptian and non-Egyptian archaeologists. We are pleased to promote this cultural exchange and affirm our commitment to continued archaeological training in Egypt.

Apply for the AFT 2015: aeraweb.org/field-training/

* *AERAGRAM* 14-1, Spring 2013, page 15. All back issues of *AERAGRAM* are available for free download at our website, aeraweb.org.

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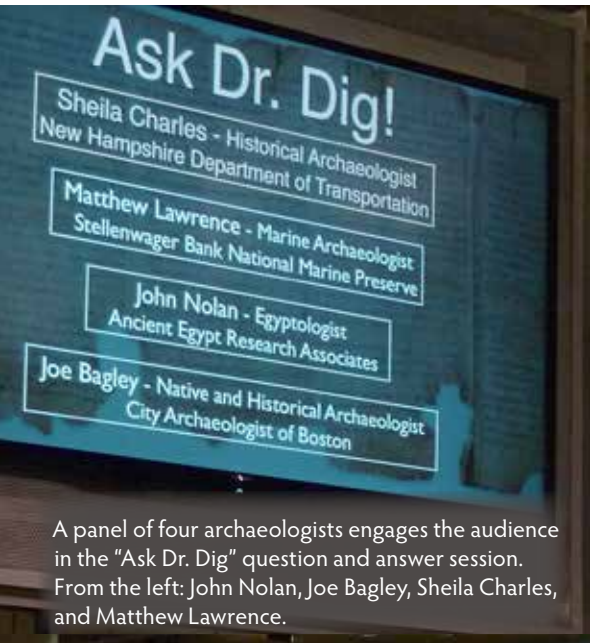
John Nolan guides a visitor as he rolls a reproduction cylinder seal over a daub of clay. The materials covering the board simulate the textures that might be found on the back of a real archaeological sealing. All photos on this page by Mark Lehner.

AERA Struts Its Stuff at Archaeology Fair



A panel of four archaeologists engages the audience in the "Ask Dr. Dig" question and answer session. From the left: John Nolan, Joe Bagley, Sheila Charles, and Matthew Lawrence.

In October AERA joined 20 other organizations at the Boston Museum of Science to share the excitement of archaeology with the public. During the two-day 7th Annual Archaeology Fair, hosted by the American Institute of Archaeology (AIA) and the Museum of Science, attendees learned about ancient cultures, technologies, excavation methods, analysis, and more through hands-on activities, displays, and demonstrations.

John Nolan (AERA Associate Director, sealings specialist) and Chris Dilks (AERA Community Outreach Director) commanded AERA's two tables demonstrating analysis of sealings, animal bone, and pottery, with volunteer Stephen Dilks helping out.

John Nolan was one of the four professional archaeologists answering audience questions during the presentation "Ask Dr. Dig," by the AIA and the children's magazine *Dig*.

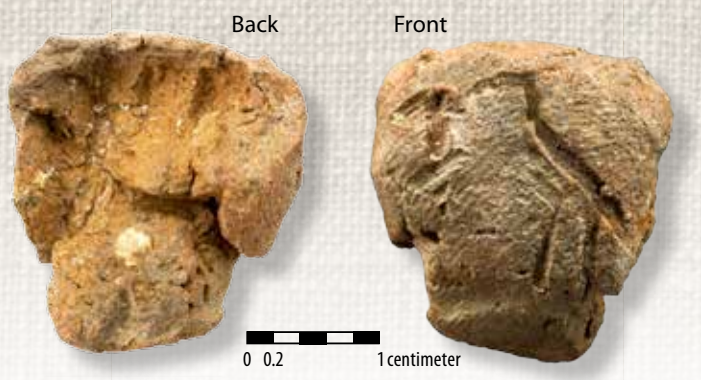
On AERA's behalf, George Mutter and Bernard Fishman put on a 3D stereoview tour of the Nile in the late 19th and early 20th centuries using images from their vast archive (http://www.photoarchive3d.org).[1] We are grateful that they joined us in our outreach to the public.

We look forward to bringing AERA to the Archaeology Fair next year.

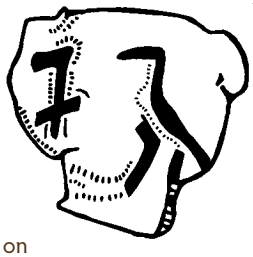
1. See *AERAGRAM* 14-1, Spring 2013, pages 16–21, for George and Bernard's article "First Photos Taken from the Great Pyramid Summit." All back issues of *AERAGRAM* are available for free download at our website, aeraweb.org.

Chris Dilks explains how archaeozoologists identify animal bone from archaeological sites. Above right: she holds two modern specimens for comparison with the ancient bone.

A Small Clay Label, a Bundle of Linen, and an Ancient Economic Network *by John Nolan*



Sealing 5209 served as a label. The front shows the hieroglyphs of a reed-leaf and buzzard, which together represent the name of a special kind of linen. The back shows the impression of cloth folds, presumably the cloth named on the front. The sketch on the right is from the field registration form.



The inscription on Sealing 5209 was created by writing directly on the clay. Note the fingerprints on the front where the scribe patted down and prepared the clay before he incised it with the stylus. We have written in our newsletter mostly about formal sealings impressed with cylinder seals. But incised sealings, such as this linen bundle label, make up a significant portion of our sealing collection.

After bread and beer, linen was a mainstay of daily life in ancient Egypt. Nearly all clothing was made of linen, as were bedding and other household goods. Thus the fabric held an important place in ancient Egypt's economy, serving as one of the rations paid to temple priests and people working on the king's building projects.

During the late 5th Dynasty, priests of the Pyramid Temple of Raneferef at Abusir recorded in their account registers linen shipments from the Menkaure Valley Temple (MVT) at Giza, one of the sites where we have ongoing excavations. The archives from the Raneferef Temple have been published and studied by Egyptologists, and their connections to archaeological evidence are taking on increasing importance.

Thus when we discovered last spring that a clay sealing from our excavations at the MVT had been used in the 5th Dynasty to label a bundle of folded linen, we were thrilled. But before considering the sealing, we need to first set the scene at the MVT.

The Menkaure Valley Temple

When the AERA team began the 2011 excavations here, we already knew much about the temple's long history from the excavations of George Reisner. Menkaure began work on his mortuary complex—including the valley temple—during his reign, but died before it was finished. His successor, Shepseskaf, the last 4th Dynasty king, took over the project and finished the MVT in mudbrick.

During the following 5th Dynasty, royal construction activity, and the royal support that goes with it, moved south to Abusir and Saqqara. But the community in and around the Menkaure Valley Temple—most likely priests and staff— adapted to the changing times. The accounts at Abusir suggest that the temple community grew into a source of linen textiles. Our unassuming scrap of sealing clay, registered last spring as sealing number 5209, may testify to a strategy for coping with the changing economic circumstances of the 5th Dynasty.

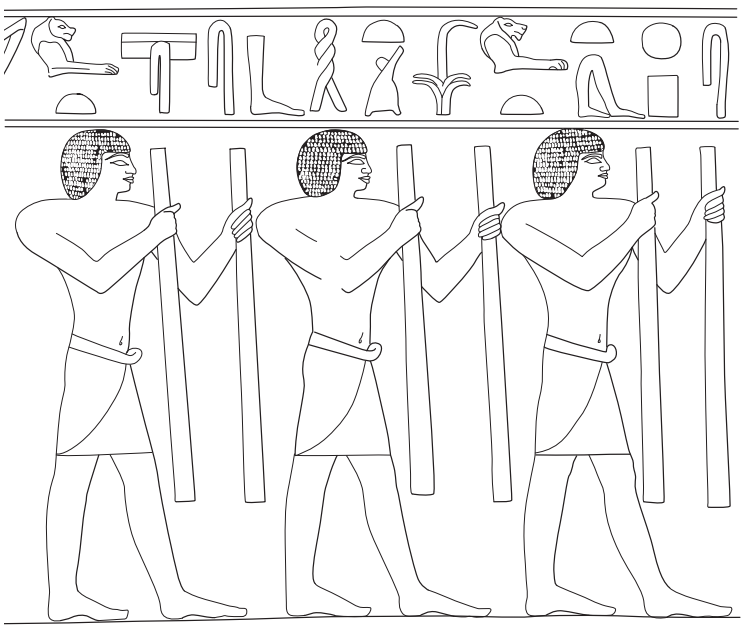
Sealing 5209

On the front of this clay sealing, two very clear signs in cursive ancient Egyptian—a reed-leaf and a buzzard—were written when the clay was still wet. Since the edges of this sealing are intact, these two signs must form a complete inscription. They are to be read as *j* and *tjw* and taken together spell the word *jtjw*, the name of a special kind of linen.

This inscription is complemented by the flip side of the sealing, which preserves an impression of what the clay had originally sealed. This back impression shows a series of compact, neat folds of a tightly woven textile trailing off through the body of the sealing.

It seems likely that this textile was the very same *jtjw*-linen mentioned on the front and that this sealing served as a kind of label, perhaps from the time of the late 5th Dynasty when the Menkaure pyramid complex participated in a fabric distribution network for various royal cults throughout Egypt.

It is striking how this bit of sealing clay found in the AERA excavations still echoes the connections of the pyramid settlements of Giza with the broader economy of Pyramid Age Egypt.



A scene of offering bearers from the tomb at Saqqara belonging to Mereruka, vizier of Teti, a 6th Dynasty king. The hieroglyphs (read from right to left here) say, "Bringing the first-quality royal linen cloth …" The long rolls are the linen cloth. (After *The Mastaba of Mereruka, Part I, Chambers A 1-10,* P. Duell, Oriental Institute Publications 31, Chicago, The University of Chicago Press, 1938, plate 72).

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